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An Investigation of Comic-Based Permission Requests

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Abstract. Research suggests that permission requests do not adequately inform users about the implications of granting or denying such requests. It is important that informed consent is given should users grant the request. This paper reports on the results of a study that examined novel comic-based permission request design in terms of user response and preferences for permission-granting decisions. We conducted co-design workshops to design the comic-based permission requests. We then compared our comic-based designs to current Android text-based permission requests using five common permission request types in an online survey. Our results showed that 52% of participants preferred the comic-based requests, and 24% the text-based requests. While comics were found to be an effective medium to achieve informed consent, some participants reported that the text-based request offered sufficient information to make decisions. Given that a relatively large number of participants preferred the comic-based permissions, we encourage future designers to consider alternative forms of permission requests.

Keywords: Mobile privacy, comics, app permission requests

1 Introduction

Many smartphone features are provided through applications (apps) that typically require the smartphone user to grant access to resources on their phone by responding to a permission request. However, apps sometimes request access to resources that are not necessarily required, for example a gaming app that requests access to a phone's location. Even when the requested access might be necessary, the permission request descriptions may not be engaging or informative. Previous research showed that users paid little attention to the currently employed, text-based permission requests and displayed low comprehension of what was being asked of them [1]. Almuhiimedia et al. [2] and Balebako et al. [3] concluded that users were generally unaware of data collection practices and were not comfortable with the amount of data being gathered and where this data was sent. This suggests that text-based permission requests can leave some smartphone users unaware of potential risks to the privacy of their data.

Previous research has explored the impact of personalized and contextualized versions of text-based permission requests [4,5]. Kelley et al. [6] found that presenting participants with permission requests in a clear, simple and timely manner increased the likelihood of participants installing applications that requested fewer permissions.

Shih et al. [7] similarly found that when participants were presented with information that details the data that an app can access and the reasons why access is required, they were less likely to grant permissions. Despite these measures, researchers have found that many people still do not read permission requests.

Similar to permission requests, research into user acceptance and understanding of app Terms and Conditions (T&C) and Privacy Policies (PP) revealed that such information can be difficult to understand and is often not read [8]. Tabassum et al. [9] and Zhang-Kennedy et al. [10] used comics to teach users about threats to their privacy and security. They established that comics can increase the attention paid to T&C and PP. Researchers in other contexts, such as the medical field, have shown that comics can better educate patients and increase the understanding of, or adherence to medical instructions [11,12]. As far as we are aware, no research has explored comic-based permission requests compared to their text counterparts.

In this paper, we report on the design of comic-based permission requests that are then compared to current text-based permission requests. Our approach involves user-centered co-design workshops to inform the creation of the comic-based permission requests, and a survey to assess their effectiveness. In section 2 we discuss related work and our comic-based request design in section 3. In sections 4 and 5 we respectively present the survey design and results. In section 6 we discuss some design implications, then our limitations in section 7, followed by our conclusions and future work in section 8.

2 Related Work

2.1 User Awareness

Users have been found to disregard or pay little attention to Terms and Conditions (T&C), Privacy Policies (PP) or privacy permissions [1,13,14]. Talib et al. [14] found that participants were not interested in reading the PP of social networking websites as they were too long, difficult to understand and not presented in an appealing manner. They further suggested that the presentation of PPs should be geared towards a multimedia and interactive approach to better engage users. Kelley et al. [6] similarly reported that most of their participants did not consider permissions when downloading apps and actively chose not to check which permissions would be required to install and use the app. Further, Morrison et al. [13], found that only 30% of participants realized a game that the researchers made available on an app store was part of an academic trial despite this being made clear in the T&C. They also found that none of the participants interviewed had read the T&C. Furthermore, even when users do read the T&C they do not necessarily understand them, due to complicated terminology and legalese [14]. Harris et al. [15] discovered that 63% of their participants felt there was often a good reason for apps to request questionable permissions and trusted the Apple app store and Google play markets. Despite this trust Kuehnhausen and Frost [16] have shown that app stores such as Apple app store and Google Play, often contain unsafe apps. Felt et al. [1] found that only 3% of the participants who had read information

related to permission requests had a good understanding of them and 42% of participants were unaware of the existence of permissions.

