# Usable Security: A browser's security warnings assessment

Devinna Win Anak Boniface Emang[a] & Zarul Fitri Zaaba[a*] & Azham Hussain[b]

[a]*School of Computer Sciences, Universiti Sains Malaysia, 11800 Pulau Pinang, Malaysia.*
[b]*School of Computing, Universiti Utara Malaysia, 06010 Kedah, Malaysia*

### *Abstract*

*Security warning is a form of message of alerting. It specifies the functions to notify, to warn and to advice users about the consequence or any possible menaces by allowing random applications to run on the computer system. However, the majority of computer user tends to ignore security warnings that convey excessive technical messages which are difficult for user to understand and lead to lack of motivation for decision making. A survey utilised 250 participants had been conducted to address end-user's comprehension about the warnings based on their browser's preference. The results revealed that most users preferred to use Google Chrome and Mozilla Firefox as compared to Safari and Internet Explorer. It can be noted that users experienced significant challenges to comprehend the signal icons and technical jargon based on the presented warnings. There is a corresponding need to design a usable security warning that able to ease end-users security decision.*

***Keywords:** usable security, security, usability, human computer interaction security, information security*

## 1. INTRODUCTION

The usage of Internet has increased rapidly as people are dependent heavily on its usage on daily basis. Internet is a ubiquitous tool that allows society to interconnect with each other through online world. According to the Statistics Portal (2020), 4.54 million people were active Internet users whereas 4.18 million were mobile social media users under the digital population worldwide as of January 2020. The number of Internet users worldwide scored the highest numbers in the global digital population worldwide as shown in Fig. 1 below.
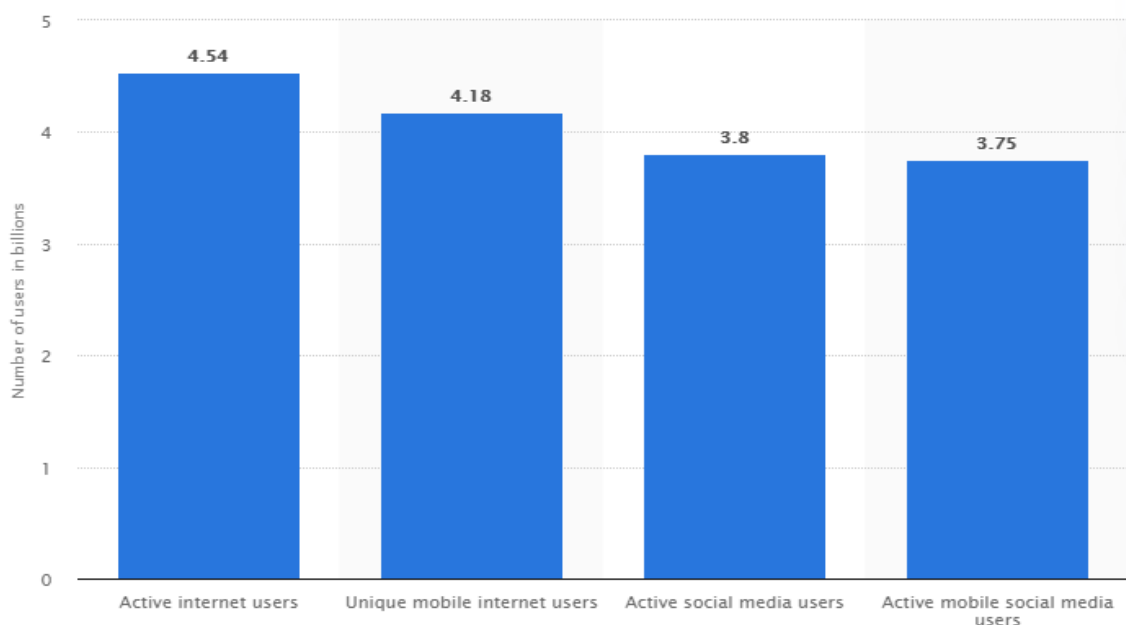


Fig 1. Global digital population as of January 2020 (in millions) (The Statistics Portal 2020).

