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The Temporality and Accessibility of Message Types (TAMT) Model: Examining Social Media Message Types and the Associations Between Exposure to Alcohol and Binge Drinking

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Abstract

Scholars have indicated that social media contribute to various health-related behaviors (e.g., substance use, body dissatisfaction) among adolescents. This study adds to the literature on health-related social media effects through theoretical advances supported by empirical evidence. First, we introduce the TAMT model, in which we assess the media environment along a continuum of two dimensions: the temporality (from ephemeral to persistent) and accessibility (from private to public) of message types. By combining these dimensions, we argue that there are four message types: ephemeral private, persistent private, ephemeral public, and persistent public. Second, we draw on the TAMT model to advance our knowledge of the role of social media in alcohol-related behaviors. We expected that, due to the distinctive characteristics of the four message types, they would be differently related to alcohol references and binge drinking. Based on cross-sectional data (N = 1,636, M_{age} = 15, SD = 1.17), we found that moderate alcohol references are encountered across all message types, while more extreme references are more likely to be prevalent in ephemeral public and ephemeral private messages. We show that exposure to moderate and extreme alcohol use references in ephemeral private and persistent private messages was associated with a higher probability of engaging in binge drinking, whereas exposure to ephemeral public and persistent public messages was not. Ephemeral private messages played the most crucial role in the association with binge drinking. These findings illustrate the importance of broadening the scope of research to ephemeral private environments when studying health-related behaviors. While we have illustrated the usefulness of the TAMT model against the background of two specific types of alcohol references, this new model can be extended to other behaviors (e.g., sexual risk-taking behaviors, cyberbullying).

Keywords: social media; message types; alcohol references; binge drinking

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Introduction

Social media, browser-based and standalone applications that are used to interact with multiple audiences (Carr & Hayes, 2015), have become pervasive in adolescents' lives (i.e., those aged 12 to 18; Rideout et al., 2022). In parallel with the rapid establishment of pervasive social media use, research on its potential aversive impact on health behaviors has increased dramatically (Alhabash et al., 2022; Donaldson et al., 2022; Ryding & Kuss, 2020). Content analyses and qualitative research suggest that there are now omnipresent online references depicting unhealthy behaviors, including alcohol (Hendriks, van den Putte, Gebhardt, & Moreno, 2018), weight loss (Jebeile, 2021), and risk-taking sexual behaviors (Berndtsson & Odenbring, 2021). This phenomenon has consequences, as several meta-analyses have shown that exposure to such references is linked to people's own risk-taking behaviors (Donaldson et al., 2022; Ryding & Kuss, 2020; Vannucci et al., 2020).

However, the literature on health-related social media effects is limited in that it focuses on a single platform, such as Facebook or Instagram, or one type of message, such as wall posts (Alhabash et al., 2022; Ryding & Kuss, 2020; Vannucci et al., 2020). According to research, adolescents use different platforms and applications, such as Facebook, Instagram, Snapchat, WhatsApp, on a daily basis (Vandendriessche & De Marez, 2020). Moreover, individual platforms feature multiple message types. For instance, some messages are ephemeral in nature and disappear after a few seconds (e.g., Instagram stories, Snapchat snaps), while others are more persistent and remain available unless they are deleted by the user (e.g., Facebook wall posts, Instagram feed posts). Some messages are private (e.g., one-to-one messages via WhatsApp), while others are more public and can be seen by a large group of intended and unintended people (e.g., Instagram wall posts). Consequently, research focusing on one platform or message type does not consider the heterogeneity of the media landscape. Because this landscape changes rapidly, a more future-proof model is needed to study social media and produce research that will stand the test of time. To illustrate, whereas platforms such as Facebook and Instagram originally enabled the sharing of persistent messages that remained permanently visible, they continue to evolve in their message types and now allow the sharing of ephemeral and of private messages.

In response, the present study first introduces the TAMT model, which distinguishes between four message types that are present across different platforms based on *temporality* (from ephemeral to persistent) and *accessibility* (from private to public). Second, we illustrate the TAMT model against the background of alcohol-related social media effects. We empirically examine how the characteristics of message types are distinctively related to encountering different alcohol references and how that may impact the association with binge drinking, which is defined as the consumption of four alcoholic drinks for girls and five for boys within two hours. We selected this topic because social media has been linked to adolescents' offline alcohol (mis)use (Curtis et al., 2018), which is a major public health concern (World Health Organization [WHO], 2018).

Introducing the TAMT Model: A Future-Proof Conceptualization of Social Media

Research has documented relationships between social media and health behaviors such as substance use, body dissatisfaction, and risky sexual behaviors (Alhabash et al., 2022; Ryding & Kuss, 2020; Vannucci et al., 2020). These studies investigate one platform or application and thus overlook the fact that multiple platforms are used concurrently (Vandendriessche & De Marez, 2020). Moreover, studies focusing on specific platforms or applications risk becoming quickly outdated as new platforms and applications emerge or existing ones introduce new features. For instance, Facebook and Instagram recently introduced ephemeral message functionalities similar to Snapchat snaps. This makes it difficult to compare the uses and effects of different platforms and highlights the need for a future-proof model.

One potential way to gain more durable results is to focus on message types that are inherent in multiple platforms and applications (e.g., Meier & Reinecke, 2021; O'Sullivan & Carr, 2017). This approach recognizes that social media communication encompasses complex processes of interaction that are driven by the properties of message types and enables the more comprehensive study of communication phenomena, regardless of a specific platform. Thus, the present study introduces the new TAMT model, which distinguishes between message types in an effort to better capture the heterogeneous media landscape.

