User Perceptions and Attitudes Toward Untraceability in Messaging Platforms

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Abstract

Mainstream messaging platforms offer a variety of features designed to enhance user privacy, such as disappearing messages, password-protected chats, and end-to-end encryption (E2EE), which primarily protect message contents. Beyond contents, the transmission of messages generates metadata that can reveal who communicates with whom, when and how often. In this paper, we study user perceptions of "untraceability", i.e., preventing third parties from tracing who communicates with whom, with the goal of informing the design of privacy-enhancing features in messaging platforms and untraceable communication protocols that depend on large anonymity sets and widespread user adoption. We explore this from a broad conceptual standpoint: rather than studying mental models of a particular solution, we analyze how users reason about what features should be incorporated by two fictitious platforms, Texty and Chatty, to prevent third parties from knowing who communicates with whom. Through a vignette-based survey with 189 participants, we found that users associate the concept of untraceability with a wide range of privacy enhancing technologies, implying a diverse set of threat models. Overall, the features suggested by participants show awareness of privacy threats stemming from forms of surveillance and unauthorized access to message contents. Many participants also associated untraceability with the notion of anonymity, but interpreted it as senders and receivers concealing their identity from each other rather than only from third parties. We discuss the gap between users' perceptions of untraceability and the threat models addressed by untraceable communication protocols, as well as how different privacy attitudes point to challenges and opportunities for the adoption of untraceable communication tools in messaging platforms.

Keywords

Messaging apps, metadata privacy, qualitative methods, untraceable communication

1 Introduction

Most usable privacy research on messaging platforms has focused on end-to-end encryption (E2EE), which provides confidentiality for communication contents. However, a lot can be inferred about a person or a community simply by identifying who communicates with whom, when, and how often. This kind of *metadata* can reveal who someone's friends are, how much time they spend chatting instead of working, or even if they have children or not [5]. The mere knowledge that someone was in contact with a journalist, a political activist, or a health support group, even without access to message content, can reveal sensitive affiliations, personal circumstances, or whether they are a whistleblower.

This metadata is generated as part of the message transmission process and is typically accessible to the messaging platforms themselves. Some platforms introduced mechanisms to keep metadata confidential, such as Signal's *sealed sender* messages [42]. More commonly, platforms declare their metadata retention policies in their privacy policies, for example, by stating that "transaction logs" are not stored after message delivery (unless required by a valid legal request) [70]. However, even with such protections in place, metadata revealing who communicates with whom, when, and how often can still be observed at the transport layer by network attackers using *traffic analysis* [19].

In this paper, we are interested in understanding user perceptions and attitudes toward *untraceability* in messaging platforms, which we define as the conceptual goal of preventing third parties from knowing who communicates with whom. Our goal is two fold: On one hand, we want to develop a first general understanding of the threat models that users associate with untraceability and how they feel about related tools, extending our knowledge about privacy concerns beyond message contents. On the other hand, we are particularly interested in how this new understanding informs the design of specialized protocols for *untraceable communication* [14], which we use to refer to mechanisms that protect transport-layer metadata by breaking the observable link between sender and receiver, such as IMProxy [7] and DenIM [46]. Since the effectiveness of these protections often depends on widespread adoption, it is important to align the design of these tools with users' understanding of untraceability and their attitudes toward adopting related tools.

The focus on untraceability is particularly important in light of the growing number of messaging platforms and features that advertise themselves as solutions for "sending messages, not metadata" (e.g., Session [39]), for "leaving no traces" (e.g., Telegram [63]), or to "communicate [...] anonymously" (e.g., Threema [66])—despite the fact that each of these could resonate with the idea of preserving the confidentiality of who communicates with whom, they all refer

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to very different forms of protection, such as onion routing (Session), disappearing messages (Telegram), and data minimization (Threema). This calls for an understanding of which technologies or features users associate with untraceability, which can help inform the design of user interfaces in ways that more clearly communicate what kinds of traces or metadata are protected—and which are not.

To explore this, we designed a survey that investigates how people think about untraceability and the technologies that support it. Since we expect that most users may not find untraceability directly relevant to their everyday lives, we framed the survey around fictional characters, rather than asking participants about their own behavior and preferences. Participants were presented with two vignettes where untraceable communication aided or hindered the characters' goals: one involving a whistleblower seeking to avoid detection, and another involving a criminal investigation requiring access to communication records. Through these scenarios, we prompt participants to reflect on the trade-offs between privacy and accountability with the purpose of eliciting nuanced opinions on the value of untraceable communication tools, and understanding their attitudes toward its widespread adoption.

Participants suggested a wide range of privacy enhancing messaging functionality and workarounds as means to reduce or avoid the traceability of senders and receivers in a messaging conversation, from using aliases to messaging over VPNs. Most notably, a large proportion of participants associated untraceability with the concept of anonymity, but the features they proposed for anonymity relied on hiding visible identifiers from the recipient, rather than hiding from parties *outside* of the conversation, such as network attackers. Moreover, when asked about their opinions on the widespread availability (or absence) of the privacy enhancing technologies (PETs) they associate with untraceability, their rationale did not center on threat models but rather on their overall stance towards privacy, their trust in technology, service providers, and institutions. We contrast participants' discourses of advocacy for individual privacy and safeguarding of online safety with Westin's seminal privacy indexes, resulting in three trending attitudes towards making untraceability widely available in messaging platforms: the *privacy fundamentalists*, the *safety fundamentalists*, and the *optimists*. We discuss the implications and significance of this study for narrowing the gap between untraceable communication researchers and user mental models of untraceability.

2 Background and related work

We present a review of relevant PETs for messaging in the context of obfuscating or erasing traces of communications broadly, research on untraceable communication solutions, and relevant user perspectives on privacy in messaging platforms.

2.1 Untraceable communication

In this paper, we use the term *untraceable communication* [14] to refer to protocols that protect transport layer metadata that reveals who communicates with whom, when they communicate, and how often communication takes place. From a technical standpoint, untraceable communication protocols traditionally aimed to make it difficult for a network observer to trace individual messages in a network, beyond the scope of messaging platforms [14, 15]. The same techniques are sometimes also called *anonymous communication*, or more recently, *metadata-protecting communication systems* [53]. To refer to the goal of preventing third parties from knowing who communicates with whom in a messaging platform more generally, we use the term *untraceability*, such that there is a distinction between the policy (untraceability), and the mechanism (untraceable communication). User adoption is crucial for untraceable communication: privacy guarantees get stronger as the number of users, the anonymity set, grows. For this reason, understanding user dispositions toward the concept of untraceability is essential for the effectiveness of untraceable communication protocols.

Untraceable communication protocols include DC-nets [15], mixnets [14], and onion routing [34]. Apart from Tor [22], which had an estimate of 2M users in 2024 [65], most protocols for untraceable communication are not adopted in practice. Notably, the Tor protocol has tooling support in the form of the Tor Browser Bundle [64] which is a customized Firefox browser bundled with Tor. As for untraceable communication for IM, specialized IM platforms like Briar [11], Ricochet Refresh [52] and Session [39] do offer metadata privacy via Tor. Unfortunately, while Tor is the only untraceable communication protocol with real-world user adoption, Tor is susceptible to de-anonymization attacks [40]. In other words, the protocols with the strongest privacy guarantees have not reached users yet. Recent work in untraceable communication explores protocols specifically designed for IM. IMProxy [7] presents a defense using proxy servers, and DenIM [46] extends the Signal protocol to support untraceable communication.