Since the introduction of Android 6.0 (Marshmallow) Android permissions have changed and are now often displayed on an Ask on First Use (AOFU) basis rather than prior to installation [17,18]. AOFU permissions pop up on the screen when the user tries to use the functionality of an app. The request must be accepted or declined before the user can proceed. This means access is not requested or granted until required, which limits unwanted data collection. The introduction of AOFU permission requests means that whether a user ignores the T&C or PP, or fails to understand them, they will have to interact with permission requests.

2.2 Personalization and Contextualization of Permission Requests

HCI research has investigated how personalization and contextualization can affect user receptiveness to permission requests. Personalization refers to information that has been tailored to each user specifically, whilst contextualization refers to the provision of additional information related to how other users have reacted to requests. Tan et al. [19] found that participants were more likely to grant permission requests when they had been allowed to personalize them. Additionally, they found that participants were more likely to grant access to permission requests which contained an explanation of why the app needed access, regardless of whether the explanation contained useful information. Raij et al. [20] likewise, argued the importance of personalization. They reported that participants did not understand the “sensitive nature” of the data shown if they had little or no personal stake in it.

Contextualization, unlike personalization is not concerned with the user personally, but with the circumstances surrounding them. Researchers have found that the way information detailing privacy is framed can influence the extent to which users are willing to share their information. Zhang and Xu [5] found that if privacy information is framed socially, such as “91% of people share location”, people are more likely to share their information.

The framing (personalization and contextualization) of the information presented in the request should be designed carefully. Permissions requests should contain a sufficient amount of information to ensure users are informed, not coerced into decisions [7,21]. This suggests the exploration of alternative, multimedia methods, such as comics, to frame permission requests could encourage users to pay more attention to the requests and in turn make more informed decisions.

2.3 Educational Comics

Comics are an alternative medium that researchers are exploring to successfully convey information more effectively than plain text. A comic is composed of a series of panels in which a story and message are conveyed using imagery and text. Pavo posited that as pictures are coded in two areas of the brain (visual and verbal), and words only one (verbal) that pictures are better remembered and retained for longer than words, which suggests comics could be useful aids in smartphone privacy [21].

Comics have proven to be effective educational tools, with research showing their successful implementation in the healthcare field [11,22,23]. Comics have proven similarly effective in online security and privacy contexts [9,10]. Tabassum et al. [9] explored the use of comic versions of T&Cs as a replacement for text-based T&Cs. They found that comic versions held user attention for longer than text versions but did not improve comprehension. Conversely, Zhang-Kennedy et al. [10,24] found that the graphical and interactive elements of their comics (Secure Comics) aided reader comprehension. Additionally, they found that Secure Comics improved the understanding of security threats and facilitated readers into more security conscious decisions. Equally, Mekhail et al. [25] explored the use of infographics in a mobile privacy context to determine whether infographics were more beneficial for users than text. They found the infographic information led to 64% of participants reportedly taking additional measures to protect their privacy and approximately two thirds of the users could describe the concepts shown in the infographics. This suggests images alongside text not only help with comprehension but are more likely to be read than their text counterparts and in some cases lead to more privacy conscious decisions.

3 Comic-Based Permission Requests Design

3.1 Co-design Workshops

Over the course of three days we conducted a series of 3 co-design workshops in several UK locations to inform the design of our comic-base permission requests. 13 participants were recruited through a social media and poster campaign (Table 1). The workshops began with a general introduction to comics and comic creation, after which participants in each workshop were spilt into 2 groups and used “big paper” prototyping techniques [26] to create the comics together. Participants were given the descriptions of the permission requests available today on the Android Google Play Store [18] to help guide them. An example of one of the created comics is in Fig. 1. Within their group (intragroup) participants then used the sticky note evaluation technique to answer pre-set evaluation questions, such as “*How could your comic(s) be improved?*”. They then similarly discussed their comics to the other group (intergroup). The intragroup and intergroup discussions were recorded and transcribed. The comics created were analyzed using four design themes inspired by McCloud [27]: (1) tone, (2) characters, (3) content, (4) aesthetic quality. We similarly use these themes to present our final designs in Section 4.