Due to the increasing of Internet usage, the computer system is also vulnerable to various types of computer security threats. It is undeniable that these threats are evolved along with the increasing of Internet usage. According to Secure List (2017), Kaspersky Lab stated that on average, 17.26% of computers connected to the Internet globally were subjected to at least one malware-class web attack during the quarter. Therefore, the study of improving security warning dialogues is important to alert the user whenever security threats have been detected and prevent potential harm from occurring. The security warning message has a feature that enable to protect the computer system from potential threats to help users reduce the risk of security threats (Zaaba 2014, Amran et al. 2017, Samsudin & Zaaba 2017a, Samsudin et al. 2017b, Amran et al. 2018). Other than that, it can be a type of alert system that can protect computer systems from other threats such as information theft, spoofing and malwares while trying to open an attachment, running an application that is downloaded from the Internet. The rest of the paper is organised as follows: section 2 briefly discuss the background. In section 3, the methodology is presented. Section 4 and 5 presents the results and discussion. Finally, the paper is concluded in Section 6.

## 2. BACKGROUND

There is always a warning occurred when people are confronting themselves in a danger or unsafe event. For instance, it may warn user about safety awareness regarding natural disaster, workplace accidents or even in any products that available in the marketplace. The warnings explain that risk might occur, and possible precautions should be considered before users proceed with the potential risk action together with key important aspects of usability (Zaaba 2014, Samsudin & Zaaba 2017a, Samsudin et al. 2017b, Hussein et al. 2019, Yi et al. 2020, Ahmad et al. 2020). On the other hands, Bravo-Lillo (2014) defined warning as a form of communication that implement to protect people from any dangerous type such as health problem, personal injury and workplace accidents. Commonly, warning can be described as a statement or event that warns of something or that serves as a cautionary example (Oxford Dictionaries 2017). Hence, warning can be acted as cautionary advice to user about any possible harm and consequences.
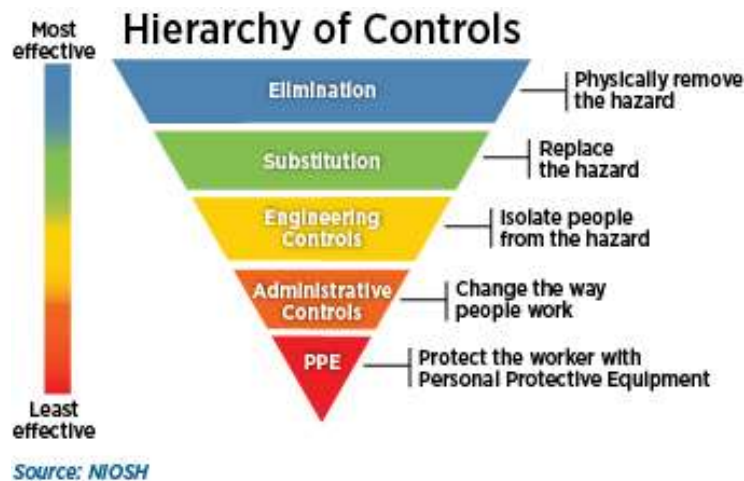


Fig 2. Hierarchy of Hazard Controls (OSHA 2017).

There are various ways to prevent unwanted accidents especially in workplace. According to The National Institute for Occupational Safety and Health (NIOSH), the hierarchy of hazard controls as shown in Fig. 2 is used in effective controls to protect workers from workplace hazards; help avoid injuries, illnesses, and incidents; minimize or eliminate safety and health risks; and help employers provide workers with safe and healthful working conditions (OSHA 2017). They reviewed that elimination and substitution are the most effective at reducing hazards, also tend to be the most difficult to implement in an existing process.