2.2 Privacy enhancing technologies for instant messaging (IM)

Mainstream messaging platforms today include a variety of PETs related to "communication traces", e.g., by encrypting message contents or minimizing data collection. Platforms typically do not support untraceable communication protocols. However, since users' mental models are influenced by the technology they are familiar with, we believe it is important to consider a broader conceptualization of untraceability and the PETs that users may associate with it.

Encryption. Many IM platforms provide confidentiality for message *contents* via encryption. The most popular protocol in IM is the Signal protocol [43, 44], used by for example WhatsApp [69], Facebook Messenger [28], Wire [72], and the Signal app. The scientific consensus is that the Signal protocol is a state-of-the-art protocol, proven formally secure [18].

Despite IM platforms such as WhatsApp focusing on end-to-end encryption (E2EE), in 2013 users still incorrectly perceived SMS as more privacy-preserving [16]. This misconception was still prevalent despite WhatsApp rolling out end-to-end encryption by default in 2016—in Gerber et al. [33]'s 2018 study over half the participants incorrectly believed that their messages could be read by third parties. Similarly, in 2019 Dechand et al. [21] found evidence that WhatsApp's users still did not believe that their messages were kept confidential, and in 2021 when WhatsApp rolled out a new privacy policy 28.42% of users tried to switch to SMS as an alternative, stating privacy and security as the reason why [37].

Minimizing data retention. Many IM platforms offer features such as disappearing messages, and also let users delete previously sent messages. It is unclear if users see both features as privacy enhancing, as users report different reasons for deleting messages. In Schnitzler et al. [54]'s study, 54.4% of participants deleted messages for some kind of privacy reason, including reasons such as messages being inappropriate, obsolete, regretted by the sender, mistakenly sent or sent to the wrong receiver. However, in the study by Warner et al. [68], participants responded that they mostly deleted messages to correct mistakes in conversations.

Minimizing data collection. IM platforms implement several ways to avoid collecting data, for example via options to disable read receipts, typing indicators, and online status. Some platforms also implement private contact discovery; Signal for example use cryptographically sophisticated methods [45] to avoid learning who speaks to whom. A study of Saudi WhatsApp users indicated that a majority of users care about privacy features in general—58.98% of users changed at least one privacy setting [50]—including features that minimize data collection, such as hiding their online status, or controlling who can view their contact details such as profile picture. However, many users may be unaware of how much data is collectible by IM servers, as a survey by Gerber et al. [33] found that many participants were unaware that IM apps were centralized.

2.3 User perspectives on untraceability and PETs for instant messaging

Most studies on how people perceive risks related to transport layer metadata or technical solutions for untraceable communication have so far focused on Tor, such as, usability aspects of the Tor browser [47], differences between expert and non-expert users [31], awareness and adoption [61], using nudging to increase adoption [60], and specific misconceptions [29]. For example, users thought that Tor would prevent websites from misusing their credit card information [31, 61], and often struggled matching Tor as a relevant protection for given use cases [61].

To the best of our knowledge, there are no studies on end-user perspectives on untraceable communication technologies in the context of instant messaging, or on the concept of untraceability in itself. There has been, however, research on mental models of and adoption of other PETs for messaging, particularly E2EE, which relates to the concept of untraceability from the perspective of preventing access to communication contents, and may provide useful insights about potential barriers or motivations for adoption of untraceable communication technologies. For instance, the 2018 study by Abu-Salma et al. [3] indicated that 75% of participants incorrectly believed third parties could read E2EE messages, and 50% of participants felt that SMS and landline phone calls were at least as secure as E2EE services. For example, previous work documented how a "nothing to hide" mentality often explains why users choose less secure tools, where they associate privacy as a need for only those that might fear "getting caught" [58, 59]. In this line, other work highlighted the "social stigma" that comes with using certain PETs, for example, being seen as secretive and paranoid [4, 20]. The idea of untraceability could further exacerbate such judgments. Moreover, even when users have accurate mental models of how a PET functions, they may still reject it due to preconceived notions about the app it is associated with [62]. Additionally, users may continue to distrust that such tools can effectively shield them from powerful actors—such as corporations or governments—despite understanding the underlying technology [21]. Since the effectiveness of many untraceable communication technologies rely on widespread adoption, we are interested in learning in what ways these barriers to adoption manifest in end-user opinions about untraceability.

Last, we take inspiration from Westin's seminal categories of privacy attitudes [38, 41] to reflect about users' dispositions toward making untraceable communication technologies widely available. Westin's privacy indexes categorizes users in three groups: *privacy fundamentalists*, who are deeply concerned about unrestricted data collection and advocate for strong legal protections of personal privacy; *privacy unconcerned*, who easily share personal information with businesses and authorities in exchange for services; and *privacy pragmatists*, who evaluate the trade-offs between privacy risks and utility on a case-by-case basis. In this paper, we contribute a new take on these privacy attitudes reflecting user reactions and opinions to the concept of untraceability.

3 Methods

We designed this study to explore how IM users think about untraceability, and their understanding and opinions on technologies that can support it. Assuming that most users are not familiar with threat models around metadata and untraceable communication protocols, we focused on the conceptual goal of preventing third parties from knowing who communicates with whom to answer the following research questions:

- **RQ1**: What are the privacy and security features of messaging apps that users perceive as tools for untraceability?
- **RQ2**: What are users' attitudes and opinions associated with untraceability in messaging platforms?

To this end, we presented participants with two *vignettes* focused on ensuring the confidentiality of *who communicates with whom* rather than on protecting the *contents* of communication.

Vignettes are a widely used method in qualitative research [8] to study general perceptions and values on a topic. By asking questions about scenarios featuring fictitious characters or personas, vignettes encourage participants to be more open about sensitive topics without requiring them to discuss personal experiences or how *they* would act in such scenarios. Scenario-based studies are common in usable privacy and security as a method to collect insights about how users recognize and react to diverse risks [23]. We anticipated that most messaging app users would struggle to personally relate to the threat of network attackers capable of traffic analysis, so we chose to use vignettes with personas for whom traffic analysis is a serious threat.

3.1 Questionnaire

We designed two vignettes to present both a positive and a negative use of untraceable communication technology—one where it aids a beneficial cause, such as protecting a whistleblower, and another where it facilitates criminal activity. This approach allowed us to help participants reflect about the trade-offs of untraceability, capturing a nuanced understanding of their perspectives on potential risks and benefits. We randomly assigned different orders of

the vignettes presented in Part 1 and Part 2 below; some participants would first reflect about potential benefits, and other about potential risks.

