International Journal of Humanities and Social Science Invention
ISSN (Online): 2319 – 7722, ISSN (Print): 2319 – 7714
www.ijhssi.org ||Volume 5 Issue 4 ||April. 2016 || PP.68-76

Examining the Usability of Message Reading Features on Smartwatches

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ABSTRACT*: This study examined smart watch message reading features by considering the following assessment points: simplicity, comprehensibility, perceived usefulness, and overall satisfaction. Three smart watches (Pebble Watch, Samsung Galaxy Gear2, and Sony Smartwatch2) were subjected to user tests, and in-depth user interviews were conducted. The results showed that 83.3% of participants experienced difficulty in checking and reading messages. Screen size, text size, and accessing messages were the top three factors causing inconvenience. The participants believed that the most useful feature of the smart watch was message notification, and message reading was also considered useful. The message notification function could be further developed for smartwatch design.*

KEYWORDS: *smartwatch, message reading, perceived usefulness, comprehensibility, simplicity*

I. FEATURE AT A GLANCE

Wearable computers have received increasing attention with the development of computing and telecommunication technology (Mottl, 2014). The smartwatch is a new type of wearable device and has various applications (Llorente&Morant, 2014; Wright &Keith, 2014). Two types of smartwatches, namely the standalone smartwatch (Samsung Gear S) and smartphone companion (i.e., Pebble Watch; PW), are currently available in the market. In general, smartwatches are largely observed as an extension of a smartphone (Smartwatch Group, 2014a). Although standalone smartwatches can connect with a network through integrated mobile phone technology and function independently, using the smartphone as a hub in most scenarios is sensible. First, mobile devices are available to people almost all the time. Second, integrating Bluetooth Low Energy into a smartwatch instead of installing mobile technology is substantially simpler and cheaper. Third, one smartphone subscription is sufficient; a complete standalone smartwatch increases recurring costs. Therefore, smartwatches are designed to function with a smartphone rather than replace smartphones.

As smartphone companions, smartwatches act as notification systems for phone messages. Whensmartwatches are paired with smartphones via Bluetooth, the display is integrated with the smartphone, enabling users to view notifications, read text messages, play music, answer calls, and take pictures (Lee, 2014; Shanklin, 2013; Trew, 2014). Among all features, display of text messages and other notifications is the most frequently used. According to Fixya (2014), the smartwatch acts as a liaison with a smartphone rather than constitutes a new means through which consumers genuinely interact with the digital world. Shanklin (2013) reported that short message service notifications were much more functionalthan e-mail integration. In addition to reading full messages, a user can scan the entire messaging inbox at any time. However, few studies have investigated the usability of the message reading feature of smartwatches. Accordingly, this study examined the message reading features (i.e., social network apps and e-mail messages) through a user test.

II. EXPLORING SMARTWATCHES

In 2013, PW, Samsung Galaxy Gear 2 (SG), and Sony Smartwatch 2 (SW) were the highest-selling smartwatches (market shares of 6%, 34%, and 7% respectively), excluding health and fitness trackers (e.g., Nike, Fitbit, and Garmin) (Smartwatch Group, 2014b). These smartwatches were analyzed (Figure 1) not only because of their popularity but also because of their unique feature specifications. Table 1 shows a comparison of message reading features.

(a) Pebble Watch

(b) Samsung Galaxy Gear 2

(c) Sony Smartwatch 2

Figure 1: Three tested smartwatches.