In computing context, hazard can be viewed as computer threats yet not every hazard can be eliminated or substituted. To protect the computer against the hazard, computer security warnings are

one of the best safeguards that can taking part in the hazard avoidance. According to Microsoft (2018), warnings are used in the situation when involving the risk of losing valuable asset (financial or personal data), system integrity, privacy, and user's time. Windows update, allow programs through the firewall, install a new application and restart computer are the example of scenarios that trigger the security warnings. Various types of security warning had been derived from operating system to defend a user's personal computer from harm. Some of the warnings might directly interrupt the user's primary task and some might just appear for a while. Based on the guidelines by Microsoft (2018), warnings can be classified into 5 different user interface context which is dialog box, in place, notifications, balloons, and banners to alert users as shown in Table 1.

Table 1. Five different user interface warning contexts (Microsoft 2018).

| User Interface Context | Explanation |
|---|---|
| <br>Modal Dialog Box | Critical warnings which include confirmations that users must respond to now. |
| <br>In-Place | Information that might prevent a problem, especially when users are making choices. |
| <br>Notifications | Information that might prevent a problem, especially when related to completing a task. |
| <br>Banners | Significant events or status that can be safely ignored, at least temporarily. |
|  | A control is in a state that affects input. This state is likely unintended, and the user may not realize input is affected. |

Balloons

## 3. METHODOLOGY

This work utilises survey method to gain more understanding about security warnings dialog based on users' preference of browsers. Online survey was chosen because it gave higher rate of respondents in short amount of time. Wright (2017) stated that online surveys allow a researcher to reach thousands of people with common characteristics in a short amount of time. Furthermore, most of the society are connected through Internet where the survey can easily be conducted. The dialog box warning was chosen because it can be used for critical warnings that includes information that make the users to respond to the warning instantly (Microsoft 2018). Moreover, users are more familiar with dialog box security warning as it pop-up more frequently compare to the other warnings. The online surveys were well distributed mainly through social media such as Facebook and WhatsApp as well as via words of mouth communication and mailing list. Participants were asked about their demographic details. Then, participants chose their preferred web browser and they were asked about their comprehensions (i.e. decision making, icons, words, jargon etc) based on the portrayed warnings.

## 4. RESULTS

The survey had gained a total of 250 responses. Only those who are 18 years old and above allowed to participate in this study. The responses were treated as confidential as possible and anonymous. Participants were free to withdraw from the survey at any times. The demographic results as shown in Table 2. It can be noted that most participants were derived from 18-25 years old age group with undergraduate level. The majority also indicated that their computing skills were at intermediate and advanced level and they were using computers more than 5 years.

Table 2. Summary of the background and demographic of participants.

| Characteristic (n=250) | Frequency Distribution | Percentage Distribution (%) |
|---|---|---|
| **Gender** | | |
| Male | 68 | 27.2 |
| Female | 182 | 72.8 |
| **Age** | | |
| 18-25 | 238 | 95.2 |
| 26-35 | 9 | 3.6 |
| 36-45 | 2 | 0.8 |
| 46-55 | 1 | 0.4 |
| 56 and above | 0 | 0 |
| **Educational Level** | | |
| High School | 1 | 0.4 |
| Pre-U | 23 | 9.2 |
| Undergraduate | 222 | 88.8 |
| Postgraduate | 4 | 1.6 |
| **Computing Skills** | | |
| Beginner | 21 | 8.4 |
| Intermediate | 169 | 67.6 |
| Advanced | 59 | 23.6 |
| Expert | 1 | 0.4 |
| **Years of Using Computer** | | |
| < 1 year | 0 | 0 |
| 1-2 years | 3 | 1.2 |
| 3-4 years | 14 | 5.6 |
| >5 years | 233 | 93.2 |

**4.1 Browser's Case study**

In this section, user's understanding toward security warnings were explored in detail using one scenario. Based on the preference of browser (i.e. Mozilla Firefox or Google Chrome or Internet Explorer or Safari), participant was presented with one security warning after received the following message:

*"Imagine you want to watch a movie and the movie need the VLC Media Player. So, you download the application from free download website (gfs-cf.softonic.com) to install the application in your PC. Suddenly, there is a pop-up warning in your web browser as shown below."*

