

Improving Sexting Safety through Media Forwarding Control

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Abstract—Sexting, the practice of sending and receiving self-generated sexually explicit contents via mobile phone, is becoming more and more popular among the young generation, although at the cost of risking the exposure of their private material. Teenagers are not the only category at risk: one may wonder whether this practice can be even more dangerous for people with disabilities or an opportunity for them to explore their sexuality in an exposure-controlled way. In this work, we present preliminary results of an analysis regarding sexting through multimedia and how its use is perceived. Furthermore, without denying that it is crucial to educate people about the best behaviours and the drawbacks related to sexting, yet we believe that technology could help users in controlling the dissemination/forwarding of their sexy selfies and we discuss here how.

Index Terms—disability, messaging application, sexting

I. INTRODUCTION

Sexuality is an important part of the life experience and well-being of humans. It is included among the physiological needs in the well known Maslow’s hierarchy of needs [1].

In the last decades, the Internet and mobile revolutions have changed our lives in many ways. Sexuality has not been spared by this revolution, as it has brought the possibility to have access to an almost endless storage of erotic material and to provide a way to feel closer and interact with each other even when far away. In this context, sexting is a recent phenomenon that is gaining popularity among young people (but not only) and that represents a topic of interest for doctors, psychologists, sociologists and even computer scientists.

Although the medical and psychological aspects of online sexual experiences are out of the scope of this work, we have to mention the work of Barrense-Dias *et al.* [2] that discusses the possible definitions of sexting. They observe how, despite the growing interest in the scientific community, a precise definition still does not exist. However, we can refer to sexting as the practice of sending or receiving any sexually explicit content (e.g., text, images, video) across media platforms, such as instant messaging applications, dating ones, social networks, etc. However, other definitions could exist and be acceptable considering different aspects of the topic.

Sexting is a controversial subject as it has been associated with cases of misuse, in particular when practitioners

become victims of private material leakage, finding themselves exposed in their most intimate sphere. This may happen by mistake, maliciously done by hackers, carelessly and selfishly done by the receiver or even by revenge as a consequence of a relationship breakup (i.e., revenge porn).

On the other hand, sexting also embodies an appealing way to express sexual interaction without the need for physical presence. Consider, in particular, long-distance relationships, pandemic related lockdowns, or even people looking for sexual interactions with strangers while reducing physical risks or deciding what to show and what to hide about themselves.

Regarding the latter aspect, a particularly interesting case study is represented by people with disabilities. Indeed, even though they share the same needs for social interaction and, coherently, for fulfilling sexual life, the perception of their sexuality has been controversial and fraught with prejudice [3]. Indeed, people with disabilities have been often seen as asexual or recognized in their sexuality and affectivity only in problem behaviors. Instead, through the Internet, messaging platforms and sexting, people with disabilities could decide how much of their condition and sexuality show. They could gain confidence in their attractiveness, explore their taste and decide eventually to experiment even in the real world [4].

In this paper, we present the preliminary results of an analysis regarding sexting (intended as sending multimedia content) and how its use is perceived. Furthermore, we analyse messaging applications and provide guidelines on how they can be improved by adding the possibility to control the forwarding of sexting-related images.

The rest of this paper is organized as follow. Section II describes the related works present in the scientific literature. Section III presents the results of our questionnaire regarding sexting along with the related perception of users. A review of some commonly used messaging applications from a safe sexting standpoint is discussed in Section IV. Section V presents some technological solutions to the issues related to sexting. Finally, we draw our conclusions and present some future directions in Section VI.

II. RELATED WORKS

Nowadays, the relationship between sexuality and socio-technological systems (e.g., social networks, messaging ap-

plications, etc.) is stronger than ever, but very few works investigate this subject. In computer science, online sexual experiences have mainly gained the interest of the Human-Computer Interaction community. For instance, Razi *et al.* [5] analysed several posts on an online peer support mental health forum to learn more about adolescent online sexuality behaviours. They found that online sexual experiences have become a fundamental part of teens' life.