Table I: Comparisons of Pebble Watch, Samsung Galaxy Gear 2, and Sony Smartwatch 2

		Pebble Watch (PW)	**Samsung Galaxy Gear2 (SG)**	**Sony Smartwatch 2 (SW)**
Display screen	Color	B/W	Color	Color
	Size	1.26”	1.63"	1.6"

	Type	Transflective LCD	Super AMOLED	Transflective LCD
Operation method	Input and Control	Hard keys	Touch screen	Touch screen
Social Networking Apps	Notification	By Vibration	By Vibration & Ring tone	By Vibration & Ring tone
	Sender's name	display with Notification	display with Notification	display with Notification
	Content Preview	Not Available	Available	Available
	Reply by text	Available with third-party apps	Via the Fleksy Messenger	only provided reply templates
E-Mails	Notification	Vibration	Vibration	Vibration
	Sender's name	display with Notification	display with Notification	display with Notification
	Content Preview	Available	Available	Available
	Reply by text	Not Available	Not Available	Not Available

(Data Source: The three smartwatch manufacturer's websites. https://getpebble.com, http://www.sonymobile.com, and http://www.samsung.com/global/microsite/gear/gear2_specs.html)

The objective of this study was to examine the message reading feature of smartwatches,and interaction through the display screen and control method affect the overall user experience. Almost all current smartwatches use a backlit liquid crystal display (LCD) or organic light-emitting diode (OLED) display that requires battery power for lighting, and the display is active only when viewing it, as in a smartphone.

Display screen. Both PW and SW use the transflective LCD technology, which uses existing ambient light to keep the screen active without the use of a button and visible at all times without considerable power loss; internal light is required only in reduced ambient light conditions. Transflective LCD is a combination of both a backlit transmission mode and a reflective mode (e.g., traditional LCD wrist watches). By comparison, SG uses an OLED display, which requires input (i.e., pushing a manual button or monitoring by using a gesture sensor) for activation. In summary, for PW and SW, the displayed information, including time, is readable in most environments under various brightness levels without the need to activate the display, but, for SG, the display must be activated even for viewing the time.

Operation method. Compared with smartphones, smartwatches have a much smaller display on which users navigate desired information. The display, or user interface window, influences the user experience regarding text readability and the information navigation method. SG and SW offer touch-control screens, whereas PW offers hard keys for information navigation. The touch screen provides considerable flexibility in operating various apps through direct input by a finger; however, a small screen size could be restrictive because of the finger blocking the display view. Comparatively, independent hard keys offer a full view, but do not provide users with a flexible information navigation experience.

III. USER TEST ENVIRONMENT

The message reading experience of 18 participants who used one of the three smartwatches daily for 2 weeks was analyzed. A quantitative survey was first conducted, andpeople who were interested in purchasing a smartwatch and lacked experience in using a smartwatch were then recruited. Seven men and 11 women were selected. Of these participants, 56% were aged 18–35 years, 33% were aged 36–55 years, and 11% were aged older than 55 years). Because the objective of the experiment was not to compare the quality of each smartwatch but to evaluate the quality of the message reading feature, each participant tested only one smartwatch. After 2 weeks of the wear-and-use test, in-depth interviews were conducted with each participant to evaluate their experience. Questions in the interviews were divided into four experience measurement categories: simplicity, comprehensibility, perceived usefulness, and overall satisfaction.

Simplicity. The level of difficulty and efficiency in accessing and reading text messages was evaluated. User interface design quality was not considered; the measured properties (i.e., factors that affect the readability of message) were interactions that occur between the user and the smartwatch when the user reads messages (i.e., control using touch screen or hard buttons, text size, and screen color).

Comprehensibility. The level of understanding achieved when reading messages and feeling of comfort when performing tasks such as reading social network messages and e-mails, reading messages of varying lengths, viewing images, controlling multiple messages, and adjusting the size of the screen were evaluated.

Perceived usefulness. The participants' perceptions of the value of the message reading features and degree of objective implementation when using the smartwatches were evaluated. Perceived usefulness could show user requirements that can be integrated into the smartwatch. Although a smartphone is used for reading social network messages or e-mails and has a larger screen, a smartwatch should offer a definite motivation to wear and use it, including dependency of usage on a smartphone, capability to reply to messages, and calling or receiving phone calls.