Fig. 3 highlighted four different security warning dialogues from four different web browsers. These four security warnings are related to download software from free download website. It can be triggered when participants tried to download software and store or run it in the computer. This scenario was chosen by the assumption that most participants had significant experiences to download software from the Internet source.
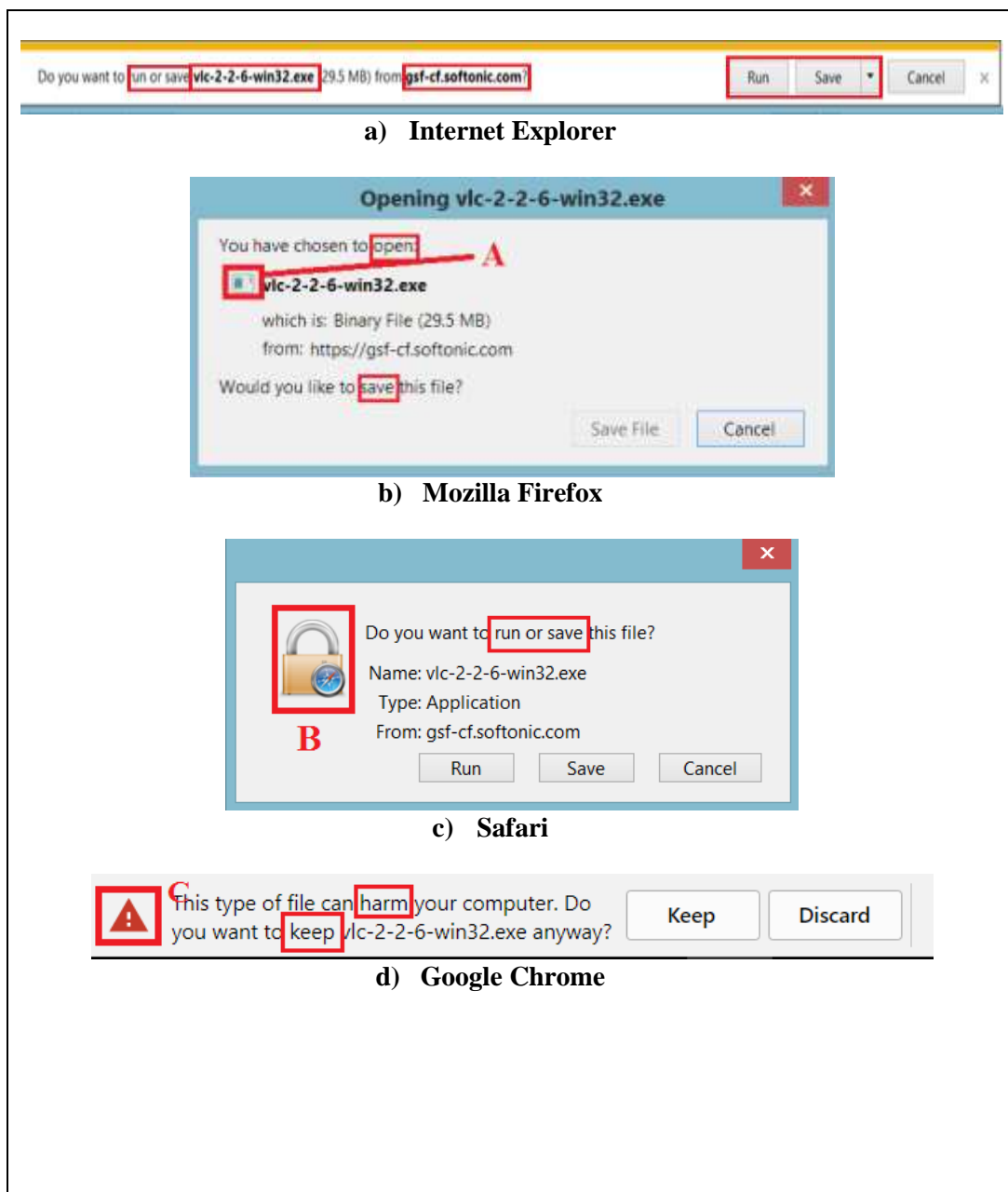


**a)   Internet Explorer**

**b)   Mozilla Firefox**

**c)   Safari**

**d)   Google Chrome**

Fig. 3. Four different security warning dialogues from four different web browsers.