Table 1. Co-design Workshops Demographic Information

Workshop	Participants	Mean Age	Gender
1	1-4	26.75	2 Male, 2 Female
2	5-8	26.75	4 Male
3	9-13	31	3 Male, 2 Female



Fig. 1. A comic showing the addition of a solution, created during the workshop

For theme one, tone, participants indicated the comics should be light and humorous to some extent, which aligns with people's perceptions of most comics [27]. They were also cautious about the frequency of "negative" or "scare mongering" aspects of comics. For theme two, characters, participants preferred and drew characters that could exist in the real world, that were likeable, relatable and that reoccur. For theme three, content, participants felt that the comics should have a clear storyline, be easy to follow and that showed negative and positive aspects of permission requests. One group realized that their comic was entirely negative, so they decided to add narrator text to their comic's last slide which informed the reader that they could still make changes to their permissions (Fig. 1). This group wanted comics to show solutions and felt that in doing so they could make comics more positive. For the final theme, aesthetics, participants believed that the amount of text and imagery should be balanced and expressed concern over the quality of their drawings and lack of color. Participants also felt that comics should be large enough for readers to read. We used the information gained from these participatory workshops to support the design of our online survey comic-based permission requests, as discussed below.

3.2 Comic-Based Permission Request Creation

Fig. 2 provides examples of the comic-based permission request and sample of the text-based permission request for a generic storage and camera app (respectively) that we used in our survey. Permissions were created for five of the more risky permission types concerning privacy and security (camera, calendar, contacts, location and storage) [28]. The comic-based permission requests are centered around 2 main characters, who encounter permission requests and consider their impact.

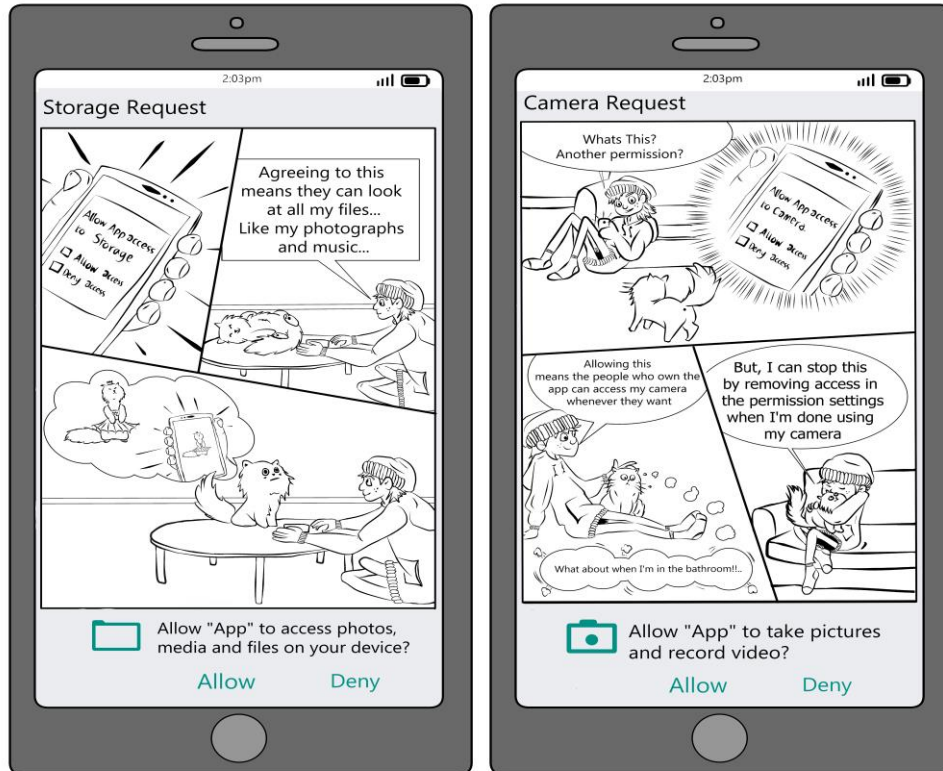


Fig. 2. Two comic-based requests shown to participants. For the text-based variants participants saw only the bottom portion, centered vertically (as with current requests).