Overall satisfaction. The general user satisfaction with the message reading features of the tested smartwatch was evaluated. A 5-point Likert scale was provided to the participants for evaluating their subjective perceptions from 1 (completely unsatisfied) to 5 (very satisfied). In addition, the motivation for purchasing a smartwatch on the basis of the message reading function was evaluated on a 5-point Likert scale ranging from1 (not motivated at all) to 5 (very motivated).

IV. USER TEST RESULT

On average, each participant installed four social networking apps and two e-mail accounts during the 2-week testing period. Some (39%) participants had difficulty in pairing the smartwatch with their smartphone, but they all resolved the problems by self learning, and the smartwatches functioned normally with the smartphones during the testing period.

Simplicity. Most (83.3%) participants experienced difficulty in checking and reading messages. The following factors were ranked according to the difficulty that they cause in message reading: screen size, accessing messages, wrist angle during reading, language availability, text size, and display color. An overall ranking of each factor based on the average rank from all participants was established (Table 2). Screen size, text size, and accessing messages were the top three factors causing difficulty in message reading.

Table II: Average ranking of the factors by all participants

Rank	Factors	Means
1	Small screen size	1.82
2	Text size	2.79
3	Getting to the message	3.00
4	Wrist angle during reading	3.57
5	Language availability	3.88
6	Display color	4.50

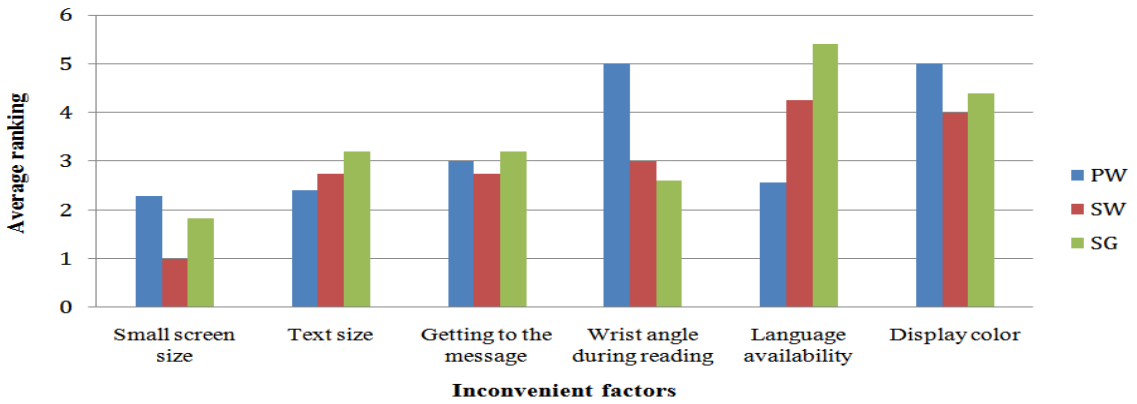

Figure 2:Ranking of the factors causing inconvenience for the three smartwatches.

The screen size was the greatest source of inconvenience for all three smartwatch models (Figure 2). Although PW has a smaller screen than that of the other two smartwatches (Table 1), the inconvenience ranking was lower. The text size was ranked as the second greatest source of inconvenience. Participants complained that the text was too small or that they disapproved of the font entirely. The small screen and text size of the smartwatches seriously affected visibility.

Regarding navigating to a message by using the touch screen or hard control keys, SW and SG did not differ substantially compared with. Although touch control offers more direct access to desired information than hard keys do, enabling actions such as scrolling through a list of text, users prefer a full view of the screen, which is blocked by a finger on smartwatches with touch screens.

The reading angle was the fourth most inconvenient obstacle for all three smartwatch models. Unexpectedly, the users of SW and SG perceived the reading angle of the wrist to be more inconvenient than did the users of PW. One reason could be that the SW and SG users read more messages than the PW users did.

The display color was not a major factor affecting perceived inconvenience in reading text. Although PW has a black and white display and SW and SG have colored displays, the difference in the perceived inconvenience rating was small. This shows that a black and white display is not a factor causing inconvenience in message reading. Thus, the availability of colored text is not a major concern for reading social app messages and e-mails.