Some works investigate the relationship between sexting and disability, even though the research community has often given little attention to this category of people. The problem of the sexuality of people with disabilities, both mental and physical, is ignored by the broader part of our society because there is the false belief that they are a sort of asexual individuals. Instead, teens with disabilities report having more sexual experiences than people without impairments and express sexual desires and expectations [6]. Hence, a rapid mind shift is needed. As described in [4], sexting can be a tool for people with disabilities, especially physical ones, to gain confidence with their bodies and the first step toward a sexual experience or a romantic relationship. On the other hand, in the case of private media leakage, we may wonder whether the consequences could be even worse for this category, considering them as more fragile (although not necessarily true).

A group of mobile applications called parental control apps promote adolescents online safety. Some examples of functionalities are logs of various apps, screentime limit, and so on. Wisniewski *et al.* [7] analysed 42 features of 75 Android mobile applications and mapped them against the Teen Online Safety Strategies (TOSS) theoretical framework. They found that most apps favoured a parental control approach over teen self-regulation. However, a teen-centric design would give more chances to teens to learn the confidence necessary to engage safely with others through mobile devices. Moreover, as stated in [8], the adoption rates of these apps are low for the aforementioned reasons.

Various applications have already been developed to tackle sex education for adolescents. Some works try to co-design such applications with the help of children and teenagers [9] [10]. Other works propose serious games as a tool to either stimulate dialogue on sexuality or educate teenagers and even children [11] [12]. Indeed teaching new generations how to behave safely online is essential but not effective in the short term. Therefore, developing applications designed with safety in mind could be at least as important.

III. USERS' PERCEPTION ABOUT SEXTING

We administered a questionnaire to a group of people, aged between 20 and 55. The aim of the questionnaire was to gain some insights about sexting and people's perception about its opportunities and issues, as well as their thoughts on some possible technological solutions. Before administering the questionnaires, participants attended a brief presentation about the sexting phenomenon and what are the issues of interest for our research.

Our questionnaire includes four main sections: the first one asks the participants to describe themselves, the second one allows to gain some knowledge about the personal sexting experiences of who compiled the questionnaire, the third one assesses the participants' perception about opportunities and issues of sexting, whilst the fourth one asked an evaluation of some possible technological solutions to limit the risks related to multimedia sexting content leakage.

Participants can decide to abandon the survey when they want. Thirty participants answered to all the questions: 66.7% are aged 20 to 25, 30% are from 26 to 35, and one participant (3.3%) is aged between 36 and 55. They are approximately equally distributed between males and females, respectively, 14 and 16, and 90% of all the participants already had some knowledge about sexting even before our presentation. The majority of the participants have done sexting in their life, whilst only 13.3% have never done it; 60% have been engaged in sexting with 1 - 3 people, 16.7% with 4 -7 people, 3.3% with a number of people between 8 and 12, whilst 6.7% with more than 12 people.

Some interesting considerations emerged from the responses to the questionnaire. It seems that people have an optimistic view of themselves, assessing their risk of becoming victims of sexting abuse lower than what they claim for their age group. Indeed, let us consider as a representative example the ages 20 - 25 and the answers presented in Figure 1 (*"How appealing do you think sexting could be for the following categories?"*), Figure 2 (*"How easily can a person in the following categories be victim of an abuse of the sexting contents they have created and sent?"*) and Figure 3 (*"How impactful can be the consequences of an abuse of sexting contents they have created and sent?"*). Participants are asked to evaluate the answers on a scale from 1 (very little) to 5 (very much). As it is evident, people state lower values for themselves than for their own age group in general. The same behaviour is reported also in the other age groups. Underestimating sexting risks could lead to worse scenarios in terms of sexting related issues.

Furthermore, the answers to our questionnaire bring out the typical prejudices about disability and demonstrate a general lack of knowledge on the topic. For instance, Figure 4 shows that a significant percentage of people consider sexting as not appealing for people with disabilities (especially in case of mental issues), in contrast with the reality [4] [6]. This prejudice is confirmed also by the answers to the question *"How easily can a person in the following categories be victim of an abuse of the sexting contents they have created and sent?"* where participants evaluated with a higher score the possibility for people without disability to fall victim of sexting abuse (see Figure 5) even if this is not necessarily true and can vary a lot from person to person. Although the average impact of the consequences does not present significant differences when considering people with or without disabilities, Figure 6 shows a higher number of people assessing the highest possible impact for the former.