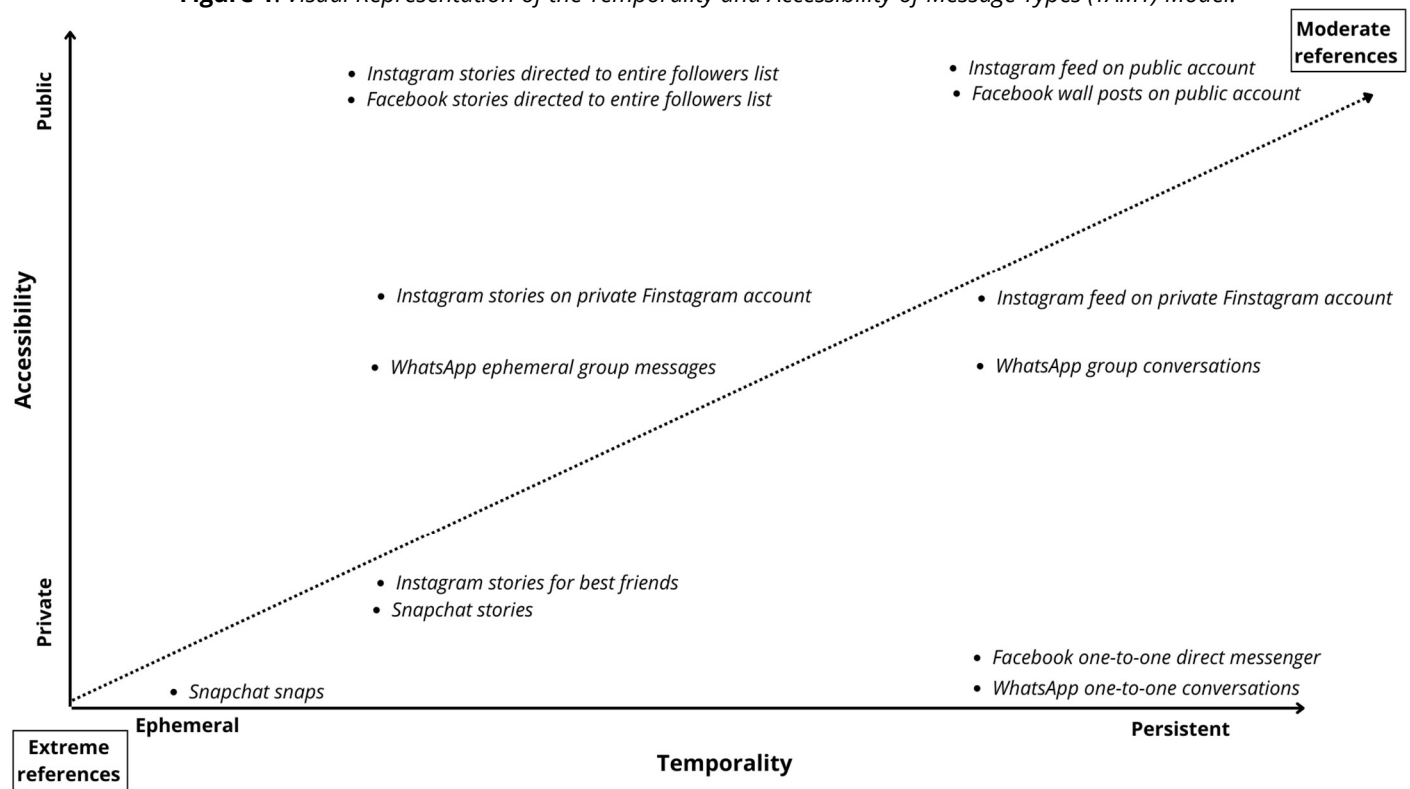
We argue that four types of messages can be identified based on a two-dimensional continuum (Figure 1). The dimension of temporality reflects the degree to which messages are temporally bounded (Meier & Reinecke, 2021). At one end of the continuum are ephemeral messages, which disappear after a few seconds like Snapchat snaps

or at most 24 hours like Instagram stories (Bayer et al., 2016; Kreling et al., 2022). At the other end of the continuum are persistent messages, such as Facebook wall posts, that remain accessible for longer periods of time unless they are deleted by users (Meier & Reinecke, 2021).

The dimension of accessibility reflects the degree to which messages are accessible and ranges from private to public (O'Sullivan & Carr, 2017). Private messages like direct messaging on Instagram are only accessible to sender-selected recipients, who are typically proximal ties such as friends (Vanherle, Hendriks, & Beullens, 2022). Public messages like Facebook or Instagram wall posts on public accounts are easily accessible to a user's entire group of followers or even anyone with access to a platform, depending on the privacy settings that a user has set both in general and specific to a given post (Vanherle, Hendriks, & Beullens, 2022). These messages are directed to broader audiences and can easily include some unanticipated recipients such as future employers (Duffy & Chan, 2019; E. Litt & Hargittai, 2016).

By combining these dimensions, we develop a model of four message types across multiple platforms and applications: (a) ephemeral private messages (e.g., Snapchat snaps, Snapchat direct messages, Instagram stories for best friends); (b) persistent private messages (e.g., Facebook direct messages); (c) ephemeral public messages (e.g., Facebook and Instagram stories on public accounts); and (d) persistent public messages (e.g., Facebook wall posts and Instagram feeds on public accounts). Since these message types are derived from the two-dimensional continuum (i.e., the temporality and accessibility of message types), we call this conceptualization the TAMT model. While that model can be applied to many online health-related behaviors, it is particularly relevant for studying alcohol-related media effects because alcohol (mis)use is one of the world's leading factors in mortality, morbidity, and disability (WHO, 2018). Thus, drawing on the TAMT model, the present study empirically examines whether the temporality and accessibility of message types are related to different alcohol references and whether these dimensions can help explain the associations with binge drinking.

Figure 1. Visual Representation of the Temporality and Accessibility of Message Types (TAMT) Model.



Note. The TAMT model distinguishes between four message types based on variations in their temporality and accessibility. For clarity, we have not indicated the four quadrants. Each bullet point demonstrates the extent to which the messages are temporal and accessible. Note that this is a general conceptualization; thus, it can be used beyond the scope of alcohol-related social media references.

Exploring the Role of Message Types in Exposure to Different Alcohol References and the Association With Binge Drinking

Alcohol-Related Social Media References Across Platforms

One of the most important purposes of using social media is to document positive moments (Lee et al., 2015). In adolescence, these moments can include the consumption of alcohol at social events or in one's home environment (Rosiers, 2020). Although the legal age (16, 18, or 21 years) for alcohol use differs between countries, evidence suggests a high prevalence of underage drinking in multiple countries across Europe and in the United States (Substance Abuse and Mental Health Services Administration [SAMHSA], 2018).

Content analyses and qualitative research focusing on both older platforms like Facebook and newer ones like Snapchat, Instagram, and WhatsApp illustrate that these drinking experiences are increasingly shared online (Geusens & Vranken, 2021; Hendriks, van den Putte, Gebhardt, & Moreno, 2018). According to the alcoholpost typology (Hendriks, van den Putte, & Gebhardt, 2018), platforms and applications appear to differ in terms of the nature of the alcohol references that are depicted, ranging from moderate (e.g., consuming a glass of alcohol) to more extreme portrayals (e.g., intoxication). For instance, Instagram's focus on aesthetically rigid content makes it a preferred destination for individuals to portray moderate alcohol use references in which positive outcomes like social connectedness are highlighted (Boyle et al., 2017; Hendriks, van den Putte, & Gebhardt, 2018). By contrast, Snapchat's playful culture of use and its distinctive feature of disappearing content makes it a popular channel for people to document extreme and negative references (Boyle et al., 2017; Geusens & Vranken, 2021).