## 4.2 First Action Towards Security Warning

Once the respondent chose their preferred web browser earlier, they will be prompt with question "What would you do next if you encountered security warning dialogues?" Results revealed for Internet Explorer, it indicated that only two participants chose it as their preferred web browser and they chose "Ignore the warning and proceed with the downloading process" and "Close or cancel the warning" based on the given options respectively . On the other hand, four participants opt for Safari and their decisions were to choose "Try to find out the meaning of the message", "Use "Help" function if available", "Close or cancel the warning" and "I don't know" respectively. Table 3 illustrated the majority of participants who opt for Google Chrome and Mozilla Firefox.

Table 3. Participant's first action towards security warning.

| Web Browser Used (Mozilla Firefox) N=26 First Action Choices | Frequency | Percentage (%) |
|---|---|---|
| Try to find out the meaning of the message | 3 | 11.5 |
| Close the browser | 4 | 15.4 |
| Ignore the warning and proceed with the downloading process | 14 | 53.8 |
| Close or cancel the warning | 4 | 15.4 |
| Use "Help" function if available | - | - |
| I don't know | 1 | 3.8 |
| **Web Browser Used (Google Chrome) N=218 First Action Choices** | **Frequency** | **Percentage (%)** |
| Try to find out the meaning of the message | 3 | 1.4 |
| Close the browser | 28 | 26.6 |
| Ignore the warning and proceed with the downloading process | 85 | 39 |
| Close or cancel the warning | 30 | 13.8 |
| Use "Help" function if available | 11 | 5 |
| I don't know | 3 | 1.4 |

For Mozilla Firefox and Google Chrome, both prefer with "Ignore the warning and proceed with the downloading process" with 14 and 85 participants respectively. This indicates most participants had the tendency to ignore the warnings presented (i.e. habituate) and proceed to download with the assumption that everything was in a good condition.

## 4.3 Understanding Towards Security Warning

In terms of evaluating participants understanding towards warning, for Internet Explorer, both participants agree and disagree respectively with the statement "I understand what the security warning is all about". On the other hand, "I did not face any difficulties when encountering the warning" obtain disagree and neither agree nor disagree from the participants. For Safari browser, all participants agree that they understand the warning whereas for "I did not face any difficulties when encountering the warning" statement obtain three with agree and one feels neither agree nor disagree.
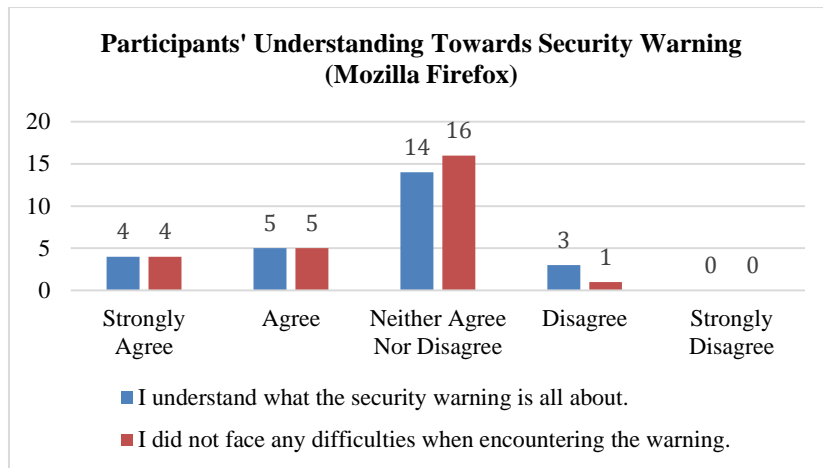
Fig. 4. Participant's understanding towards security warning (Mozilla Firefox).