Finally, Figure 7 shows that participants do not consider in different ways people with and without disabilities when

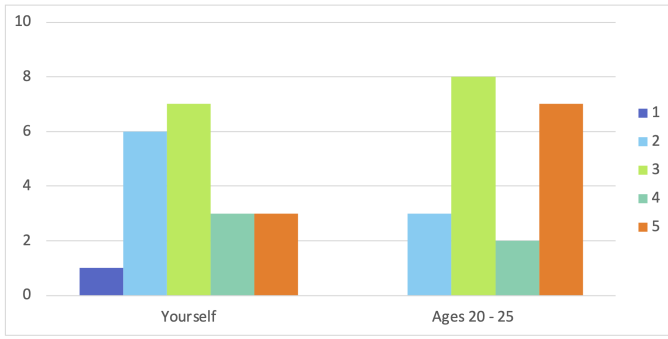


Fig. 1. Evaluation of appealingness of sexting for age group 20 - 25

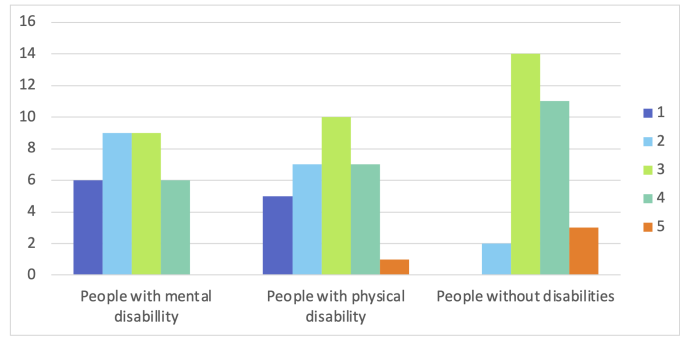


Fig. 4. Evaluation of appealingness of sexting for people with disabilities with respect to people without disabilities

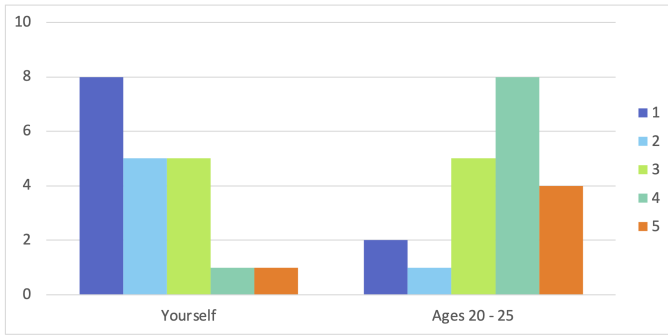


Fig. 2. Evaluation of easiness to be victim of sexting abuse for age group 20 - 25

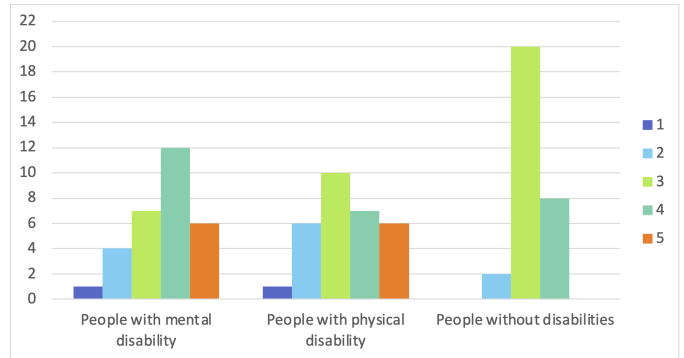


Fig. 5. Evaluation of easiness to be victim of sexting abuse for people with disabilities with respect to people without disabilities