For the first design theme, tone, humor has been incorporated into the stories to lighten the mood and to help to create a more enjoyable reading experience. Humor has been found to be a successful tool in gaining and holding attention [29], which is an aspect that the current permission requests are lacking [14], though it is also recognized that humor can be culturally-specific [30]. For the second theme, character, most of the characters created during our workshop were human. Therefore, we focused on creating a relatable human protagonist, designed to have few gender defining characteristics. These choices were made in the hope that readers would identify or relate with the character more if they could interpret the character to be of whichever gender they choose or desire. The literature on character identification has highlighted that people are more likely to have wishful identification with a same-gender character [31]. The secondary character is an anthropomorphic cat, designed to introduce humor into the comic and facilitate dialogue or the progression of the storyline. For the third theme, content, the comic text has been kept relatively informal and simple, as literature has suggested that this helps to increase user understanding [14]. The comics have also been designed to provide the reader with more information about the permission request and

has the characters consider what using the app could mean for their privacy. The characters never suggest a correct decision, rather they simply reflect on what granting the permission could mean for them. Additionally, as suggested in our workshops, two of our comics (camera and location) were designed to offer solutions to participants on how they could protect their privacy if they choose to grant the permission, such as by later revoking access or turning off location (e.g., camera request in Fig. 2). Finally, for the fourth theme, the aesthetic of comics are minimized, with simple line drawings for the illustrations. Research has shown that stripping down the comics to their simplest form amplifies the message conveyed by the comics and minimizes distraction [27]. The simplistic style of the comics also helped ensure the comic-based permission requests were more easily read and understood on smaller screens. We decided against the introduction of color, as it could prove problematic with cultural differences and color associations [32].

4 Survey Design

Given our focus on behaviors and perceptions of permission requests an online survey was created to compare the viability of the comics-based requests to the current text-based permission requests [33]. The text-based permission requests were based on Android permission requests, and displayed as they would look on a smartphone, (participation in the survey was open to users of any device or operating system). Participants were not provided any context for the app requesting the permissions in this study, in order to reduce the number of variables influencing their decision and to allow us to focus on a comparison of the two permission request styles. The survey consisted of 3 stages: (1) Demographics and permission statement questions, (2) Permission request responses and (3) Preference and efficacy questions.

In the first stage, demographic information was used to determine any answer patterns for our survey participants. Demographic questions included age, gender, and familiarity with comics. The permission statement questions sought to evaluate participant knowledge of permissions and privacy risks, and whether this influenced their responses. For these questions, participants were asked whether they agreed or disagreed (or were unsure) with statements such as “*Once a permission requests is accepted you cannot change your mind*”. There were eight statements based on similar statements from related research [24]. In the second (and main) stage, participants were presented with comic and text-based permission requests for each of five permission types: camera, calendar, contacts, location and storage (see examples in Fig. 2). The different permission types were presented to each participant in random order. For each permission request, participants were asked how likely they would be to allow each permission on a 5-point scale (1=*extremely likely*, 5= *extremely unlikely*), as well as an open-ended question “*what makes you feel this way?*”. In the third stage, participants were asked which permission requests they preferred, felt taught them more (teachability), and felt they understood better (understandability).

A series of statistical analysis tests were carried out on the quantitative data using SPSS. As the data collected is ordinal data and not normally distributed a series of non-

parametric tests were completed. Due to multiple comparisons being made, Bonferroni Corrections were employed, dividing the significance value by the number of tests run. Content analysis was used to analyze the qualitative data from our open-ended questions. Krippendorff's alpha [34] inter-coder reliability test with one other coder (who was not involved in our study) was run to confirm the coding reliability. A sample was randomly selected and alongside the generated categories was sent to the second coder. The chosen sample was approximately 10% (112 units) of the data gathered [35]. Results showed a solid inter-coder reliability score ($\alpha = 0.8928$).

5 Survey Results

We recruited 240 participants, with 204 completing the survey. Considering the stage 1 demographic data, of the 204 participants 83 were male (41%), 120 were female (59%) and 1 preferred not to say. The mean age was 33.5, (med=29, min=18, max=69). The majority of participants were from the UK (38%) and New Zealand (37%) with some from the USA (5%) and the rest from 20 other countries. The majority (71%) were employed, with the remainder being students (22%), self-employed (8%), unemployed (3%), retired (1%), or unable to work (<1%) – some participants chose multiple options. 52% were Android users, with 48% Apple iOS users.

The responses to the permission statement questions suggest that participants did not fully comprehend the potential consequences of granting permission requests, with fewer than half (41%) answering half or more of the questions incorrectly, while only 8% of participants answered all the questions correctly. We graded the responses using a letter grading system, to help group and compare participants by their levels of understanding. A letter based on the percentage of correct responses was assigned to each participant, split into 5 groups, with A=90-100% and E<60%. Therefore, for example, those who scored 8/8 were assigned an A, whereas those who scored 4/8 or under were grouped E. We used these grades to examine if participants with different grades responded differently to the permission requests.