Informed consent and messaging app use. We first present an information sheet explaining the purpose of the study, a consent form, and a commitment request to providing thoughtful, personal answers [32]. After obtaining consent, we ask for the frequency of use of a list of 18 messaging apps, including mainstream ones such as WhatsApp, iMessage and Signal, as well as less popular but privacy-focused apps such as Wickr, Session and Threema.

Part 1. A vignette presents participants with a scenario where untraceable communication could play a crucial role in protecting a person trying to do good. The goal is to show the *positive* implications of untraceability, suggesting that it can protect individuals undertaking actions that carry a personal risk but also significant benefits for others. The vignette is presented as follows:

> Alice is a member of parliament. She recently confirmed that an alleged case of corruption involving people of her political party was indeed true. She feels that the people involved should confess and resign, but her party plans to keep denying it. She wants to send Bob (a journalist) some confidential documents that expose the corrupt party members but she's afraid of being caught as "the whistleblower". She wants to leave no traces of communication between her and Bob, so instead of sending Bob an SMS or an email, she sends the documents via the app "Texty", which is popular for its privacy and security features.

The vignette does not specify a threat model in particular (e.g., traffic analysis), and does not mention what kind of privacy and security Texty already provides. Instead, it presents a scenario where the characters need to keep the fact that they communicated with each other confidential. In this way, we distance the scenario from any particular privacy enhancing technology, allowing us to ask participants to fill that gap to their best ability and get a broad overview of their mental models about what it means to prevent third parties from knowing that two specific people were communicating with each other. We then ask about:

(1) what features Texty should have to prevent other people from ever knowing that Alice and Bob texted each other;
(2) whether there are risks or disadvantages to the solution they proposed;
(3) whether they think that all messaging apps should include such features;
(4) whether they would recommend Alice and Bob to use any of the messaging apps they are familiar with;
(5) whether they would recommend them *not* to use any messaging app in particular.

Through these questions, we aim to access a nuanced account of participants' understanding of threat models of untraceability, the PETs they consider as relevant solutions, and the perceived benefits and risks of untraceability in general.

Part 2. A new vignette presents a scenario where, unlike in Part 1, untraceable communication could favor people with malicious intentions, illustrating *negative* implications of untraceable communication.

> There are two suspected criminals who claim that they don't know each other and have never been in touch, but the police suspect that they communicated electronically to organize the crime. The forensic team is trying to find communication records between them, and they think they communicated via the app "Chatty", which is popular for its privacy and security features.

We then ask about:

(1) what features Chatty should have in order to obstruct the police from proving that the criminals communicated with each other;
(2) whether there are advantages or opportunities to using the features they proposed;
(3) whether they think that all messaging apps should avoid including such features;
(4) whether they would recommend the police to look for traces of communication between the two suspects in any of the messaging apps they are familiar with; and
(5) whether they know of any messaging apps that would effectively allow the two suspects to communicate in such a way that the police could never prove that they interacted with each other.

Part 3. Since our pilot studies showed a tendency for participants to suggest E2EE as a solution in both vignettes, before asking the final question, we introduce the notion of untraceability[1] explicitly, focusing on preventing third parties from determining *who communicated with whom* rather than from accessing the *contents* of the communication, differentiating it from E2EE. We also clarify the conflicting role that untraceable communication plays in the two previous vignettes to help participants further reflect on its trade-offs. Participants are presented with the following text:

> **Important message**
> Thank you for your answers so far. Before moving on to the next section, we would like to clarify some facts about messaging apps. Please read the following carefully.
> The security and privacy features needed for both Texty and Chatty in our previous examples are not available in any mainstream messaging app. Apps such as WhatsApp or Signal guarantee that **the contents** of the messages are kept confidential via "end-to-end encryption", **but this does not prevent intruders, hackers or the police from tracking senders and receivers and determining who communicated with whom**.

[1] In this section of the survey, we use the term "untraceable communication" instead of "untraceability", but still to refer to the goal of preventing third parties from knowing who communicates with whom rather than a particular protocol.

> In the next section[2], we will ask you about your opinions on features related to untraceable communication. If Texty and Chatty incorporated features for untraceable communication, they could ensure that no intruder could ever prove that Alice sent messages to Bob, but they may also hinder the police from investigating whether the criminals communicated with each other.

Last, we ask: *"What kind of features do you think Texty or Chatty should add to help both Alice (Scenario 1) and the police (Scenario 2)? You can suggest features you're familiar with as well as ideas that don't exist yet".*

3.2 Participants

We recruited 189 participants via Prolific[3] and collected responses through Qualtrics[4] between April 29 and July 23, 2024. The study protocol was approved by the IRB of one of our affiliations [5] and all data collection and processing were carried in accordance with GDPR. We paid participants £5 for an estimated response time of 30 minutes; the mean response time was 24:06 minutes. We configured Prolific to recruit participants from a list of countries with the intent of enriching the diversity of perspectives in the data. We chose six of the countries with the largest participant pool.

Participants came from the United Kingdom (110), Spain (26), Germany (19), the United States (14), France (13), and Ireland (7). The median age was 33 (range: 18-73 years), with 108 (57%) identifying as female, 79 (42%) as male and 2 (1%) who preferred not to disclose their sex. Participants used the following messaging apps: WhatsApp (178), SMS (170), Instagram (direct messages) (158), Facebook Messenger (154), iMessage (97), Discord (88), Telegram (80), Snapchat (75), Slack (37), RCS (42), Google Chat (31), Other (22), Signal (20), WeChat (11), Kik (10), Wickr (4), Matrix (4), Threema (1), Session (1). The messaging apps reported to be used "very frequently" were WhatsApp (131 participants), Instagram (direct messages) (40), Facebook Messenger (35), iMessage (25), Discord (16), SMS (14), Snapchat (8), Telegram (7), Slack (6), Other (4), RCS (3), WeChat (1), Google Chat (1).

3.3 Analysis

We took a mixed-methods approach to the data analysis: to analyze participants' perceived tools for untraceability (RQ1), we chose content analysis as the analytical method. This method allowed us both to quantify the frequency of mentions of different types of features that participants suggested for preventing third parties from knowing who communicates with whom, and to systematically identify families of suggested features (which we call strategies in Section 4) and analyze potential threat models associated with them. To analyze participants' values and opinions related to untraceable communication, we opted for a reflexive thematic analysis approach (RTA) [10], where we looked for cross-cutting patterns of meaning across answers and participants.

Content analysis. We compiled all individual suggestions about features for Texty and Chatty, resulting in 385 and 334 entries respectively. One author labeled every single mention of a feature with the closest privacy or security mechanism to what the participant suggested, e.g., *"deleted after being read"* (P117) as "self-destructing message". This phase resulted in 39 unique labels, which the same author grouped in eight strategies, presented in Section 4. Labels with only 1-2 data points were all grouped in the label "Others". A second author went through all categorizations done by the original labeler and marked disagreements, proposing alternatives. Then, they reflected about the disagreements in a meeting, addressing them one by one, until they agreed on all categorizations. Last, all authors discussed over several meetings and writing sessions in what ways these strategies implied diverse threat models of untraceability as a broad concept, paying attention to critical gaps with the main threat model addressed in technical untraceable communication research, i.e., network attackers.