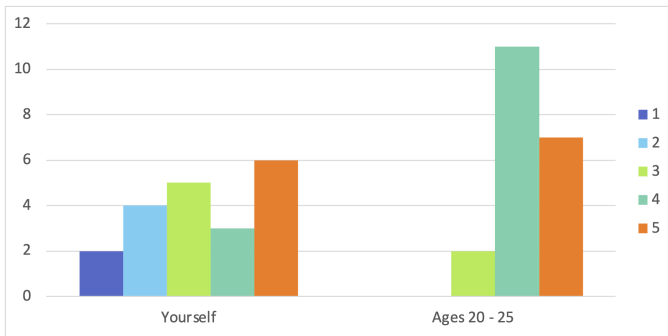


Fig. 3. Evaluation of impactfulness of sexting abuse consequences for age group 20 - 25

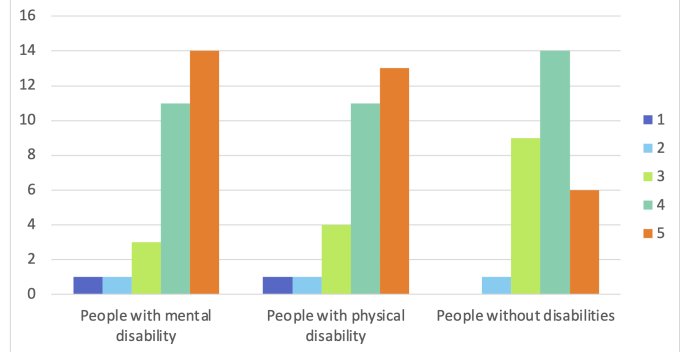


Fig. 6. Evaluation of impactfulness of sexting abuse consequences for people with disabilities with respect to people without disabilities

evaluating how sexting could facilitate having sexual experiences. Indeed, both categories reported very similar scores: 30% of participants think that sexting can be helpful for people with any mental disability, 40% for people with any physical disability and 33% for people without disabilities. Instead, we believe this aspect deserves further investigation as people with disabilities may feel less fragile through sexting rather than starting a sex-based conversation in person. Through sexting, they might learn to embrace their bodies and fantasies and, as a consequence, have (real) sexual experiences with increased confidence in themselves [4] [6].

IV. ANALYSIS OF THE EXISTING APPLICATIONS

In this section, we analyse applications which can be used for sexting from the point of view of their features that could improve the safety of this practice. Indeed, several applications published in both Play Store and App Store contain messaging features. Some of them are introducing functionalities to build a safer user experience.

We have selected applications belonging to three categories (i.e., pure messaging apps, dating apps and social networks), since messaging features are not present only in messaging applications; hence, it is interesting to consider different

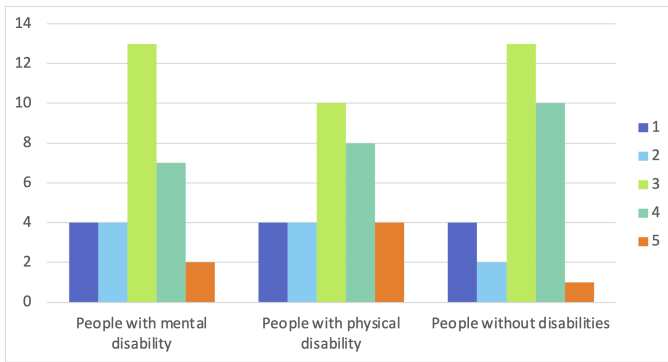


Fig. 7. Evaluation on how sexting could facilitate people with disabilities in having sexual experiences with respect to people without disabilities

categories of apps, highlighting the differences. In particular, we have chosen some of the most famous applications in the sections Social, Dating, Communication, and Lifestyle, in alphabetic order, Badoo, Instagram, Snapchat, Telegram, Tinder, Tumblr and Whastapp.

We evaluate the chosen apps from the point of view of safe sexting, considering the following features:

- whether the chats are end-to-end encrypted or not;
- the possibility to delete messages already sent;
- whether it is possible to set an auto deletion timer for messages or not;
- whether the application notifies the user when someone takes a screenshot or does a screen recording of the conversation.

All the aforementioned applications provide messaging functionalities. However, there are several differences in both their features and their philosophies. For instance, on Tinder, a commonly used dating app, it is not possible to send photos at all. On the contrary, the other apps allow users to send multimedia contents.