Fig. 4 portrayed Mozilla Firefox participants on their understanding towards security warning. As depicted the majority decided with the neutral answer. It can be speculated that the current features and usability can be further improved to convince the current status of the warning.
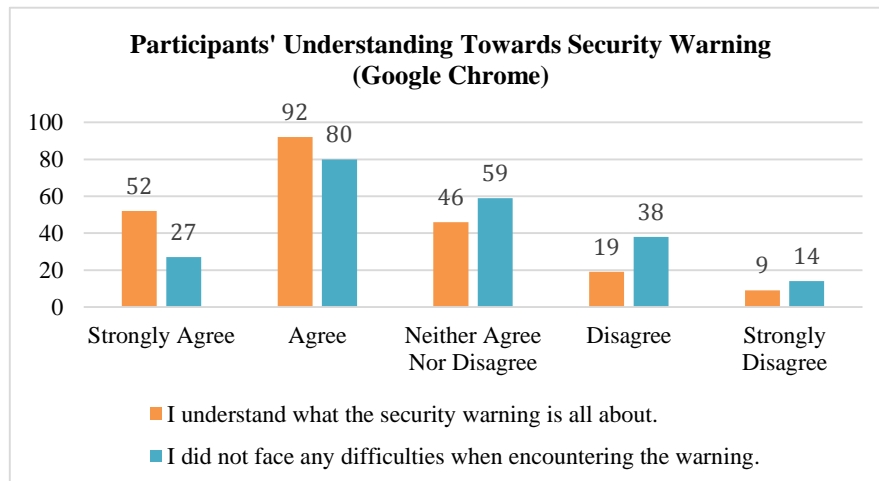


Fig. 5. Participant's understanding towards security warning (Google Chrome).

With regards to Google Chrome as shown in Fig. 5, from 218 participants, 144 claimed to comprehend the warning with strongly agree and agree and left with 28 participants with disagree and strongly disagree (i.e. "I understand what the security warning is all about:). Moving to the statement "I did not face any difficulties when encountering the warning", again the highest value indicated that 92 participants agree with that. However, the 52 participants claimed to experience significant difficulties as they opt for disagree and strongly disagree. In addition to that, in both statements, participants highlighted quite a number of neutral decisions accordingly.

## 4.4 Understanding towards Signal Icon/Word/Technical Terminology Used

Based on Fig. 3 in section 4.1, the four security warnings from four different web browsers had been labelled accordingly. Download warning for Internet Explorer is interesting because it did not contain any specific icon. Therefore, we speculated what makes this warning to be important or at risk? It also provided the file name with its extension (.exe). On the other hand, icon A in download warning of Mozilla browser is symbolized as application file or .exe (Zaaba and Teo 2015 & Samsudin & Zaaba 2017a). Icon B in Safari is symbolized as system permission for outside application to make change to the system. For Icon C, Google defined the icon as "not secure" icon (BrightLabs 2017). In term of signal word used in the warning, both Internet Explorer and Safari use the same word which is "run or

save" whereas for Mozilla, it is a bit different such as it aware that participants wanted to open the application, yet it asked for the participants to save it instead. For Google Chrome download warning, it stated that the file maybe harmful. Participants had two options to keep it or to remove it.