Reflexive thematic analysis (RTA). We chose an RTA approach for studying the questions about perceived risks and perceived benefits of untraceability to learn about user attitudes and opinions of untraceability (RQ2). In this approach, we acknowledge that our personal backgrounds and agenda as researchers in security and privacy and human-computer interaction significantly shape our interpretation of the data. For example, at every step of the thematic analysis process [17], we reflected about how the line between what we interpreted as a "misconception" or an "opinion" was rooted in our own stances towards privacy. We followed an inductive (data-driven) approach to constructing the themes, while acknowledging that our interpretative lens was significantly influenced by our research questions and general goal of generating implications for the design of messaging platforms and PETs.

The RTA mostly focused on all answers about risks and benefits of the features suggested for Texty and Chatty, about whether they should be available or banned from all apps, and their final answer regarding what features could help both Alice and the police, but, when relevant, also considered app recommendations for either Alice, the criminals or the police. A first data familiarization phase served to assess that the quality of the data was good enough to find patterns across participants, and that answers were relevant to learning about diverse perspectives and perceptions of (their understanding of) untraceability. One author then performed open coding. After coding 60 participants, the author made a first grouping of codes and a thematic map. The coding of the next 30 participants focused on enriching the patterns of the first thematic map, mostly repeating existing codes. Then, the author created a new thematic map, including the presented themes in Section 5 for the first time, which they discussed with the rest of the co-authors. At this point, the authors felt that the themes were capturing a nuanced, cohesive story about tensions between privacy, safety, and in-between misconceptions, and decided to stop performing open coding and move on to refining the themes and producing the report. The answers of the remaining participants served as extra examples of the different themes and subthemes.

[2]The survey included a Part 4 that is outside of the scope of this paper. Part 4 asked participants about their opinions on a particular, speculative approach to untraceable communication in messaging apps, moving away from general understandings about untraceability.
[3]https://www.prolific.com/
[4]https://www.qualtrics.com/
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3.4 Reflexivity and limitations

In this qualitative study, we approached the analysis from a constructivist perspective, acknowledging that the reported results are the product of our interpretation and that we are constructing knowledge, not discovering it [30]. We agree with Elmimouni et al. [25] that "as people who design and build privacy-enhancing tools and who belong to a privacy habitus, it's important to recognize and own our expert biases". Throughout both analyses, we reflected about how our personal backgrounds, research interests, and stances toward online privacy and security influenced our interpretation of the data. This contributed more nuanced, diverse considerations in the interpretation of open-ended answers. Thus, it is important to note that even though we present counts in the results of the content analysis for RQ1, this was an interpretative analysis [57] based on open-ended answers. We report the frequencies of the categories that we assigned to each participant feature suggestion because we are interested in having a first indication of what the most salient conceptualizations of untraceability are today. However, these counts *should not* be seen as statistically representative. We believe, however, that the range of features we present as perceived tools for untraceability can inform future surveys specifically designed to calculate and hypothesize about frequencies. We also chose not to present counts in our thematic analysis, since it describes complex, interpretive constructions rather than the categorization of feature suggestions. Moreover, reporting frequencies in reflexive thematic analysis is discouraged [9], since it would risk misrepresenting the interpretive nature of the analysis and the epistemological stance behind it. Future work can build on our analysis to develop quantitative methods that may help identify and quantify the three different user stances we present.

4 Features perceived as tools for untraceability

To reason about the participants' understanding of what it means to prevent third parties from knowing that a sender and receiver communicated with each other, we interpret their suggested defenses by inferring possible *threat models* that describe their envisioned attacker. Table 1 presents participants' suggestions for privacy and security features that Texty and Chatty should have to help Alice or obstruct the police investigation, grouped by general strategies.

Message deletion. Participants suggested erasing already sent and/or received messages to prevent others from knowing that two people communicated: *"Texty should have a way of clearing the history of messages sent between people"* (P55). Some emphasized that deletion should be irreversible (e.g., *"Deleting the messages forever"*, P11), on both sender's and receiver's devices, or on servers (e.g., *"ability to remove the files from servers completely after downloading"*, P143). Most suggested automatic deletion features: "disappearing" or "self-destructing" messages, e.g., *"It should include a feature that erases all traces of the message after it's been read"* (P141).

These suggestions can be interpreted as participants being concerned about an attacker with access to the chat history. This could for example be an attacker that has physical access to a device or an attacker that gains remote access to the device. Participants may also consider the recipient to be a potential attacker who may share the chat history with other parties. The mention of how deletion should be irreversible can also be interpreted as considering a forensic attacker with the ability to reconstruct deleted messages.

Data encryption. Encrypting communication data was the most frequently suggested type of feature, e.g., *"A good feature that Texty might have would be to be able to encrypt the content of the documents before sending them so that, if intercepted by a third party, they wouldn't be able to be read or understood. Once received by Bob, the could be unencrypted so he can read them"* (P169). Suggesting encryption as a solution indicates that the participants' threat model considers an attacker that will attempt to read message contents. Participants also seem to consider the platform provider a potential attacker that could attempt to read messages, and explicitly suggest E2EE as a defense: *"messages should be end-to-end encrypted"* (P48), and *"Texty should be End-End encrypted"* (P183). Since encryption is a broad term, participants could be considering both a network attacker that observes messages as they are being sent, and an attacker with access to the device that could be prevented from reading encrypted messages while they are stored on the device. For example, P172 suggested that *"Encryption at both ends would help too"*, which could be interpreted either as encrypting messages as they are being sent, or as encrypting messages on both sender and receiver's devices while they are stored.

The suggestions to use encryption indicate that participants are concerned with hiding data, but it is difficult to interpret what type of data participants believe is possible to hide with encryption. Specifically, the participants' suggestions do not explicitly address metadata and thus suggest that for many, the concept of *traces* may be linked with the concept of *message content*. However, it is generally unclear if participants believe encryption would make it possible to hide metadata such as when and to whom a message is sent, or whether they have simply not taken into account the metadata's existence in the first place. Still, encryption would be a necessity for leaving no traces in both vignettes, but far from sufficient in and of itself.

Hiding identifiers. Many participants suggested hiding identifying attributes of communication partners. Most often described in terms of "anonymity", we interpret their rationale to be that if the receiver cannot see who sent the message, neither can third parties. Some suggested to send anonymous messages, i.e., without sender information: *"Communication should be completely anonymous, so no names attached to the chat messages"* (P91), while other participants put emphasis on anonymity being linked to accounts' personal data, especially names and phone numbers: *"No real names used. Not even pseudomized, but really anonymous"* (P181); *"Ideally it would also allow someone to message without their number/handle or anything else that can be identifiable being disclosed"* (P57). This reasoning may explain suggestions to use aliases or fake accounts, e.g., *"feature where you can change your username to remain anonymous"* (P55); *"Maybe Messenger with fake profiles"* (P19). It also aligns with suggestions about creating anonymous accounts, i.e., accounts that require no contact information or personal data for signing up: *"completely anonymous signup, with no identifying features, or a completely anonymous no signup service"* (P3). However, many responses were vague about what they meant by anonymity, e.g., *"Users should be completely anonymous"* (P48).