Recently, several applications have moved toward end-to-end encryption that makes messages readable only to sender and receiver; e.g., Whatsapp is end-to-end encrypted, whilst Instagram is going to introduce this additional level of security in 2022. Telegram supports this kind of encryption only for secret chats. On the other hand, Tumblr, one of the most used microblogging platforms, serves all over HTTPS, with the content encrypted only between client and server.

Several applications lack transparency on their privacy and encryption policies, making it difficult for users to get information [13] [14]. For instance, we did not find any official details about Snapchat, Tinder and Badoo.

Overall, end-to-end encryption is an obstacle for service providers that want to elaborate in some way data generated by users, but it is a strong guarantee for users' privacy.

Some applications allow the deletion of messages already sent for both sender and receiver. In this way, users have a tool that can be used when they regret to have sent a specific message. For instance, whilst on Telegram and Instagram is always possible to delete a message, on Tumblr, Tinder and

Badoo, it is not possible at all. On Whatsapp, users can delete a message already sent only within 7 minutes of its generation. Instead, Snapchat presents a more complex behaviour: all messages are deleted by default if the receiver has already read them and the user closes the conversation view. However, users can save messages and, in this case, a saved message must be deleted manually by the user.

The automatic deletion of non-saved messages of Snapchat is a form of autodeletion timer. Other apps provide similar functionalities: e.g., Whatsapp now allows to send a photo or a video visible only once. Similarly, on Instagram, it is possible to send both images and videos viewable only once or twice. Instead, on Telegram secret chats, users can set a timer for all messages' life.

Lastly, we consider the behaviour of the applications when someone takes a screenshot or starts a screen recording of a conversation because these actions can be a threat when we are dealing with sensible and private content. Snapchat is the only analysed application that differentiates the alert for screenshots and screen recordings. Instagram and Telegram show the same message for both actions. However, Telegram provides this feature only for secret chats.

In Figure 8 we report the answers to the question “*How confident would you feel in terms of feeling protected from the abuse of self-generated sexual content?*” related to some well-known applications. Results do not show a general consensus in assessing the various applications, nor seem the evaluations coherent with the feature of each application we highlighted above. However, people agree in not trusting the safety against the abuse of sexting of any of the analysed applications.

V. FORWARDING CONTROL BY DESIGN

Our findings, presented in Figure 9 and Figure 10, show that the frequency with which people send and receive self-generated nude or semi-nude pictures is significant, exposing themselves to all the risks of sexting abuse.

To overcome the issues of sexting described in this work and provide a safer experience to users, we designed the system architecture of a safe sexting messaging system (and application) with a forwarding control feature for images, generalizable to video as well. This messaging system has to represent images in a concise and computationally efficient way; in this way, every time a user wants to send out an image, the system can compare it with the ones already known and can decide whether to send out or not the photo. Consequently, if a user tries to forward an image received from someone else to a third user, the system detects this leakage and can block the forwarding and/or notify its owner while forwarding the photo.

The system must implement this forwarding control for personal self-generated nudes or semi-nudes images and behave as any other messaging system for all the other photos. Thereby, the system must be able to classify an image as containing some nude parts of the body or not. Otherwise, the system would block any image forwarding, creating obvious and non-negligible usability issues.