Different Types of Alcohol References Across Different Message Types

Despite these important results, many studies focused on only one platform or application and a single message type, even though it is quite reasonable to expect that the temporality and accessibility of message types help determine how people represent the use of alcohol because those message types offer different levels of privacy control (Geusens & Vranken, 2021; Vanherle, Hendriks, & Beullens, 2022).

Social media users could be more inclined to engage in impression management in their persistent and public messages due to perceptions of a lower degree of privacy control (Atkinson & Sumnall, 2016; Goodwin et al., 2016; Vanherle, Hendriks, & Beullens, 2022). Users appear to be aware that persistent messages remain visible either permanently or for a long period of time (Vanherle, Hendriks, & Beullens, 2022) and are conscious that public messages are accessible to a broader audience, including people whom they did not consider when initially sharing such messages (Duffy & Chan, 2019; E. Litt & Hargittai, 2016). Therefore, they may fear that content they once shared may tarnish their reputation if it does not align with prescribed societal norms (Duffy & Chan, 2019). These concerns may lead them to carefully accentuate the positive aspects of their identities (Atkinson & Sumnall, 2016; Goodwin et al., 2016; Yau & Reich, 2019). Consequently, social media users could portray a desirable drinker identity in which moderate alcohol behaviors are depicted as an intrinsic part of having fun with friends in persistent and public messages.

Conversely, individuals may be less concerned about their self-presentation in ephemeral and private messages. There is scholarly evidence to suggest that individuals are conscious that ephemeral messages disappear after a predetermined period and that private messages are restricted to a self-selected group of recipients, which may result in greater privacy control (Vanherle, Hendriks, & Beullens, 2022). Therefore, they may believe that the content shared in these message types is less likely to tarnish their reputation, which could decrease their need to select socially appropriate content (Bayer et al., 2016; Geusens & Vranken, 2021). As such, individuals may prefer to use ephemeral and private messages to share extreme use references related to, for instance, binge drinking and drinking games (Boyle et al., 2017; Geusens & Vranken, 2021; Vanherle, Hendriks, & Beullens, 2022). Especially in private messages, they could consider extreme alcohol-related references as a positive form of self-presentation. Specifically, given that users employ private messages to communicate with like-minded peers, sharing extreme alcohol use references may be perceived as being a normative component of one's group identity. While initial evidence derived from qualitative research has found evidence for these assumptions (Vanherle, Hendriks, & Beullens, 2022), this has not yet been empirically tested among a large sample of adolescents. Therefore, we hypothesize as follows:

H1: Moderate alcohol use references are more likely to be encountered than extreme alcohol use references in all message types.

H2: Extreme alcohol use references are more likely to be encountered in ephemeral private messages than in persistent private, ephemeral public, and persistent public messages.

The Association Between Different Message Types and Binge Drinking

The dimensions of temporality and accessibility may not only be related to different alcohol references but may also impact associations with binge drinking. The social cognitive theory (Bandura, 2001) posits that individuals observing others engaging in behaviors that result in rewarding outcomes are more likely to emulate these behaviors. Given that individuals frequently encounter alcohol references that are linked to having fun (Hendriks, van den Putte, & Gebhardt, 2018), adolescents may perceive these behaviors as normative and desirable, leading them to adapt their cognitions and behaviors. Several cross-sectional studies (Geusens & Beullens, 2018; Hoffman et al., 2017), and some experimental studies (D. M. Litt & Stock, 2011; Mesman et al., 2020) have demonstrated a link between exposure to alcohol references and alcohol-related attitudes, norms, and alcohol use. Following the reinforcing spirals model (Slater, 2007) and the differential susceptibility to media effects model (Valkenburg & Peter, 2013a), a few longitudinal studies have pointed toward a reciprocal relation between exposure to alcohol and alcohol use (Boyle et al., 2016; Erevik et al., 2017).

The present study extends these findings by focusing on the role of multiple message types to more systematically and comparatively investigate how the dimensions of temporality and accessibility may be associated with binge drinking. There appear to be differences in the attention paid to messages depending on whether they are ephemeral or persistent (Bayer et al., 2016). Individuals have been shown to be more vigilant in attending to ephemeral messages because they have a limited amount of time to interpret them before they disappear (Bayer et al., 2016). This could be the case for exposure to extreme alcohol references in ephemeral messages because, in line with social norms theory (Berkowitz, 2004), people tend to recall extreme behaviors more vividly than common, normative ones (e.g., moderate alcohol consumption).

Additionally, adolescents' decision-making processes may be influenced by message accessibility or message source(s). Theoretical models such as social impact theory (Latané, 1981) and social comparison theory (Festinger, 1954) hold that people are mostly affected by their proximal peers. Thus, given that social media users communicate with proximal others via private messages (Bayer et al., 2016; Karapanos et al., 2016), they would be most receptive to these types of messages.

Lastly, the ways in which individuals interpret content could be at least partly determined by both the temporality and the accessibility of messages. For instance, social media users deem ephemeral messages to be more authentic because the content of those messages focuses on what is happening in the moment (Kreling et al., 2022). Similarly, they could consider private messages to be authentic because they typically come from proximal peers. Following Austin's message interpretation process model (2007), the perceived realism of alcohol use references increases the strength of the association between exposure and alcohol use (Hoffman et al., 2017). Consequently, it is reasonable to expect that ephemeral private messages in particular are strongly associated with binge drinking.

There is already some evidence that supports our assumptions. Boyle et al. (2016) examined the reciprocal impact of alcohol use and exposure to alcohol across various platforms. Their longitudinal study indicated that exposure to Snapchat content, which mainly featured ephemeral private messages, predicts alcohol use more strongly over time than exposure to Facebook or Instagram posts, which only featured persistent public messages at the time those authors conducted their study. We thus offer the following hypotheses:

H3a: Exposure to moderate alcohol use references in ephemeral private messages is more strongly related to binge drinking than exposure to those references in persistent private, ephemeral public, and persistent public messages.

H3b: Exposure to extreme alcohol use references in ephemeral private messages is more strongly related to binge drinking than exposure to those references in persistent private, ephemeral public, and persistent public messages.

Demographic and Personality Factors in Binge Drinking

Against the background detailed above, the present study focuses on the role of message types in exposure to alcohol references and the association with binge drinking among adolescents, who are at the stage of life when people seek to become autonomous individuals and explore their identities (Berk, 2014). Therefore, this group frequently consumes alcohol (Rosiers, 2020). However, older and male adolescents consume alcohol more frequently and more excessively than younger and female adolescents (Rosiers, 2020). Hence, we add age and gender as control variables. Additionally, adolescents scoring high on sensation seeking—a personality trait characterized by the tendency to seek out novel experiences—are motivated to obtain the stimulation of alcoholic beverages and underestimate the negative consequences of certain alcohol-related behaviors (Woicik et al., 2009), increasing their likelihood of consuming alcohol (Hittner & Swickert, 2006). Thus, we also control for sensation seeking.