Strategy	Type of suggested feature	Vignette 1	Vignette 2
Message deletion	Self-destructing messages	66 (35%)	56 (30%)
	Message deletion	18 (10%)	17 (9%)
	Message deletion (also from servers)	4 (2%)	2 (1%)
	Total	**88 (47%)**	**75 (40%)**
Data encryption	E2EE	40 (21%)	38 (20%)
	Message encryption	24 (13%)	25 (13%)
	E2EE messages	6 (3%)	3 (2%)
	General mentions of encryption	28 (15%)	32 (17%)
	Total	**98 (52%)**	**98 (52%)**
Hiding identifiers	Anonymous account	30 (16%)	21 (11%)
	Anonymous message	15 (8%)	2 (1%)
	Change usernames	3 (2%)	2 (1%)
	Throwaway/Fake accounts	3 (2%)	0 (0%)
	Other mentions of anonymity	17 (9%)	9 (5%)
	Total	**72 (38%)**	**37 (20%)**
Restricted access to accounts	Password/biometric lock protection	17 (9%)	17 (9%)
	Multi-factor authentication	6 (3%)	6 (3%)
	Total	**23 (12%)**	**23 (12%)**
Preventing data copies	Disabled screenshots	18 (10%)	1 (1%)
	Disabled forwarding/copying messages	4 (2%)	0 (0%)
	Total	**22 (12%)**	**2 (1%)**
Minimizing data in servers	No collection/processing of contacts	3 (2%)	1 (1%)
	No/minimal collection of personal data	4 (2%)	3 (2%)
	No sharing of data with third parties	3 (2%)	1 (1%)
	No storage of data in servers	5 (3%)	10 (5%)
	P2P communication	3 (2%)	1 (1%)
	Total	**13 (7%)**	**13 (7%)**
Untraceable IP	VPN / IP obfuscation / masking	23 (12%)	16 (8%)
	No collection of IP address	2 (1%)	1 (1%)
	Total	**25 (13%)**	**17 (9%)**
Other strategies	Too high level/conceptual	18 (10%)	11 (6%)
	No suggestion	5 (3%)	6 (3%)
	Others	20 (11%)	52 (28%)
	Total	**43 (23%)**	**69 (37%)**

Table 1: Suggested features for vignette 1 (to help whistleblowers) and vignette 2 (to obstruct police work)

These suggestions indicate that participants consider the receiver to be a potential attacker, or that the receiver's device could be compromised by an attacker. The same suggestions also show a concern that the chat history could be shared with an attacker, in which case the lack of identifiers could protect the sender. Moreover, the suggestions for accounts without personal data indicate that participants perceive the platform provider as a potential attacker to whom they wish to avoid disclosing identifying data.

Restricted access to accounts. Some participants focus on stronger authentication, though it was not clear if they expected to restrict access to the sender's account or device, or the recipient's. Suggestions include securing accounts with passwords or biometric locks: *"Password or Face ID to get into the app"* (P43), and two-factor or multi-factor authentication: *"could use multi factor authentication so no one else can access"* (P179).

These suggestions point to participants considering either an attacker with physical access to the device, or a remote attacker. In both of these cases, the additional authentication layer would make it more difficult for the attacker to break in to the messaging app than the phone itself, showing awareness of defense in depth.

Preventing data copies. Some suggestions expressed concerns about how the receivers would handle messages. For example, participants suggested ways to prevent messages or documents from leaving the app: *"not letting copy the text or take screenshots"* (P159); *"impossible to forward"* (P180).

These suggestions indicate a threat model where the receivers, or the receivers' devices, are potential attackers. For example, the suggestion to make it impossible to forward messages expresses a concern that the receivers may share information with someone the

message is not intended for. The participants could also be considering an attacker with physical access to the receiver's device, though what we could term a *Polaroid attacker* could still take a photo with a different device instead of attempting to take a screenshot. These concerns show that participants consider transitive information flows, where information is forwarded, as part of their threat model.

Minimizing data in servers. This category illustrates an understanding of a client-server architecture, and awareness of risks related to data stored on servers. Suggestions include avoiding data backups (e.g., *"no database back up of messages on the Texty side"*, P25), and avoiding storage and/or processing of data on servers. For example, P157 suggested *"a feature by which no data is stored in the cloud or other system"*, and P167 emphasized that *"obviously the app needs to have zero telemetry that could report compromising information to the developer."* Other suggestions referred to how data stored on servers should be treated, referencing GDPR or using terms similar to those expected in a privacy policy: *"a company promise from Texty that they will not grant access to messages other than the account holder"* (P130).

These suggestions indicate that participants trust their devices more than the platform's servers, which points to a threat model where the platform is a potential attacker, or where the platform can be compromised by an attacker. Similar to the concerns about recipients forwarding data, these suggestions show that participants perceive transitive information flows as a potential threat, either because they might not trust the platform, or because they believe the platform itself risks being compromised.

Untraceable IP. Some participants also showed an understanding of computer networks by suggesting protection for IP addresses, and methods to make IPs untraceable. For example, participants suggested preventing the app from collecting the user's IP address, e.g., *"No way of finding out where the message came from E.g no IP address attached"* (P138), *"untraceable IP addresses so the information could not be traced back to Alice"* (P148), and *"Masking of ip addresses"* (P162). Notably, some participants specifically mentioned using untraceable communication tools: *"Go through **TOR** and have as many nodes as possible or something similar"* (P161). Participants also suggested using VPNs: *"it should also have a VPN built in to obscure user's location"* (153).

These suggestions indicate a network layer attacker, which is the main threat model that drives the research field of untraceable communication. However, the suggestion to use VPNs implies a weaker attacker, for example a local network attacker that only has access to some part of the network rather than a global one.

5 Privacy attitudes towards untraceability

We analyzed participants' opinions and reflections on the risks and benefits of untraceability to identify trends in *attitudes* towards making tools for untraceability widely available. The attitudinal trends we see in the data resonate with societal debates about the tensions between individual privacy and collective accountability [2, 6]. These tensions are particularly relevant to recent regulatory initiatives such as UK's Online Safety Act [67] and the EU's new ProtectEU strategy [26, 27], which both challenge encryption as an individual privacy protection in order to facilitate the detection of child exploitation and terrorist recruitment. Moreover, during the analysis, we found an unexpected, cross-cutting pattern in the way participants' opinions were expressed: when justifying why the PETs they suggested should be available or banned from messaging apps, they tended to skip any reference to a particular PET or threat model and resorted to general statements about "privacy" as a broad concept. We interpret such statements as indications of privacy attitudes triggered by reflections about the risks and benefits of (their understanding of) untraceability.

Next, we describe three themes, each representing salient attitudes towards privacy in relation to adding support for untraceability of senders and receivers in messaging platforms: *privacy fundamentalists*, advocating for individual privacy as a human right, *safety fundamentalists*, advocating for public safety above anything else, and *optimists*, advocating for a pragmatic but idealistic balance between privacy and safety.