5.1 Permission Request Responses and Preferences

For our stage 2 data, Wilcoxon signed ranks test indicated that there was a statistically significant difference between those who would grant access to permissions based on whether the permission request was comic-based or text-based. Overall, participants were less likely to grant access when shown a comic-based permission request (Mdn = 2) than they were when shown a text-based permission request (Mdn = 3), $Z = -7.359$, $p > 0.001$. Overall, we found that participants aged 18-44 were significantly less likely to grant comic based permissions and this difference was not significant for those over 44 years. Out of the 5 different permission types investigated (camera, calendar, contacts, location and storage), the comic-based versions for the calendar, contact and storage permissions were all significantly less likely to be granted (Table 2). These were the comic-based requests that did not offer a solution. The two requests which offered a solution, camera and location, were not significantly different when compared to their

text-based counterparts. However, when compared against the other permission types, location and camera are significantly more likely to be granted in general than all the other requests (both comic and text-based versions), which suggests that the location and camera permission types might be more likely to be allowed in general. We found no other statistically significant differences in participants responses to comic-based versus text-based permission requests for any other demographic factors, or participant responses to the permission statement questions. A comparison of all permissions is in Fig. 3.

For stage 3, participants were asked which permission request types they preferred: 52% preferred comic requests, 24% text, 17.2% had no preference, and 6.9% would prefer no requests. Additionally, participants were asked which permission request they would rather experience in the future. 52.9% preferred comic requests, 27.9% text, 15.2% said it did not matter, and 3.9% preferred no permissions. Tests were carried out to explore whether demographics or the permission statement questions influenced preference and no such correlations were found.

5.2 Permission Request Understanding & Teachability – Quantitative Results

In stage 3, participants were also asked how understandable they felt the comic and text-based permissions were. Likert scale results showed that 62.3% of participants felt the comic-based requests were *extremely easy* to understand, and 25% felt they were *somewhat easy*. For the text-based 39% of participants felt that they were *extremely easy* to understand and 29% *somewhat easy*. A Wilcoxon Signed-Ranks test showed that there was a significant difference between the perceived understanding of comic and text-based permissions, with comic-based (Mdn=5) permissions being perceived as more understandable than the text-based (Mdn=4), $Z=-4.298$, $p>0.001$.

Table 2. Sig. Wilcoxon Signed-Rank test results comparing comic and text-based permissions

Type of Permission	Median	Mean	Std. d	Z	p
Calendar Comic	2	2.45	1.34	-6.16	>.001
Calendar Text	3	2.96	1.36		
Camera Comic	3	2.75	1.36	-0.453	0.651
Camera Text	3	2.8	1.36		
Contact Comic	2	2.10	1.20	-5.08	>.001
Contact Text	2	2.47	1.35		
Location Comic	3	2.91	1.30	-0.122	0.903
Location Text	3	2.90	1.25		
Storage Comic	2	2.81	1.32	-5.12	>.001
Storage Text	3	2.35	1.26		

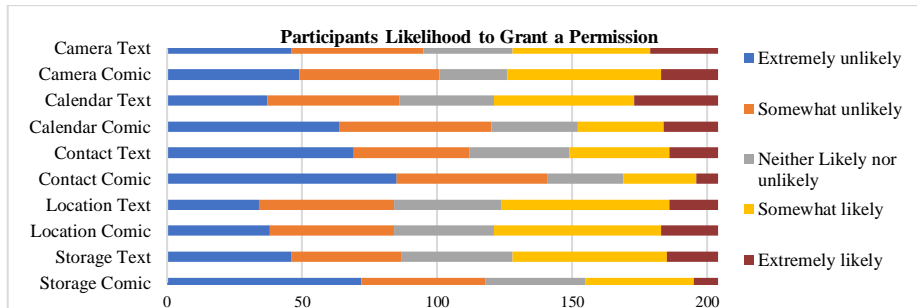


Fig. 3. Graph comparing participants overall likelihood to grant each permission

Additionally, participants were asked how effective they felt the comic and text-based requests were at teaching them about what can happen to their data if they allow access. Likert scale results showed that 43% felt the comic requests were *extremely effective* at teaching, and 13% felt the text requests were *extremely effective*. 33.8% felt that comic requests were *somewhat effective*, and 18% felt text requests were *somewhat effective*. A Wilcoxon Signed-Ranks test established a significant difference between how much participants felt that each version of permission request taught them, with the comic-based requests (Mdn=5) being viewed as more effective at teaching participants than the text-based (Mdn=2). $Z=-8.895$, $p>0.001$.