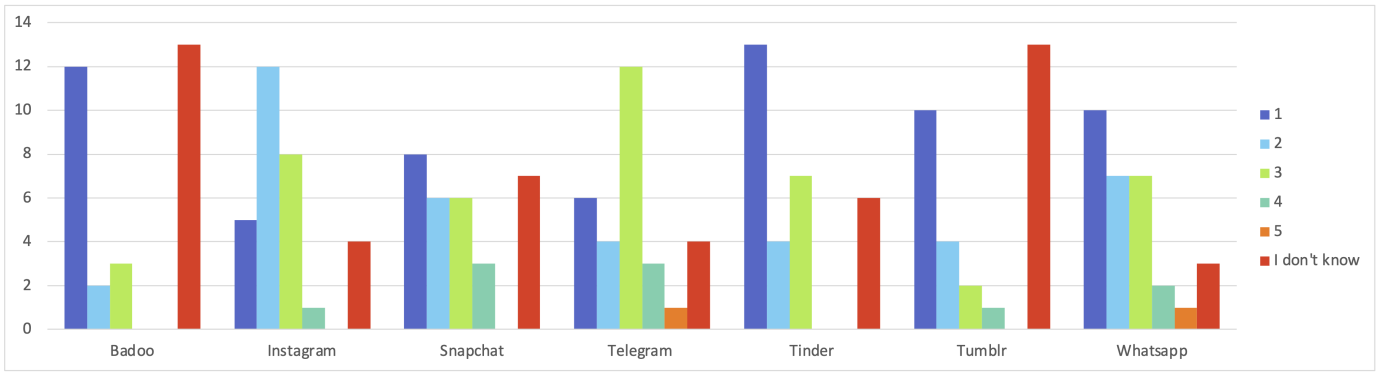


Fig. 8. Users' evaluation of the analyzed applications

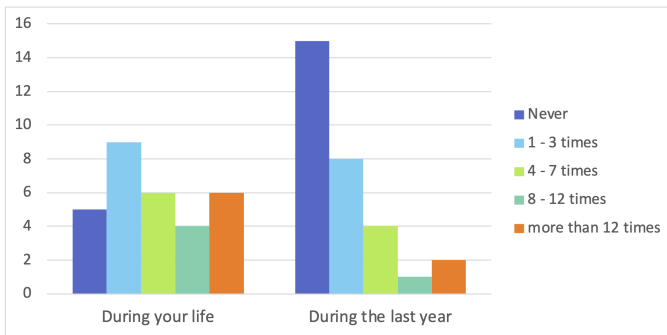


Fig. 9. Number of times participants have sent their self-generated sexy pictures

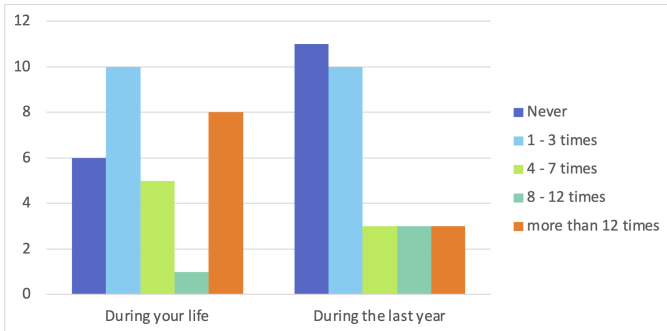


Fig. 10. Number of times participants have received self-generated sexy pictures from someone else

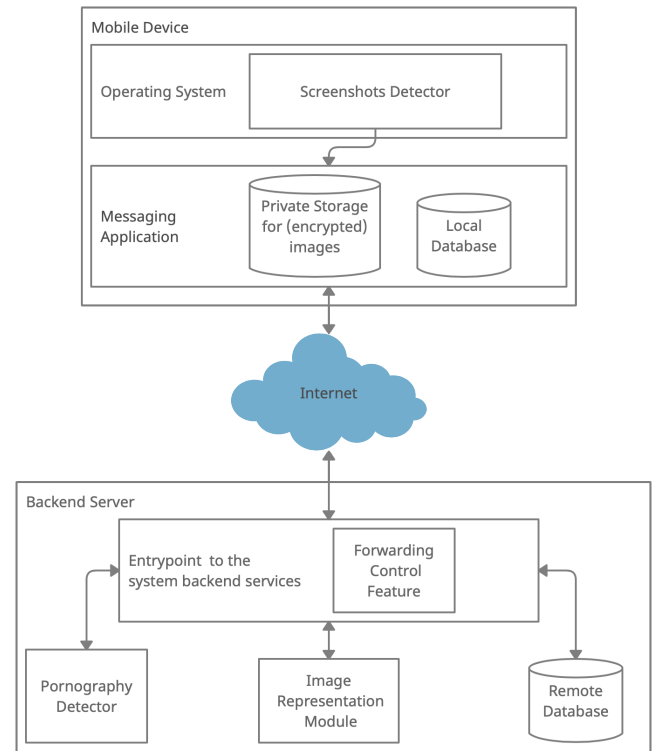


Fig. 11. System architecture for a safe sexting messaging system

Some other functionalities could be interesting to further protect users from dangerous behaviours related to sexting. For instance, in line with other messaging applications, allowing users to delete messages for both parts of a conversation could help in case of regrets.