5.1 Privacy is a human right—the privacy fundamentalists

This stance marks a firm support for PETs and frames privacy as a "human right"—a protection that, *on principle*, applies to everyone. Participants taking this stance often talked about privacy as a universal right, for example, *"we all **deserve** privacy"* (P19); *"I **should** be able to send sensitive information without third parties finding out."* (P15); *"People are **entitled** to privacy"* (P40). Because of this principled attitude towards privacy in general, we believe that this group aligns with Westin's *privacy fundamentalists*, who strongly distrust companies collecting personal data, prioritize privacy over convenience, and advocate for laws that protect individual privacy rights [41]. In this study, we indeed see that the privacy fundamentalists distrust the companies behind their messaging platforms, but also that they are concerned about government surveillance, for example:

> No [they should not be banned] because people should have the right to privacy from people and governments and also people who abuse powers (P26)

Privacy fundamentalists often defended the availability of privacy features in messaging apps *"above anything else"* (P10). When reflecting about how the features they suggested for untraceability could potentially hinder criminal investigations, they acknowledged that the features could be misused, but also refused to blame the technologies themselves. Instead, they placed responsibility on those who misuse them:

> I think there should be secure services where data isn't shared on. If it's used for nefarious reasons then that is the nature of the beast imo (P25).

> Some part of me thinks that we should have privacy online because there's a lot of weird people. It is true that it can be a problem in legal situations, but if someone wants to do illegal stuff and hide their communications, they'll find a way either way (P11).

In line with defending PETs rather than placing the blame on them for potential misuse, some called for authorities not to compromise privacy in favor of criminal investigations:

> [Texty and Chatty] should include untraceable communication to help Alice. The police, however, shouldn't change the encryption system. The communications should be private, and if the police needs to access them, they (with a proper court order) should take the suspect's credentials (or their devices) and access them. (P31)

Their arguments in favor of privacy often emphasized its importance for those seeking to do good, or those in vulnerable situations, such as whistleblowers. We believe that this points to a commitment to privacy that goes beyond concerns about personal communication data, showing care for the rights and safety of others:

> Yes - everyone deserves a right to privacy. When apps are forced to comply with orders to disclose private information, it becomes a slippery slope. In that case, people who aren't guilty of breaking the law have their rights trampled on & whistleblowers don't feel safe exposing wrong doing that could be criminal for fear of prosecution. (P141)

> They should not be banned at all. Even 'democratic' countries might want to apply high levels of surveillance to their citizens and this is not ok, we should have the right to privacy and the fact that the apps can also be used in a criminal way does not take away from our right to privacy. (P57)

These perspectives suggest that privacy fundamentalists may be especially receptive to adopting untraceability solutions not only for their own benefit, but for the sake of preserving a public infrastructure of trust and resistance to abuse.

5.2 Safety comes first—the safety fundamentalists

The "safety comes first" stance captures diverse concerns about how tools (perceived to be) for untraceability could be harmful if they were misused:

> Yes [there are risks], bullying, blackmail, sharing of confidential images, affairs etc. (P29)

> These security features would mean that messages sent are untraceable and open to abuse. They could be used to defraud. (P30)

> Yes I think so [the suggested features should be banned]. So much bad stuff is going on using these apps. child pornography, people trafficking, drug trafficking etc. (P59)

While participants holding this view may appear diametrically opposed to privacy fundamentalists, their discourse is not centered on indifference, as we would find in Westin's "unconcerned" category. Rather, it conveys deep concern for preventing online harms that they blame on PETs, especially those they associate with untraceability. These concerns drive them to advocate for safety over privacy in a strong, principled way, similar to the privacy fundamentalists they would oppose, and for this we call them the *safety fundamentalists*. We notice a trend to conflate privacy with criminality, to view surveillance as a safety feature, and to misinterpret from whom messages would be untraceable.

Privacy benefits criminality. A prominent pattern in the dataset showed concerns that features (perceived) to help Alice communicate untraceably with Bob could be exploited by criminals and malicious users to organize crime and cause harm without leaving evidence. Data is not seen as something to safeguard for individual privacy, but as potential evidence that should be accessible to authorities. Consequently, safety fundamentalists tend to associate privacy with criminality.

> Yes, there are lots of situations where it would be better not to have [the suggested features]. For example, if a crime has been committed and the police need to track phones. (P105)

> The information could get lost. If there is any negative interactions, there would be no way of showing it. (P45)

Beyond associating privacy with criminality, some responses implied or claimed that privacy features *enable* crime and harmful behavior. Unlike privacy fundamentalists, safety fundamentalists attributed online harms to the technology itself over the individuals that misuse it. From this perspective, their solution to prevent crime is to ban the technology that enables it:

> No i think its good to an extent that you cant be completely anonymous on anything digital, because it most likely **leads to** corruption. (P52)

> I think it **leads to** freedom to cyber bully (P23)

> This **creates** environments where people can feel indestructible in regards to talking about illegal & harmful things (...) Whilst they are useful in small cases they should be banned as **it provides** an environment that can be harmful (P104)

These answers signaled distrust in technology, and directed blame of online harms to PETs, rather than attributing blame to malicious users. Because of these positions, we see safety fundamentalists as a hard to reach audience for platforms implementing solutions for untraceability.

Monitoring for safety. Contrary to perceiving surveillance mechanisms as a threat, many participants described monitoring of online communication as a *protective* measure, particularly for vulnerable groups like children and victims of intimate partner abuse. This perspective indicates a prioritization of crime prevention over individual privacy, and reflects a significant level of trust in messaging platforms, the companies behind them, as well as in authorities and the justice system, believing that they would responsibly manage access to individuals' communication data.

> No, parental overview for young people is necessary in this day and age, plus vulnerable people may need oversight and that can't be achieved with this method (P4)

> No, illegal activity needs to be traced. (P29)

> I think the police should have accessed to all messages. It can be beneficial during terrorist attack (P42)

We see a strong connection between these opinions and the "I have nothing to hide" narrative [58] as an argument favoring surveillance to ensure safety. Participants sharing this view seem to

separate themselves from the need for individual privacy, associating privacy with something only criminals need, and as law-abiding citizens, they perceive no personal threat from increased surveillance. Their rationale seems to be that privacy mechanisms are *solely* for hiding illegal activity—implying that surveillance does not affect people who "have nothing to hide":

> I always thing is a little bit suppiscius when someone is too worried about their online life (messages etc), i think that when you don't have anything to hide you don't need to be scared or worry about it. (...) **this privacy thing in the end only helps the so called bad guys!** (P6)

> Honestly, I am not an IT specialist... there should always be a possibility for police to access even encrypted messages in case of a crime investigation. In Alice's case, if she wants to make a difference, she should worry more about doing the right thing and less about not being traced. (P27)

> No, I feel if you aren't doing anything wrong, then you have nothing to hide (P112)

Even though safety fundamentalist have a strong sense of protecting others, they appear to only want to extend the protection to other law-abiding citizens. As they associate privacy with criminality, they are unlikely to want platforms to ensure untraceability as long as it applies to everyone alike.