5.3 Permission Request Understanding & Teachability – Qualitative Results

Out of the 204 participants, 178 (87.3%) stated they felt that the comic-based permission requests were *somewhat* or *extremely easy* to understand. When asked “*what makes you feel this way?*” 106 participants indicated that this was due to the informative nature of the requests. Participants wrote that they felt the comics were detailed and offered a better explanation. Participants also stated that the comic visuals made it easier to understand the consequences of allowing the permission, and that they grabbed their attention “*You see a picture and you get the words in it. If it was just text I don't think the questions would capture my attention as much as they did with the cartoon*” (P5). Participants responded positively to the characters and humor of the comics “[The comics are] *Really straightforward, the scenarios are great, funny but also raise awareness. Love the cats, especially the lady cat*” (P83).

However, ten participants reported that the additional information in the comic-based permission requests was difficult to understand. In terms of aesthetics, participants remarked that the requests were cluttered, and that comics are an inappropriate medium to convey permission requests. Some participants felt that the comic-based requests were “*unprofessional*”, and even though they were easy to understand, they found the comic-based requests “*a little trivializing*” (P23). Participants also remarked that the comic-based requests were too positive and assumed that they would encourage readers to either ignore them or be too open to accept, “*Comic versions seem too light-hearted for my device. A little too 'right on'*” (P23) despite the results showing evidence of the reverse. Another participant disliked the comic-based permissions as they taught

them too much and preferred to be left in the dark “*comic version made me less likely to want to accept, so couldn't use app if wanted to*” (P176). Some participants also felt that more information should be included, such as why access needs to be granted, e.g., “*I only really trust permission popups when they have some context about why the app requires the permission*” (P113).

Out of the 204 participants, 139 participants (68.6%) said they felt the text-based requests were somewhat or extremely easy to understand. 22 participants indicated this was due to the straightforward nature of the requests, as they found the requests, “*Neutral, straight to the point and clear*” (P150) and that there was “*No misleading jargon*” (P156). Other participants indicated that it is what they are used to e.g. “*It's what's always used, so everyone understands it*” (P129). Participants also indicated they preferred the “*clear and concise*” (P110) nature of the text requests, as “*They were simple and not overwhelming with information*” (P184).

Some participants stated their preference for text-based permission requests was due to their prior knowledge, e.g. “*I'm younger and have been using this tech from the beginning*” (P103) and “*They seem straightforward. Maybe because i have a CS background or i'm just familiar with them.*” (P83). However, one participant did suggest that people may not be engaged by text-based requests, “*I feel I'm slightly more tech savvy (and paranoid) than the average user. I doubt most people do more than glance and agree*” (P117). Participants also indicated that more information should be included, e.g. “*Easy to understand but lacking context*” (P23), and “*they were pretty straight forward but didnt give much context to someone who doesnt understand*” (P8). Additionally, some participants expressed concern for other user's privacy as the implications are not clear in the text-based requests e.g. “*the permission requests are easily understood. The implications of them are not. They can seem innocuous, but I could be giving away far more than I realise*” (P28) and “*They are written simply and seem clear, but there are unspoken implications of decreased privacy*” (P202).

77% of participants felt that the comic requests were either “*somewhat*” or “*extremely effective*” at teaching people about smartphone permissions and indicated that this was due to the informative nature of the requests. Participants commented on how the comics reminded them of potential consequences of allowing access, e.g., “*[the comics are] much better than text, many users would just hit approve without thinking it through but this step forces a secondary appraisal*” (P69). Participants also regularly commented about the “*succinct*” nature of the requests and the level of convenience offered through the visual aspect of the comic-based permission requests, e.g., “*Visually better at communicating the point than words*” (P79). The addition of a graphic element was said to help visualize what happens when a request is allowed and how to change it. Participants also mentioned how the visual nature of the comic requests may be beneficial to people who have limited knowledge of permission requests.