Methods

Sample

A two-step procedure was used to collect data from 1,636 adolescents in March 2019. First, a random sample of 50 secondary schools was selected from the official list of secondary schools in Belgium. School principals received email messages and then phone calls requesting that they consent to their students' participating in a well-being study. Of the 50 principals, a total of 18 provided consent to participate, for a response rate of 36%. In these schools, between four and 20 class groups participated, with a total of 160 groups across all schools. The school principals selected which class groups took part. With the principals' consent, practical arrangements were made for the participation of students from Grade 2 (14-year-olds) through Grade 6 (18-year-olds and older). These ages were selected because, on average, Belgian adolescents are initiated into alcohol at the age of 14 (Rosiers, 2020). Research assistants visited the schools and informed all pupils from the different class groups about the study's aims, procedures, and ethical guidelines; they also explained the various questions and items included in the survey. Students who provided written consent were asked to complete a paper-and-pencil questionnaire during school time. The questionnaire consisted of 36 questions and was pretested with a small sample of adolescents ($N = 33$) who provided feedback regarding the clarity of the items using a think-aloud method. All changes in the questionnaire were valuable but relatively minor (e.g., phrasing of questions and scale points). We did not obtain parental consent for four reasons: (a) the research involved minimal risk to the participants; (b) the waiver did not adversely affect the rights and welfare of our participants; (c) the research could not practically have been carried out without the waiver due to confidentiality issues; and (d) the participants were provided with pertinent information after participation¹. These procedures are in line with the ethical guidelines of the researchers' home university's institutional review board.

The average age of the 1,636 participants was 15.08 ($SD = 1.17$ years, age range between 14 and 20 years), of whom 11.7% were in Grade 2, 28.7% in Grade 3, 31.8% in Grade 4, 23.9% in Grade 5, and 3.8% in Grade 6. A total of 961 (58.7%) participants were female; 673 (41.1%) were male, and two respondents did not indicate a gender.

Measures

Exposure to Moderate and Extreme References in Ephemeral Private Message Types

The participants were asked, *How often do you encounter images, videos, or text messages referring to moderate alcohol use on the following social media channels?* and *How often do you encounter images, videos, or text messages referring to intoxication (extreme alcohol use) on the following social media channels?* The three channels were Snapchat snaps, Snapchat stories, and Snapchat messenger². Given that participants might not have been able to recall encountering references to moderate and extreme alcohol use, we included examples of both types. Examples of moderate references were pictures at parties where someone proposes a toast or during dinner where someone consumes one glass of wine. Examples of extreme references included pictures of someone playing drinking games or experiencing the negative consequences of alcohol use (e.g., intoxication). These examples were based on the alcoholpost typology (Hendriks, van den Putte, & Gebhardt, 2018). The participants rated the items on a seven-point scale: (0) = *never*, (1) = *less than once a month*, (2) = *a couple of times a month*,

(3) = *once a week*, (4) = *a couple of times a week*, (5) = *once a day*, and (6) = *multiple times a day*). Factor analyses for exposure to moderate alcohol use references (principal components; eigenvalue = 2.40; explained variance = 80.09%) and extreme alcohol use references (principal components; eigenvalue = 2.47; explained variance = 82.27%) indicated that each question formed one reliable factor ($\alpha_{\text{moderate}} = .88$; $\alpha_{\text{extreme}} = .89$). This scale was used to provide a general overview of the descriptive statistics (H1 and H2).

To analyze the associations between binge drinking and exposure to moderate (H3a) and extreme (H3b) alcohol use references in different social media message types, we recoded the exposure measures into three frequencies: (0) *never*, (1) *less than once a month*, and (2) *between a few times a month and a few times a day*. Thus, we had to collapse the five highest-frequency categories of the original seven-point scale because they did not occur often enough in our sample (less than 6% of participants for moderate references and less than 4% for extreme references in ephemeral private message types).

Exposure to Moderate and Extreme References in Persistent Private Messages

Exposure to moderate and extreme references in persistent private messages was assessed using the same questions and answers as the previously described exposure measures. Four items were investigated: (a) Facebook Messenger, (b) Instagram Direct Messenger, (c) WhatsApp individual conversations, and (d) WhatsApp group conversations². Factor analyses indicated that exposure to moderate alcohol use references (principal components; eigenvalue = 2.28; explained variance = 56.87%) and extreme alcohol use references (principal components; eigenvalue = 2.31; explained variance = 57.93%) each yielded one factor with good internal consistency ($\alpha_{\text{moderate}} = .71$; $\alpha_{\text{extreme}} = .73$). We re-coded this variable in the same manner as the previous measures. Specifically, the frequency was re-coded into three categories: (0) = *never*, (1) = *less than once a month*, and (2) = *between a few times a month and a few times a day*.

Exposure to Moderate and Extreme References in Ephemeral Public Messages

Exposure to moderate and extreme references in ephemeral public messages was assessed using the same questions and answers as the previously described measures. Two items were queried: (a) Facebook stories and (b) Instagram stories². Factor analyses indicated that exposure to moderate alcohol use references (principal components; eigenvalue = 1.33; explained variance = 66.67%) and extreme alcohol use references (principal components; eigenvalue = 1.33; explained variance = 66.83%) each formed one factor. Two new variables were created by averaging the two items ($r_{\text{moderate}} = .33$; $r_{\text{extreme}} = .34$; $p < .001$). These variables were re-coded into three categories: (0) = *never*, (1) = *less than once a month*, and (2) = *between a few times a month and a few times a day*.

Exposure to Moderate and Extreme References in Persistent Public Messages

Participants were asked how often they encountered images, videos, or text messages referring to moderate alcohol use and how often they encountered videos, images, or text messages referring to extreme alcohol use on (a) Facebook wall posts and (b) Instagram feed posts.² Factor analyses indicated that exposure to moderate alcohol use references (principal components; eigenvalue = 1.44; explained variance = 72.21%) and extreme alcohol use references (principal components; eigenvalue = 1.49; explained variance = 74.51%) formed two factors. Two new variables were created by averaging the two items ($r_{\text{moderate}} = .44$; $r_{\text{extreme}} = .49$; $p < .001$). As with the previously described exposure measures, exposure to moderate and extreme alcohol use references was re-coded into three categories: (0) = *never*, (1) = *less than once a month*, and (2) = *between a few times a month and a few times a day*.