For Internet Explorer users, the two of participants opt for neither agree nor disagree. We speculated that as not much information was depicted on the warnings made them to choose that answer. Although it was a neutral answer, it ponders some interesting question, do simplicity made things better? On the other hand, with Safari, all four participants opt for agree for the given questions except for the last two questions (i.e. the signal icon help me to decide whether I safe to proceed the downloading process and the signal icon used make me more understand of the warning). For these two questions, all participants claimed with disagreement.
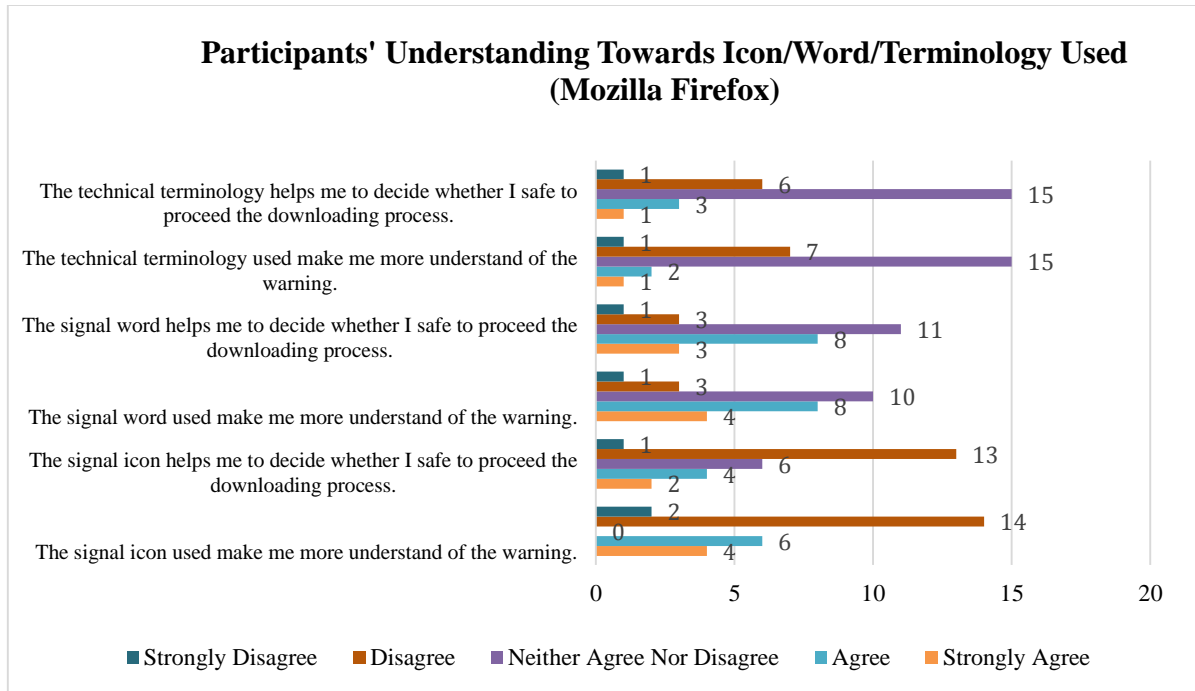


Fig. 6. Participant's understanding towards icon/word/terminology (Mozilla Firefox).