Some participants (8.3%) felt that the comic requests were “*ineffective*” or “*nether ineffective nor effective*” at teaching users about permissions and stated that they were already knowledgeable in the topic. However, one user who felt this way suggested they could see the value for other users: “*Im very aware of the dangers of cyber threats, so for me this didnt teach me anything new, but for others i see it being quite valuable*” (P1). One participant further felt the comic-based requests taught them the concepts

behind the current text-based requests *“They were straightforward.[the text-based permissions] But, I didn't really grasp the concepts behind them until I saw the comics”* (P70).

30% of participants indicated that they felt the text requests were *“somewhat”* or *“extremely effective”* at teaching people about smartphone permissions. Participants indicated this was due to the text-based requests being familiar and the simplicity of the requests. Participants specified that they felt that text-based permission requests contained *“Clear information”* (P110) and that *“They asked you simply so it's easy to understand what they want”* (P78). The experience of the participants also had an impact on their perceived teachability, as participants commented, *“I am aware of security and privacy concerns so more openness and transparency is good”* (P127) and *“I can read”* (P32). One participant also felt the lack of information was a positive, *“you are not aware of danger you are more likely to accept the request”* (P196). In addition participants commented that their data is *“worthless”*: *“In my opinion, my data is worthless. I'm not famous, I'm not a wanted criminal. I don't care who knows about me. Privacy is dead anyways so better not to remind people that it's dead.”* (P129). A few participants displayed a lack of concern towards their personal privacy on smartphones, with participants indicating they are not bothered by permissions and that they are always going to accept them in the future.

52% of participants felt that the text requests were *“ineffective”* or *“neither ineffective nor effective”* at teaching users about permissions. 72 participants indicated this was due to the uninformative nature of the text-based requests, as *“It is easy to just click yes without fully realising the implications. They did not explain request or any of the consequences of saying yes”* (P7). Additionally, participants also suggested the level of trust between users and app providers could influence responses e.g. *“It is generic and could mean many different things, ultimately it comes down to how much trust you have in the app”* (P90) and *“I felt like I was trusting and blindly accepting just so I could use the app.”* (P202). Concern regarding less knowledgeable users was also expressed, with participants suggesting the requests *“assume knowledge”*. E.g., *“those with little technology experience won't understand the implications”* (P52) and *“no other info given. Its just assumed you understand what you're agreeing to”* (P91).

6 Discussion

While some participants continued to prefer the text-based permissions, a large proportion saw some value with the comic-based permission requests. However, there were also some criticisms and suggestions for improvement. We discuss such feedback below with an aim to inform future designs and studies. We structure our discussion based on the four design themes identified previously: (1) tone; (2) characters; (3) content; and, (4) aesthetic quality.

Tone: The results suggest that the tone conveyed by each of the permission requests had an impact on preference. Participants responded positively to humorous comics and negatively to comics perceived as *“A little too 'right on'”* (P23) or that they *“Only tells me about the negative use”* (P15). For some of the participants the somewhat

lighthearted and humorous nature of the comics made them seem “*friendlier*” (P74 & P111), and more likely to engage with the permission request as they found them entertaining “*More informative, entertaining, willing to read*” (P201) and “*It's more entertaining than the usual neutral messages.*” (P150). Overall, the majority of participants found the comics “*friendlier*”, “*entertaining*,” and more “*engaging*” and the “*light-hearted*” humorous tone of the comics an improvement over the clinical text-based requests. However, some participants felt the comics were a little “*patronizing*” or preachy which led to them favoring the text-based permissions. Participants who favored text-based permissions felt that they were more “*simple*” and “*professional*” which they felt made them more appropriate mediums to request access. Despite this, one participant who was initially wary of comics reported “*At first I thought it was childish but then I realized the importance of what's being said.*” (P98). This suggests that whilst a humorous tone shows promise in creating more engaging permission requests [29], not everybody appreciates the same humor. This could be overcome in future designs by offering user choice of whether they receive comic or text-based permission requests, and the tone (e.g., serious or lighthearted).