Binge Drinking

Binge drinking was assessed using a scale developed by the US National Institute on Alcohol Abuse and Alcoholism (2003). Participants were asked how often they had consumed at least four (girls) or five (boys) alcoholic drinks in the space of two hours during the previous 12 months. The respondents used a 10-point scale: (0) = *never*, (1) = *1 or 2 days*, (2) = *3 to 11 days*, (3) = *1 day a month*, (4) = *2 to 3 days a month*, (5) = *1 day a week*, (6) = *2 days a week*, (7) = *3 to 4 days a week*, (8) = *5 to 6 days a week*, (9) = *every day*. This variable was re-coded into two categories: (0) *no* and (1) *yes*.

Control Variables

Age (open question), gender (0 = *boy*, 1 = *girl*), and sensation seeking were added as control variables. Sensation seeking was assessed using the brief form of the well-established Sensation Seeking Scale (Stephenson et al., 2007). Participants were asked to report the extent to which they agreed with eight statements (*I would like to explore strange places, I would like to make a trip without any previously planned routes or schedules, I prefer friends who are excitingly unpredictable, I feel restless when I spend a lot of time at home, I like to do frightening things, I would like to try bungee jumping, I like wild parties, and I would like to have new and exciting experiences, even if they are illegal*) using a five-point scale: (1) = *totally disagree*, (2) = *disagree*, (3) = *neutral*, (4) = *agree*, and (5) = *totally agree*. Factor analyses indicated that all but one item (*I would like to try bungee jumping*) loaded onto one factor (principal component; eigenvalue = 2.91; explained variance = 41.67%, $\alpha = .75$).

Statistical Analyses

In line with H1 and H2, we investigated how often adolescents encountered moderate and extreme alcohol use references across the four message types. We calculated descriptive statistics and assessed zero-order correlations. We checked for multicollinearity issues based on a variance inflation factor (VIF > 10; Bowerman & O'Connell, 1990) and the tolerance statistic (tolerance < .2; Menard, 1995). Multicollinearity issues were not found, as the smallest tolerance was .79, which was considerably greater than the minimum acceptable value of .20. No VIF was > 10; the largest VIF was 1.66. Moreover, repeated measures ANOVA were conducted to examine whether there were significant differences between exposure categories. For these analyses, we used the full seven-point scale on exposure to alcohol use references described above.

In line with H3a and H3b, we conducted two hierarchical logistic regression analyses to examine the associations between exposure to alcohol references across various message types and the odds of engaging in binge drinking. Since the aim of this study was to investigate how the technical dimensions of message types relate to binge drinking rather than the impact of specific content elements, we considered exposure to moderate (H3a) and extreme references (H3b) separately. We chose this approach based on the theoretical framework of the alcoholpost typology (Hendriks, van den Putte, & Gebhardt, 2018), which uses those two examples, as do many studies in the field of alcohol-related social media effects, because it allows the users themselves to distinguish how alcohol use is depicted and how those depictions are subsequently evaluated (Geusens & Vranken, 2021; Hendriks et al., 2017). For instance, extreme references are clearly distinguishable from moderate ones due to the large amount of alcohol depicted and the focus on the negative consequences of alcohol-related behavior (Vanherle, Beullens, & Hendriks, 2022). Extreme references are considered to be less socially acceptable than moderate ones (Geusens & Vranken, 2021; Vanherle, Beullens, & Hendriks, 2022). Thus, both types of alcohol references are theoretically distinct constructs.

In the regression analyses, we entered the control variables in the first block. In the second block, we entered exposure to moderate (H3a) and extreme (H3b) references in persistent private, ephemeral public and persistent public messages. In the third block, we added exposure to alcohol references in ephemeral private messages to establish how much additional variance is explained by this message type. We used our re-coded categorical measure to determine the increase in the odds ratio (OR), depending on whether individuals were (0) *never exposed*, (1) *exposed less than once a month*, and (2) *exposed between a few times a month and a few times a year*. The models were aggregated from 1,000 bootstrapped samples. To establish significant differences between the different message types, we conducted additional likelihood-ratio tests³. All analyses were conducted using R v.3.6.2.

Results

Different Types of Alcohol References Across Different Message Types

Table 1 provides an overview of the descriptive statistics and correlations of all main constructs of the study. In line with H1, the descriptive statistics indicated that adolescents encountered moderate alcohol references more frequently ($M = 1.39$, $SD = 0.97$) than they did extreme alcohol use references ($M = 0.76$, $SD = 0.77$) in all message types.⁴ On average, adolescents encountered moderate alcohol use references between less than a month and a couple times a month and extreme alcohol use references no more than a few times a year in all four message

types.⁴ Repeated measures ANOVA showed that adolescents saw moderate alcohol references significantly more frequently than extreme ones, $F(1, 1,627) = 1,405.14, p < .01$.

In H2, we posited that more extreme alcohol use references were most likely to be encountered in ephemeral private messages. The descriptive results show that extreme alcohol use references were most prevalent in this message type ($M = 1.18, SD = 1.21$), followed by ephemeral public messages ($M = 0.83, SD = 0.86$). Conversely, persistent private messages ($M = 0.42, SD = 0.66$) were least likely to contain extreme alcohol use references. Repeated measures ANOVA indicated that the different exposure categories differed significantly from one another, $F(2.38, 3,866.55) = 504.85, p < .01$ ⁵. Post hoc pairwise comparison tests showed that extreme alcohol references were encountered more frequently in ephemeral private messages than in the other three message types.

The Associations Between Different Message Types and Binge Drinking

Exposure to Moderate References Across Message Types and Binge Drinking

To examine whether binge drinking was more strongly related to exposure to moderate alcohol references in ephemeral private messages (H3a) than to other message types, a first hierarchical logistic regression analysis was conducted (Table 2). The first block examined the relation between the control variables and binge drinking ($\chi^2 = 586.32, df = 3, p < .001$). Age ($OR = 2.80, p < .001$) and sensation seeking ($OR = 3.55, p < .001$) were significantly related to binge drinking, whereas gender was not ($p = .41$).

In the second block, we added exposure to moderate references in persistent private, ephemeral public, and persistent public messages to the model ($\Delta\chi^2 = 70.56, df = 6, p < .001, \Delta R^2 = .04$). Only exposure to moderate references in persistent private messages was a significant predictor for binge drinking. Specifically, the odds doubled for adolescents who encountered moderate references on a yearly basis ($OR = 1.89, p < .01$) in comparison to those who never saw such references in persistent private messages. Moreover, the odds of an association between exposure to moderate references in persistent private messages and binge drinking was three times higher for adolescents who saw these references on a monthly to daily basis ($OR = 3.14, p < .001$) in comparison to those who never encountered them.

In the third block, we included exposure to ephemeral private messages. This message type increased the explained variance by 5% ($\Delta\chi^2 = 75.44, df = 2, p < .001$). The OR for the association with binge drinking was three times higher for adolescents who encountered alcohol references less than once a month ($OR = 2.80, p < .01$) and seven times higher for adolescents who saw them between a few times a month and a few times a day ($OR = 7.39, p < .001$) than for adolescents who never encountered these references in ephemeral private messages. In this block, persistent private messages retained their significant association with binge drinking but only for the highest exposure category: adolescents who saw these references between a few times a month and a few times a day were more than two times more likely to engage in binge drinking ($OR = 2.37, p < .01$) in comparison to adolescents who were never exposed to these references in persistent private messages.