Misinformed safety concerns. A pattern in the "safety comes first" perspective is that participants appear to relate more concretely to risks and benefits associated with safety, than to the concept of privacy. This bias may explain a recurring, misinformed safety concern surrounding what participants express as "communicating anonymously". As described in Section 4, participants often suggested features they associate with anonymity, such as changing usernames, or using anonymous, throwaway accounts, as ways to prevent third parties from knowing who communicates with whom. These answers suggests that they believe the sender and receiver *must* hide their identity from each other to ensure third parties cannot know that they communicated with each other, although that is not necessary in untraceable communication protocols. As a consequence, safety concerned participants also associate the concept of anonymity with crimes and harmful behavior based on removing accountability from message senders.

> I think being able to send fully anonymous messages is quite scary, because I assume they also cannot be blocked... it would be very scary for victims of stalking etc to receive these messages. (P57)

> Anonymous accounts can be abused especially for harrasment which can be a downside to it. (P102)

> Someone could be talking to someone they think they know but in reality they are someone completely different - this could result in many crimes such as pedophillia or fraud. (P108)

This shows how users' understanding of the concept of anonymity may be more closely associated to hiding from the people participating *in the conversation* rather than from parties *outside* of it, which reasonably raises concerns regarding bullying, scams and other forms of online communication harms.

5.3 "I'm all for privacy, but..."—the optimists

This theme illustrates a contradictory stance trying to "get the best of both worlds", positioned between the "privacy as a human right" and "safety comes first" perspectives. Here, we see participants advocating for privacy as a right for everyone, while worrying about its potential misuse. This perspective can lead to participants struggling to take a stance, as they reflect on the tension between keeping information confidential, and sharing information under special circumstances, such as in crime investigations.

> This is a very complicated question, because the need for information and transparency that the police might need comes up against questions of individual privacy. **I am not able to answer** (P16)

Most participants appear to believe there exists a middle ground, and argue that privacy features should be available, but simultaneously take the contradictory stance of endorsing backdoors to encryption for the sake of ensuring public safety. This position presents a contradiction that participants may not recognize themselves: the exceptions to privacy protections they propose in favor of safety would compromise the very privacy protections they also advocate for. In other words, they seemingly do not understand that privacy would *either* be available to everyone, or no one [6]. We see this stance as an optimistic form of pragmatism, reflecting Westin's pragmatists in the way they weigh the benefits of PETs against, in this case, their perceived risks to safety and accountability. However, this pragmatic attitude drives them to imagine idealistic solutions, such as PETs that can selectively offer protections to the innocent but expose the criminals, or that work in some situations but not others. For this reason, we refer to participants who express this particular kind of pragmatic attitude as the *optimists*. Among the answers, we notice a trend to view privacy as something that should be possible to take away if it could interfere with justice, or that is not needed by everyone, all of the time.

Justice merits an exception. Unlike the unwavering stance of privacy fundamentalists, a consideration shaping optimists is that PETs should account for exceptions in cases where justice is at stake. These participants argue that privacy should be upheld universally, *but* they also approve of privacy breaches by authorities under 'justified' circumstances.

This drives them to imagine idealistic but impossible exceptions to privacy: such as weakening of E2EE encryption, or backdoors to secure communication protocols that could be accessed only by the police, without risk of misuse by others. This perspective reflects immense trust in authorities, the legal system, and the companies implementing the mechanisms.

> I am all for privacy but if the police need access to data like this [for a crime investigation], they should be able to get it. (P15)

> Yes [all apps should allow for deleting messages], but there needs to be a way that the information is backed up and encrypted somewhere for police to access if needed (P103)

> The privacy should be penetrable by law enforcement, but not to the every day user. (P24)

> I think the features I mentioned previously should be available for everyone, but the information could be accessed by the police ONLY if a judge authorizes it. Other way, one as user lose all their privacy because police might observe it, and I think we all need to have our privacy ensured, unless there is a justified reason (with a judge supporting that) (P5)

This rationale points to a nuanced difference with safety fundamentalists: while we believe that safety fundamentalists mainly worry about the misuse of PETs, optimists are open to sacrifice privacy for the sake of criminal investigations that may or may not necessarily relate to online harms. However, both stances trust that authorities would not abuse mechanisms for traceability.

Privacy is not always necessary. Some participants expressed a conditional perspective on privacy, where the privacy features they suggested should *not* be uniformly applied, but rather reserved for specific situations or individuals: *"I do not see total untraceability as universally beneficial"* (P121). Here, we witness a perspective where different privacy features provide "better" or "worse" protection, instead of protecting against different types of threats, and a sense that not every person or every situation merits the privilege of privacy, implying that some communications can be more or less worth protecting than others.

However, some participants appear to struggle with assessing the granularity of privacy features: they seem to assume that *all* communication in one app needs to have the same privacy guarantees, and overlook the possibility of choosing when and for what to use each privacy feature. This misconception hints at participants viewing privacy as a monolithic concept—they appear think of privacy as a binary thing, rather than there being different dimensions that can be protected.

> No [anonymous profiles and Face ID should not be available in all apps], because not all messaging involves such intensely private subject matter, and so having all the security measures would just feel like an unnecessary bother. Also, usually you want to know who you are messaging, so anonymity is irrelevant. (P43)

> I don't think all messaging apps should have high security measures, as not everything in them is always highly confidential like the original case mentioned here. (P45)

We also see this conditional perspective on privacy in opinions about *who* needs or deserves a "superior" level of privacy:

> Unsure. Possibly I think they [features for communicating anonymously] should not be allowed as most people do not need those levels of security and privacy features. (...) I think yes [sophisticated encryption should be banned] for all standard communication apps as it would help the police in solving and preventing crimes. However there does need to be a service where official agencies etc can communicate freely without that information getting into the criminal domain (P33)

These answers hint towards it being important for platforms supporting untraceability to clearly communicate how privacy can be tuned. For example, platforms could inform users that they will get to choose whether each message (or perhaps an entire chat) should be untraceable or not.

6 Discussion

Next, we discuss the implications of our findings for the adoption of untraceable communication technologies and for ongoing debates of privacy vs. safety.

6.1 Mind the gap: perceptions of untraceability extend beyond untraceable communication protocols

Participants' suggestions for PETs, described in Section 4, and the associated threat models we infer based on them, point toward a broad range of understandings of the concept of untraceability on the part of our participants. And although many participants are able to use the language of privacy and security for suggesting features, the way they do so points to conflated and ambiguous use of such vocabulary, particularly when it comes to concepts such as anonymity, encryption, and even the notion of traceability itself. For example, researchers use the term "anonymous communication" to describe a means by which to hide sender and receiver identities from *external observers*, but users likely interpret this to mean sending messages without *visible* identifiers, such as the name or phone number that may appear on the platform UI, thus becoming anonymous to the receiver.