Characters: An advantage comics have over text is that they make use of characters who inhabit a story to convey the information. The results likewise suggest that the characters in the comics had an impact on participant preference. Participants in general responded positively to the two main characters, as they felt that they were “*relatable*” and made the requests seem personal. For example, “*The comics themselves with the characters going through similar experiences to the user made the request more personal, like the request is talking to me personally. Plain text just seems flat, or dead. It doesn't care about informing me, it just wants access.*” (P16), “*The characters hesitation added to my hesitation*” (P118) and “*Consequences are shown explicitly. The character weighs up the pros and cons, showing us what is at stake*” (P70). By encouraging users to empathize with the characters, permission requests can be re-framed as a personal request from character to reader rather than a formal request for access to data. The presence of relatable characters undergoing similar experiences as the reader, and the personal nature of the request could encourage further reflection on what is being asked of the user. Previous research has shown that if participants have a personal stake in a matter it can increase participant understanding of privacy risks [20].

Content: The content of the permissions requests was also found to greatly influence user preference and likelihood of allowing different permissions. This is seen when a solution was proposed within the comic-based permissions, leading to participants being just as likely to allow a permission compared to a text-based permission request. This could be a result of the privacy and control paradox [36], with solutions offering participants a feeling of increased control over their data, helping them justify their current text-based response. In other words, the solution offered in the comic might remind the user that they can change their mind and deny access to the permission at a later time. Solutions additionally offer a rationale for participants to allow access, though it is even unclear whether participants will follow through and later deny access previously allowed. Similar effects have been noted by other researchers [37] and is reflected by participants in our study, for example, “*the actual impact by normalising the tracking behaviour. 'I can always turn it off when I want' is a big lie. Users don't*

turn things off per use. They set their settings and leave them alone most of the time.” (P30). The inclusion of a solution, providing the impression of increased control, could lead some users to allow access that they ordinarily would not, as they know they can revisit such access. In this way our results suggest that the content of the request, in particular the inclusion of a solution, could trigger other decision-making considerations by users. We encourage researchers to study the impact of solutions in permission requests further. The inclusion of solutions in permission requests warrants further study

Aesthetic quality: In terms of the aesthetic quality of the comic-based permissions requests, the majority of participants responded positively, with participants indicating that the use of visuals contributed to increased understanding. This phenomenon, “*pictorial superiority effect*” [38] was highlighted in numerous participants responses, “*The comics explain in pictures what the permission actually involves*” (P47) and “*Visuals are easier to understand than reading*” (P79). Participants indicated the comics were “*Well drawn, clear and concise*” (P50) and “*Good visual cues*” (P45). However, some felt the addition of comics to permission requests came across as “*unprofessional*”, and “*scaremongering*”. Some participants echoed this sentiment and stated they preferred text-based permission as they are “*used to it*”. This could suggest that personal preference and an individual’s opinion on comics as a medium could influence receptiveness of use: “*They were straightforward. [the text-based permissions] But, I didn’t really grasp the concepts behind them until I saw the comics*” (P70). This implies that even though some users will prefer the current text-based requests, there are users who will benefit from the additional visual cue.

7 Limitations

Our survey was not limited to users on smartphones. Therefore, the effectiveness of the comic-based permission requests may differ between participants using a larger screen. Also, the requests were not experienced by users as they would be in a real-life situation, and as such potential disruption or irritation caused by a permission request is not explored. Finally, the comparison with today’s text-based permissions doesn’t necessarily reveal which aspects of the comics affects behavior. Future studies could compare comic-based designs to enhanced text-based designs to confirm the effect of the visual aspects of comics.

8 Conclusion and Future Work

Comic-based permission requests show promise as a permission request, at least for some users. The results of our survey indicate that many participants preferred the comic-based permissions. Participants also reported that they found the comics easier to understand and that they were more informative. However, a number of participants did continue to prefer current text-based permission requests. Participants also requested that both types of requests (text and comic-based) contain more information about implications behind allowing access, and why the app requires access.

Future work could include investigating further improvements to permission requests, such as including personalized options so that users might choose the type of permission request that they would see. Furthermore, the applicability of humor could be further explored, and comics of another tone (e.g., less lighthearted) created and tested. The level of information presented in permission requests could also be explored, not only in comic-based permission requests but also text-based permission requests. Comic-based permission requests with more or less information could be tested, as could enhanced text-based permission requests. The impact of aesthetics could also be examined, with the creation of more detailed or colored comics. Future work should explore “*in the wild*” evaluations of the permission requests.

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