Given that both ephemeral private and persistent private messages were associated with binge drinking, we formally tested whether the two message types differed significantly from each other. We restricted the coefficients of exposure in ephemeral private and persistent private messages to be equal and compared the restricted and unrestricted models using a likelihood-ratio test. The test was significant ($\chi^2 = 12.87, df = 2, p < .01$), indicating that private ephemeral messages play a more crucial role in binge drinking. Thus, H3a is confirmed.

Table 1. Descriptive Statistics and Correlation Analysis.

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	M	SD	Range
Exposure moderate alcohol use references ^a																
1. All message types ^b														1.39	0.97	6.00
2. Ephemeral private messages	.88**													1.90	1.47	6.00
3. Persistent private messages	.78**	.58**												0.71	0.89	6.00
4. Ephemeral public messages	.80**	.57**	.42**											1.67	1.20	6.00
5. Persistent public messages	.79**	.55**	.43**	.78**										1.71	1.29	6.00
Exposure extreme alcohol use references ^a																
6. All message types ^b	.72**	.68**	.58**	.51**	.50**									0.76	0.77	6.00
7. Ephemeral private messages	.67**	.75**	.47**	.43**	.43**	.90**								1.18	1.21	6.00
8. Persistent private messages	.57**	.48**	.62**	.35**	.35**	.85**	.65**							0.42	0.66	6.00
9. Ephemeral public messages	.63**	.54**	.48**	.57**	.51**	.86**	.68**	.63**						0.83	0.86	6.00
10. Persistent public messages	.58**	.47**	.44**	.48**	.53**	.83**	.62**	.61**	.81**					0.73	0.90	6.00
Other variables																
11. Binge drinking	.43**	.47**	.25**	.31**	.33**	.47**	.51**	.36**	.35**	.33**				0.45	0.50	1.00
12. Age	.31**	.31**	.15**	.25**	.31**	.33**	.34**	.25**	.27**	.26**	.47**			15.08	1.17	6.00
13. Gender	.02	.02	-.09*	.08**	.07**	-.03	-.003	-.07*	-.006	-.01	-.007	.03		0.59	0.49	1.00
14. Sensation seeking	.37**	.38**	.24**	.31**	.28**	.36**	.36**	.26**	.31**	.27**	.38**	.16**	.01	3.26	0.73	4.00

Note. ^aThis variable represents an individual's overall exposure to references to moderate and extreme alcohol use. To create this variable, we collapsed all message types. ^bTo facilitate interpretation, this table provides the descriptive statistics of the original seven-point frequency scale. * $p < .05$, ** $p < .01$, *** $p < .001$.

Table 2. Logistic Regression Model for the Relation Between Exposure to Moderate Alcohol Use References and Binge Drinking.

Variables	Odds ratio	95% CI for odds ratio		<i>p</i> ¹
		Lower bound	Upper bound	
Block 1				
Age	2.80	2.47	3.18	< .001
Gender (female)	0.91	0.71	1.17	.41
Sensation seeking	3.55	2.94	4.31	< .001
Block 2				
Persistent private messages				
(1) Less than once a month	1.89	1.38	2.61	< .01
(2) A few times a month–a few times a day	3.14	2.11	4.68	< .001
Ephemeral public messages				
(1) Less than once a month	1.07	0.61	1.89	.53
(2) A few times a month–a few times a day	1.30	0.72	2.34	.44
Persistent public messages				
(1) Less than once a month	1.39	0.78	2.53	.38
(2) A few times a month–a few times a day	1.89	1.03	3.54	.15
Block 3				
Ephemeral private messages				
(1) Less than once a month	2.80	1.60	5.03	< .01
(2) A few times a month–a few times a day	7.39	4.47	12.60	< .001
Model summary at each block				
	χ^2	<i>df</i>	<i>p</i>	Nagelkerke <i>R</i> ²
Block 1	586.32	3	< .001	.41
Block 2	70.56	6	< .001	.45
Block 3	75.44	2	< .001	.50

Note. Odds ratios, *p*-values, and confidence intervals are based on 1,000 bootstrapped samples. Hosmer and Lemeshow test: $\chi^2 = 7.12$, *df* = 8, *p* = .52.

Extreme Alcohol Use References Across Message Types and Binge Drinking

To determine whether exposure to extreme alcohol use references in ephemeral private messages had a stronger relation to binge drinking (H3b) than exposure to the other message types, we carried out a second hierarchical logistic regression (Table 3). The first block included the control variables ($\chi^2 = 586.32$, *df* = 3, *p* < .01, *R*² = .41). The second block regarded the association between exposure to extreme references in persistent private, ephemeral public, and persistent public message types on the one hand and binge drinking on the other ($\Delta\chi^2 = 159.40$, *df* = 6, *p* < .001, $\Delta R^2 = .09$). With regard to persistent private messages, we found that the ORs for the association between exposure to extreme alcohol references and binge drinking was three times higher for adolescents who encountered these references on a yearly basis (*OR* = 3.22, *p* < .001) in comparison to individuals who never saw these references. Moreover, the ORs were five times higher for adolescents who saw extreme references on a monthly to daily basis (*OR* = 5.36, *p* < .001) compared to those who were never exposed to these references in persistent private messages. We also found some significant associations for public message types and binge drinking, but not for all exposure categories. With regard to ephemeral public messages, the odds doubled for adolescents who encountered extreme alcohol use references less than once a month compared to those who never saw these references (*OR* = 1.86, *p* = .03). With regard to persistent public messages, the odds doubled for individuals who saw extreme references between a few times a month and a few times a day, in comparison to those who never encounter these references (*OR* = 2.08, *p* = .04).

In a third step, we included ephemeral private messages as a predictor. This block was significant ($\Delta\chi^2 = 67.27$, *df* = 2; *p* < .001) and increased the explained variance by 4%. The ORs for the association between exposure to extreme references and binge drinking was three times higher for adolescents who saw these references less than once a month (*OR* = 3.10, *p* < .001) and six times higher for adolescents who encountered them between a few times a month and a few times a day (*OR* = 6.48, *p* < .001) than for those who never saw these references in

ephemeral private messages. In this third step, exposure to persistent private messages also remained significantly associated with binge drinking: the odds doubled for adolescents who saw extreme references less than once a month ($OR = 2.45, p < .001$) and were four times higher for those exposed between a few times a month and a few times a day ($OR = 3.67, p < .001$) than adolescents who never saw these references in persistent private messages.