To provide a further level of safety, we may think of not allowing users to save the images they receive in their gallery. On the other hand, this could be a significant limitation for the user experience. In the same way, the application could encrypt photos before saving them in its private storage, becoming unreadable from outside. Figure 11 show the main components necessary for such system.

In particular, the image representation module contains a perceptual hashing function (e.g., computed by a neural network), which calculates the hash fingerprint and passes it to the forwarding control algorithm. Then, the system can calculate the distances between the current fingerprint and those already known: if an image's distance is below a fixed threshold, the image is already in the system and owned by someone.

Moreover, the system uses a pornographic detector to decide on which photo apply the forwarding algorithm. One possibility to implement this feature is SafeSearch, which is part of the Google Cloud Vision API.

However, screenshots remain a problem for such an applica-

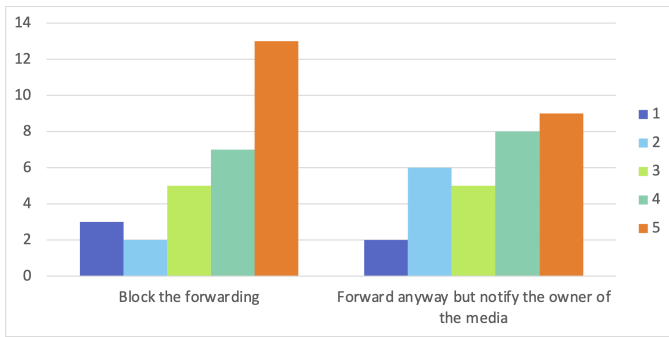


Fig. 12. Evaluation of two possible forwarding control approaches

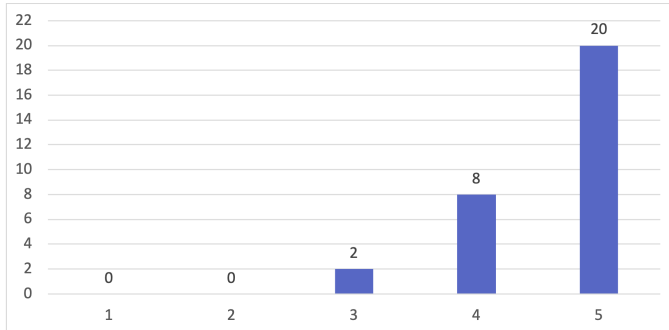


Fig. 13. Evaluation of the importance of detecting images even if edited

tion since they can be used to capture private images before the deletion by the sender. Hence, logging the information about screenshots operations can be particularly useful. Therefore, it is necessary to listen for the specific notification of the operating system and send the correct message to the backend so it can log the operation.

The answers to our questionnaire show that users think that a forwarding control mechanism could be a desirable feature for messaging applications which allows to protect people from the issues related to the abuse of sexting. In particular, Figure 12 shows that both blocking the forwarding and notifying the owner of the media are considered useful features that should be implemented, with the former considered slightly more important than the latter. Moreover, the large majority of people agree on the fact that it is not sufficient to detect only the original image or exact copies, but also the edited ones, as shown in Figure 13.

VI. CONCLUSION AND FUTURE WORK

In this paper, we have discussed sexting, also considering people with disabilities. Results from a questionnaire on the topic have been presented. Although we are aware that the number and heterogeneity of people that participated in our questionnaire is limited, we deem that the outcome is interesting and shed a light of aspects that deserves further investigation. In particular, the perception of the sexuality (and sexting behaviors) of people with disabilities seems still to be fraught with prejudice.

Moreover, as education is important but not effective in the short term in protecting people (especially fragile categories) from possible consequences of the misuse of shared sexting-related content, we have also proposed some possible technological directions for developers in order to design safer messaging applications that could allow some form of media forwarding control.

We plan to extend this work in several directions. First, extending the participants to our questionnaire to various demographics (i.e., age, people with disabilities, etc.). Furthermore, we are currently developing a messaging system implementing the forwarding control of images, as well as some of the other features described in Section V.

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