The different interpretations of the term "traces" may also point to a critical gap between user's mental models and the protections offered by untraceable communication protocols. Taken as a whole, the features suggested by participants show a general awareness of privacy threats stemming from forms of surveillance, as well as what could be broadly construed as unauthorized access to or leakage of data. Participants suggest defense mechanisms such as encryption and IP untraceability, suggesting an awareness of certain forms of real-time surveillance or tracking. However, the majority of features suggested indicate that participants largely interpret the concept of "leaving no traces" in terms of either *preventing access to* (e.g. through encryption, data minimization, or access restriction) or *cleaning up* traces that have been previously left behind (e.g. by deleting messages). This points to the likelihood that, while participants are able to reason extensively about ways to prevent third parties from knowing who communicates with whom, they have little awareness of network attackers who can trace traffic in real time, making them unlikely to adopt defenses such as those proposed for untraceable communication [53]. If the privacy enhancing technologies community hopes to encourage the adoption of PETs for untraceable communication, our findings highlight the need to consider potential misalignments between technical terms and user mental models, which may require raising awareness on the threats associated with the collection of metadata.

Indeed, it should come as no surprise that for privacy laypeople, issues surrounding metadata do not come to mind even in privacy scenarios explicitly presented as hinging on traces of who communicates with whom. Previous work indicates that, unlike privacy experts, non-experts are more likely to form their understanding of privacy based on personal experiences, news, and stories they hear from other non-experts [25, 49]. As far as we are aware, to date there has been no high-profile case of privacy violations associated with transport layer metadata or network traces. Instead, we see that participants' suggestions and their associated threat models are reminiscent of several high-profile cases, such as the US government surveillance revealed by Edward Snowden [35, 36], inappropriate use of data by platform providers as in the Facebook–Cambridge Analytica data scandal [13], leakage of data to hackers or other unauthorized third parties like the 2014 celebrity nude photo leak [12], possible access to encrypted data by governments or law enforcement [73], or concerns over privacy violations by previously trusted contacts, like revenge pornography [51]. In this sense, users of IM apps have had little opportunity to understand the existence of threats associated with transport layer metadata or untraceability in general, and more efforts to raise awareness about it are needed. We also note that warnings regarding transport layer metadata are not mentioned by app stores when installing apps, i.e., under the "App Privacy" (iOS) and "Data Safety" (Android) sections of an app profile, and they are typically not mentioned in privacy policies either. While this is understandable, since this type of metadata may exceed the legal responsibilities of apps, we see app stores and privacy policies as a place to start raising awareness about the concept of metadata and traceability.

6.2 Untraceability as a "altruistic privacy"

While we took inspiration from Westin's privacy indexes [41] in our analysis of privacy attitudes toward untraceability, an important takeaway is that we did not find attitudes about privacy in and of itself, but about a tension between what participants perceive as online privacy and online safety. We believe that the three discourses and attitudes that we describe as *privacy fundamentalists*, *safety fundamentalists*, and *optimists* highlight a shift in social norms, where concerns related to online communication are not just about data leaks and privacy breaches anymore, but about accountability, safety, and crime prevention. As this shift unfolds, we may see growing support for surveillance and tracking technologies framed as protections, rather than threats to individual and public privacy—an attitude that not only opposes the goals of untraceability, but also risks normalizing "exceptions to privacy", such as the backdoors to untraceability suggested by the *optimists* in our study.

The tension between privacy and safety has been debated extensively, and is especially relevant today. On the one hand, authorities and some new regulations expect messaging platforms to facilitate the tracing of harmful and criminal content to perpetrators, for example by proposing to implement client-side scanning [1, 6], by requesting access to data about specific accounts [55], or demanding backdoors to end-to-end encrypted data [24]. On the other hand, scholars [6, 48], and mainstream platforms [56, 71] are publicly opposing different forms of traceability, especially when they undermine the protection of E2EE. While we originally aimed to understand users' opinions about untraceability to inform the adoption of untraceable communication technologies for resisting traffic analysis, such as IMProxy [7] and DenIM [46], we believe that these findings also contribute to the larger debate on privacy vs. safety by characterizing three *end-user* stances towards technologies that seek to ensure confidentiality of who communicates with whom.

In the case of solutions that protect transport layer metadata, we see an opportunity to appeal to users by inviting them to adopt these tools *for the sake of others*, rather than for personal benefit. This may be especially important for achieving large anonymity sets. In particular, our analysis suggests that privacy fundamentalists are likely to support additional privacy measures especially when they help protect individuals in vulnerable situations, such as whistleblowers. Presenting untraceable communication technologies as a way to help *others* may also serve to discourage the "I have nothing to hide" mindset by shifting the focus from individual privacy to collective solidarity.

That being said, untraceable communication will be a harder sell for safety fundamentalists and optimists—those who advocate against, or are willing to compromise, privacy in the name of accountability and public safety. We believe there is ample room for educating general audiences about how untraceable communication can help people in vulnerable situations, and that a message centered on protecting *other people* rather than protecting *private data* may resonate more broadly. Additionally, we speculate that to appeal to safety fundamentalists and optimists, platforms adopting untraceable communication protocols can also provide mechanisms for accountability, such as message reporting.

To conclude, at a time when norms may be shifting toward prioritizing accountability over privacy, we recommend to frame untraceable communication tools as enablers of altruistic privacy, emphasizing how their adoption can help protect others in vulnerable situations. Designers and developers should consider how to communicate this value clearly, while also clarifying that untraceable communication does not imply anonymity between senders and recipients. This distinction is key to addressing concerns about potential misuse, such as bullying, scams, or other online harms. Framing untraceable communication in this way positions its additional privacy protections not as something to justify, but as something to *offer*, contributing to protecting those who need it most.

7 Conclusions

In this paper, we aimed to explore users' perceptions of and attitudes toward untraceability in order to identify opportunities and challenges to the adoption of untraceable communication protocols. Although untraceable communication has been well-studied from a technical perspective, users' perception of untraceability and its associated trade-offs are underexplored. In particular, we approached untraceability from a broad conceptual standpoint; rather than analyzing mental models of a particular technical approach, we asked participants to reason about what features should be incorporated by two fictitious messaging platforms, Texty and Chatty, to prevent third parties from knowing who communicates with whom. Our vignette-based qualitative study with 189 participants uncovered

evidence that most users overlook the risk of leaking metadata, and that many have diverse misconceptions about untraceability. Participant answers' also indicate that they employ both consistent, principled stances as well as contradictory justifications when reasoning about trade-offs of untraceable communication, stances we characterize as: the *privacy fundamentalists*, the *safety fundamentalists*, and the *optimists*.

By studying untraceability as a high level concept rather than a specific technology, we were able to characterize a critical gap between the main threat model addressed by untraceable communication research and the threats that users recognize and are concerned with. Our findings thus testify to the need for better understanding of untraceable communication on the part of users if efforts toward its widespread adoption are to be successful. Future adoption likely depends on users first becoming more aware of network-based threats, before being ready to take a stance on the morality and acceptability of untraceable communication. We believe that messaging apps, app stores, and operating systems could play a vital role in spreading awareness and conveying risks and their corresponding defenses to users. Moreover, we suggest that a notion of altruistic privacy may provide an opportunity for untraceable communication to gain widespread adoption. Ultimately, this work contributes to a nuanced understanding of user perceptions of untraceability, helping us better design and communicate the benefits and limitations of privacy enhancing technologies.

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