A likelihood-ratio test pointed out that the association between exposure to ephemeral private messages and binge drinking was significantly stronger than the association between exposure to persistent private messages and binge drinking ($\chi^2 = 7.00, df = 2, p = .03$). Thus, H3B is confirmed.

Table 3. Logistic Regression Model for the Relation Between Exposure to Extreme Alcohol Use References and Binge Drinking.

Variables	Odds ratio	95% CI for odds ratio		p^1
		Lower bound	Upper bound	
Block 1				
Age	2.80	2.47	3.18	< .001
Gender (female)	0.91	0.71	1.17	.41
Sensation seeking	3.55	2.94	4.31	< .001
Block 2				
Persistent private messages				
(1) Less than once a month	3.22	2.41	4.30	< .001
(2) A few times a month–a few times a day	5.36	3.09	9.48	< .001
Ephemeral public messages				
(1) Less than once a month	1.86	1.26	2.77	.03
(2) A few times a month–a few times a day	1.35	0.80	2.27	.37
Persistent public messages				
(1) Less than once a month	1.42	1.00	2.02	.17
(2) A few times a month–a few times a day	2.08	1.27	3.40	.04
Block 3				
Ephemeral private messages				
(1) Less than once a month	3.10	2.00	4.87	< .001
(2) A few times a month–a few times a day	6.48	4.10	10.38	< .001
Model summary at each block				
	χ^2	df	p	Nagelkerke R^2
Block 1	586.32	3	< .001	.41
Block 2	159.40	6	< .001	.50
Block 3	67.27	2	< .001	.54

Discussion

The role of social media in people's health-related behaviors has attracted considerable scholarly attention (Curtis et al., 2018; Vannucci et al., 2020). These studies showed that exposure to references to unhealthy behaviors such as alcohol use, tobacco use, excessive weight loss, and risky sexual behaviors on social media is linked to people's own behaviors (Donaldson et al., 2022; Ryding & Kuss, 2020; Vannucci et al., 2020).

This study contributes significantly to this body of research in two ways. First, we introduced the TAMT model to investigate health-related social media effects in an environment that is subject to constant change. In our newly developed model, we distinguish between four message types—ephemeral private, persistent private, ephemeral public, and persistent public—rather than focusing on specific platforms or applications. In doing so, we provide a more future-proof model for understanding media effects in a heterogeneous and dynamic media landscape. This is because social media platforms and applications regularly introduce new features, which means that studies focusing on specific platforms or applications can quickly become outdated.

Second, we empirically tested the model for the case of alcohol-related social media effects. We examined how message types are associated with encountering different types of alcohol references and how they may play a role in the association with binge drinking. Our results show that not all message types are equal in terms of

alcohol-related references. References to moderate alcohol use (e.g., pictures taken at dinner parties or people proposing toasts) appeared to be more prevalent than more extreme references to alcohol use (e.g., intoxication) in all four message types. These results seem to reflect adolescents' current drinking patterns, as 56.7% of Belgian adolescents consume alcohol, and 31.1% engage in binge drinking (Rosiers, 2020). This finding can also be explained by the fact that individuals use social media to highlight positive aspects about themselves (Yau & Reich, 2019). However, the prevalence of extreme alcohol use references depends on the message type under consideration. Those types of references are more likely to be shared and encountered in ephemeral private and ephemeral public messages than in persistent private and persistent public messages. This suggests that temporally bounded message types are preferred destinations for the depiction of behaviors that are thought to deviate from broadly prescribed societal norms. By contrast, persistent private messages appeared to be the least likely to contain references to extreme alcohol use. This may be due to an individual's concerns about self-presentation. Content shared in persistent messages remains available for longer periods and may become more public, which could increase the risk of a person's reputation being damaged (Atkinson & Sumnall, 2016; Vanherle, Hendriks, & Beullens, 2022). Therefore, ephemeral messages may be perceived as a safer way to share more consequential and potentially reputation-damaging content.

However, not all individuals encounter or share extreme alcohol use references in ephemeral messages. In this respect, individuals' predispositions (e.g., attitudes and alcohol use) and the peer groups to which they belong should also be considered. Erevik et al. (2018) showed that alcohol-related social media use depends on an individual's alcohol intake and membership in peer groups that have an affinity for consuming alcohol. This supports the hypothesis that social media function as channels through which personal behaviors and peer norms are portrayed (Valkenburg & Peter, 2013a). In the context of our study, this implies that individuals who consume alcohol excessively and witness peers engaging in similar behaviors are more likely to encounter extreme alcohol use references in ephemeral messages. Future longitudinal studies could integrate peer group dynamics and individual characteristics to determine why some individuals encounter these types of alcohol-related postings on social media more often than others.

The finding that more extreme behaviors were prevalent in ephemeral messages can also be extended to other types of content. For instance, evidence suggests that risky sexual behaviors like sexting are most prevalent in ephemeral messages, such as messages on Snapchat (Olatunde & Balogun, 2017). Thus, although we applied the TAMT model to alcohol use references, future research is needed to examine its validity in the context of other health-related behaviors.

In addition to investigating how the dimensions of the TAMT model are associated with differential alcohol references, we also empirically examined its associations with binge drinking. Our findings demonstrated the importance of considering different message types simultaneously when studying the association between social media use and alcohol. Several studies have provided evidence for the impact of social media on offline alcohol use cognitions and behaviors (for an overview, see Alhabash et al., 2022). These studies focused on specific social media platforms or applications (mostly Facebook). However, because it is reasonable to assume that individuals are exposed to alcohol use references in various message types on multiple platforms and applications, our study examined the associations between multiple message types and binge drinking. Although zero-order correlations indicated that all message types were related to binge drinking, when all four message types were simultaneously considered in one model, the results showed that only exposure to moderate and extreme alcohol use references in ephemeral private and persistent private messages was associated with binge drinking. Previous studies on the effects of alcohol-related social media use have focused largely on Facebook's persistent messages due to their dominance at the time (for an overview, see Alhabash et al., 2022; Curtis et al., 2018). Yet the results of the current study show that it is important to study the effects of social media in a context featuring multiple social media that considers various message types simultaneously and more closely reflects the real-world experience of adolescents.

The finding that only ephemeral private and persistent private messages were associated with binge drinking aligns with the limited evidence available in prior research. Jensen et al. (2018) found that private social media features (e.g., Facebook Messenger and Snapchat) are more strongly associated with alcohol use and heavy episodic drinking than public features (e.g., Facebook wall postings on public profiles, Instagram feeds, Twitter). Theoretical models like social impact theory (Latané, 1981) and social comparison theory (Festinger, 1954) may aid in interpreting these findings. These theories posit that individuals tend to compare themselves with others to adapt their own cognitions and behaviors. In this vein, comparison with proximal others influences behavioral outcomes more powerfully (Latané, 1981). Given that ephemeral and persistent private messages are often sent

by proximal others, social proximity may explain the finding that exposure to alcohol in these message types is associated with binge drinking.