For Mozilla download warning as shown in Fig. 6, the majority of the participants neither agree nor disagree regarding the terminology and signal word used can help them to understand the warning as well as proceed for safe download the content. It can be noted that the usage of extension file .exe had the tendency to complicate the situation especially to non-technical savvy participants to comprehend the meaning of the warnings.
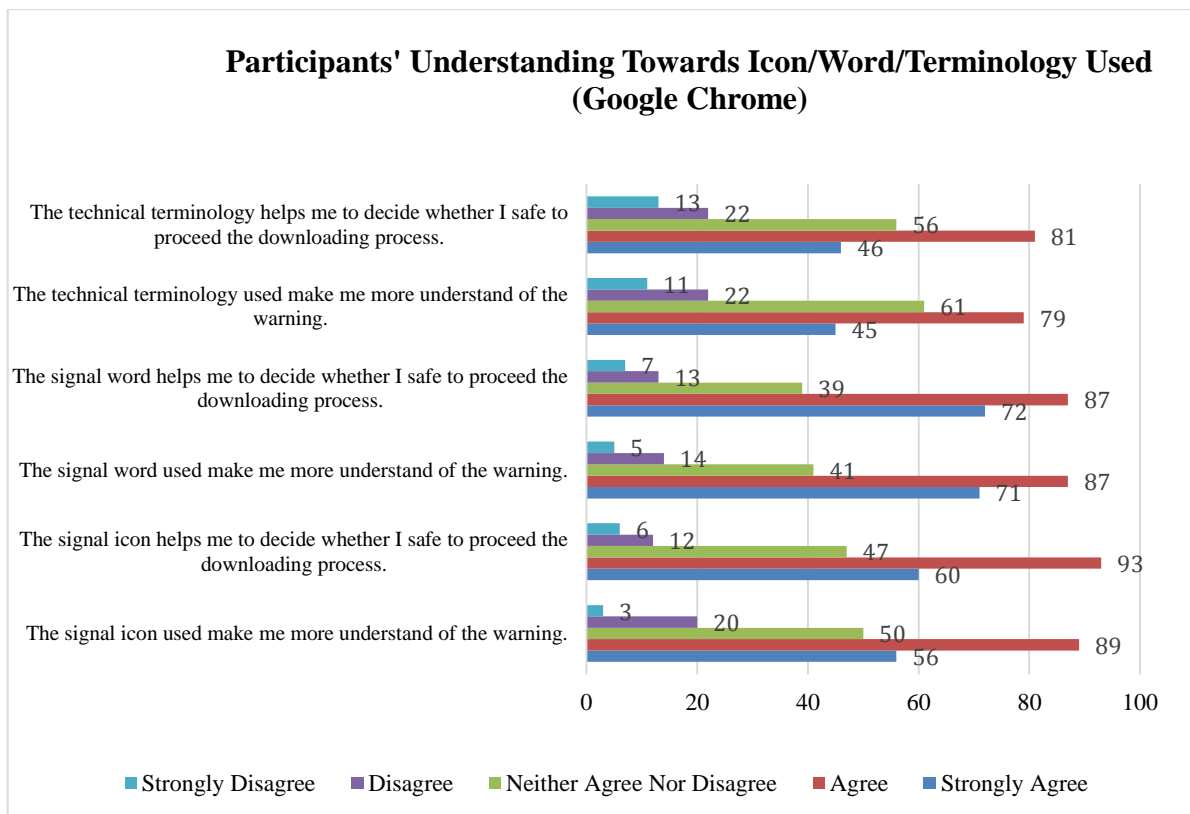
Fig. 7. Participant's understanding towards icon/word/terminology (Google Chrome).

Then again, for Chrome download warning, the majority of the participants agree regarding the terminology, signal word and icon used can help them to understand the warning as well as proceed for safe download the content as depicted in Fig. 7. The usage of exclamation marks for instance was quite distinctive for participants to aware that this was a warning.

## 5. DISCUSSION

From the findings, it can be highlighted that most users experienced different level of comprehension towards the security warnings that presented to them. It can be noted that signal icons and signal words play significant roles to portray the risks, to convey the meaning of the message and it will impact the decision-making process for the end-users. It can be addressed as well that no one size fits all solution in regard to usable security (i.e. usability and security) in terms of warnings design by the developers. Participants tend to opt for neutral answer when there are in baffled. The usage of technical terminology or jargon such extension file of .exe, binary file etc might complicate things. The implementation of symbol and picture is essential, and it must convey the right message to the user. For instance, in Mozilla and Safari, both icons used are quite confusing and it has not been explained anywhere in the warnings. Although the warnings can be designed in improve manner, many other aspects can be further study such as habituation effects once the warnings have been designed such way. Having said, this work had similarity with results from Zaaba et al. (2011). Although their works had more comprehensive comparisons but issues on terminology or jargon, icons usage and words usage were predominantly highlighted. Our result supported their findings by showing that end-users still experienced significant difficulties when encounter with security warnings. Understanding the meaning of depicted features can help users to deal with risks or threats. There are still some grey areas between the comprehension of users and the technicality of the systems.

## 6. CONCLUSION

In conclusion, the usable security and usability of security warnings are the important element that should not be disregard. It acts as the line of defence to end users. This result form 250 participants signals that current implementation of security warnings offers more room of improvement in regard to the whole implementation that utilize the signal icons, signal words, technical terminology and the warning structure. This result indicated that apparently there are no one fits all solution provided by any developers. Each developer had their own philosophy on how warnings should be designed to the users. End user's perception and understanding can be the basis or value added for further research. For future work, interview and focus group can be conducted to further understand the issues and challenges. It is expected that the outcome of the research can be useful to practitioners and researchers within this domain.

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