Although our study showed that ephemeral private and persistent private messages are associated with binge drinking, it is important to distinguish between those two message types. More precisely, our findings illustrated that ephemeral private messages play a more crucial role in binge drinking than persistent ones. In line with the message interpretation process model (Austin, 2007), this could be explained by the fact that alcohol references in ephemeral private messages are perceived as more authentic and realistic because they stem from proximal peers and are shared spontaneously during drinking events. Future studies should explore these explanatory mechanisms in detail.

Limitations and Directions for Future Research

Like all research, the present study has certain limitations. First, we relied on self-reports, which may be flawed by social desirability bias, although prior research has shown that self-reports are a reliable method for measuring alcohol use (Del Boca & Darkes, 2003). In a similar vein, we assessed the participants' *perceptions* of encountering alcohol use references rather than their *actual* exposure to such references.

Second, we did not include all existing social media features (e.g., Finstagram, Instagram stories for best friends). While some message types did not exist when we conducted the study, they appear to contain alcohol references (Vanherle, Hendriks, & Beullens, 2022) and are also associated with alcohol use (LaBrie et al., 2021). Additionally, we did not examine in-between message types such as stories or post feeds on accounts that are only accessible to friends (i.e., semi-public profiles). Yet, given that all these features can be assessed along the two-dimensional continuum of the TAMT model of temporality and accessibility, we expect that our results can be extended to all current and even possible features.

Third, we did not collect data related to the frequency with which individuals used the different message types. Research investigating the accuracy of self-report data related to social media use by studying digital trace data indicates that people tend to overestimate their time spent online (Verbeij et al., 2022). To overcome this bias, it has been suggested to focus on the content of exposure rather than an individual's overall media usage (Valkenburg & Peter, 2013b).

Fourth, we cannot draw conclusions about the temporality and causality of the associations. It is most likely that individuals who engage in binge drinking select message types in which extreme alcohol references are prevalent and that this relation is transactional. Hence, longitudinal research studies are needed to grasp the nuances of this complex relationship.

Fifth, we distinguished between moderate and extreme alcohol use references. In an effort to ensure that our classification aligned with what the participants considered moderate and extreme behaviors, we provided them with examples. Moreover, research has shown that most individuals can distinguish between the two types of references and consider extreme alcohol use references to be less acceptable than moderate ones (e.g., Hendriks et al., 2017; Vanherle, Beullens, & Hendriks, 2022).

We also used a quantitative research design, which enabled us to include a large number of participants. This came at the expense of less detailed information related to the uses of and gratification generated by different message types. Future qualitative research studies could elucidate adolescents' explicit specific motivations for sharing content in specific message types.

Lastly, the generalizability of our research findings is limited to the Belgian context. In Belgium, alcohol consumption for light beverages (e.g., beer, wine) is permitted from the age of 16. Therefore, individuals may encounter more alcohol references and may perceive them to be more acceptable in comparison to countries with stricter alcohol policies. Future studies could employ cross-cultural designs to explore these differences.

Conclusion

This study makes important theoretical advances, supported by empirical data, to the research field. We considered that studies focusing on specific platforms rapidly become outdated due to the regular emergence of new platforms and message types. We have responded to scholarly calls for more future-proof conceptualizations by developing the TAMT model, which distinguishes between dimensions of message types and enables us to

investigate communication phenomena more comprehensively, irrespective of specific platforms or applications. Drawing on this model, we have advanced the understanding of alcohol-related social media effects among adolescents. Specifically, we demonstrated that not all message types can be treated equally when looking at (a) the type of alcohol use references encountered and (b) the association of such references with binge drinking. While adolescents self-reported encountering moderate alcohol use references in all message types, they indicated that they saw extreme alcohol use references in ephemeral public and ephemeral private message types. Moreover, only persistent private and ephemeral private message types were associated with binge drinking, with ephemeral private messages the strongest predictor. These findings point toward the importance of ephemeral private environments in relation to adolescents' alcohol use. Future research should attempt to gain more access to these outlets to thoroughly grasp the portrayal of risky behaviors, including alcohol. Additionally, we encourage media literacy interventions to increase adolescents' awareness of alcohol use references in ephemeral private messages, as they would enable people to critically process these messages and help protect them from their harmful effects. This is especially relevant in today's social media landscape, with developers increasingly implementing these message types in various applications and platforms (e.g., Instagram Stories for best friends).

Footnotes

¹ For a detailed explanation of our ethical procedures, see this link at the Center for Open Science: https://osf.io/m7z48/?view_only=9ea8915a4a0347ecb48c29824d950f89

² Note that the social media landscape continued its rapid evolution after data collection was completed. We did not include questions about ephemeral private messages on WhatsApp or Instagram, as these features did not exist when our data collection occurred. Additionally, we did not specify whether the alcohol references in ephemeral and persistent messages were encountered on semi-public profiles (e.g., accounts for friends) or fully public profiles.

³ For an overview of the analyses, see this link at the Center for Open Science: https://osf.io/m7z48/?view_only=9ea8915a4a0347ecb48c29824d950f89

⁴ Additional analyses were performed to investigate whether exposure to different alcohol use references differed in relation to the function of the control variables. Independent *t*-test results revealed no significant gender differences, $t_{\text{moderate}}(1,347,15) = -0.58, p = .561$; $t_{\text{extreme}}(1,367,63) = 1.05, p = .292$. Conversely, regression analyses showed that age and sensation seeking were significant predictors: older adolescents and individuals who were more likely to seek sensation encountered moderate alcohol use references (age: $\beta = .31, t = 13.23, p < .001$; sensation seeking: $\beta = .37, t = 16.25, p < .001$) and extreme alcohol use references (age: $\beta = .33, t = 14.20, p < .001$; sensation seeking: $\beta = .36, t = 15.37, p < .001$) more often across all four message types.

⁵ Mauchly's test for sphericity was found to be violated, $\chi^2(5) = 691.71, p < .001$. Therefore, the degrees of freedom were correct using the Huyn-Feldt correction ($\epsilon = 0.80$).

Conflict of interest

The authors have no conflicts of interest to declare.

Authors' Contribution

Sofie Vranken: conceptualization, data curation, formal analysis, funding acquisition, investigation, methodology, project administration, resources, software, validation, visualization, writing—original draft, writing—review & editing. **Sebastian Kurten:** data curation, formal analysis, software, validation, writing—review & editing. **Kathleen Beullens:** funding acquisition, methodology, project administration, resources, supervision, writing—review & editing.

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