Comprehensibility. After receiving a notification, 56.5% of the participants checked the sender and read messages on the smartwatch. The SW and SG users reported a higher preference (more than 60%) than that of the PW users in reading messages on the smartwatch (Figure 3). The preferences of the PW users were reversed, with 57.1% preferring to check the sender on the smartwatch and read the message on a smartphone.

However, after receiving a message or e-mail, few participants (11.4%) read full text messages on the smartwatch; the majority (62.1%) preferred reading a message briefly on the smartwatch and rereading it on a smartphone (Figure 4). More PW users than SW and SG users preferred reading the entire message on a smartphone.

After reading messages, most participants kept the read messages on both their smartwatch and smartphone instead of deleting the record from the smartwatch (Figure 5). Regardless of the duplication of the same text on the two devices, the participants preferred to access messages on both devices.

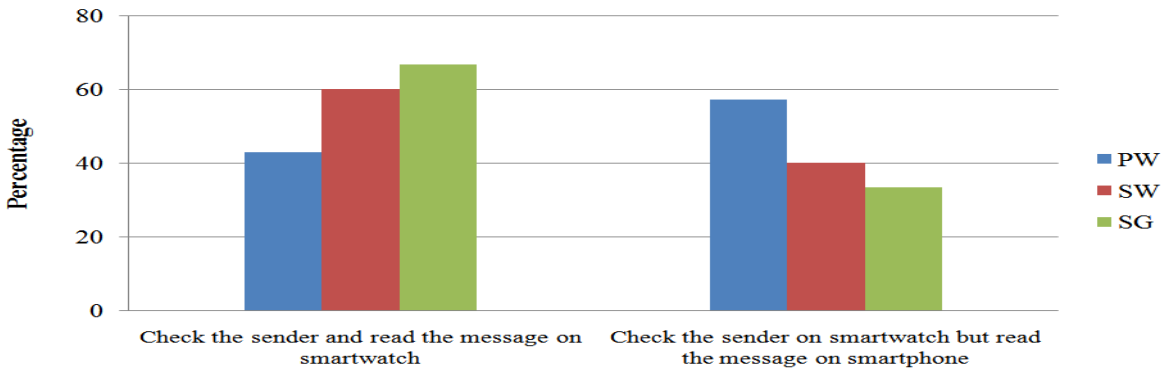

Figure 3: Use of notification.

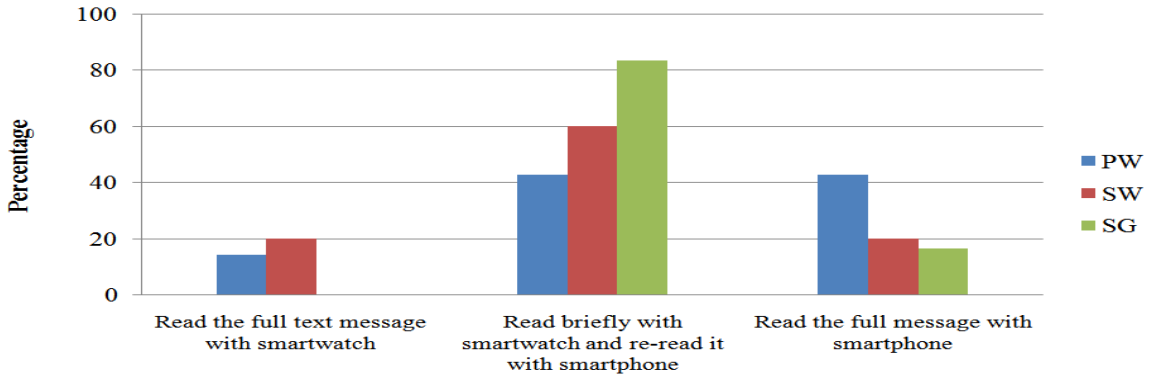

Figure 4:Message reading preferences.

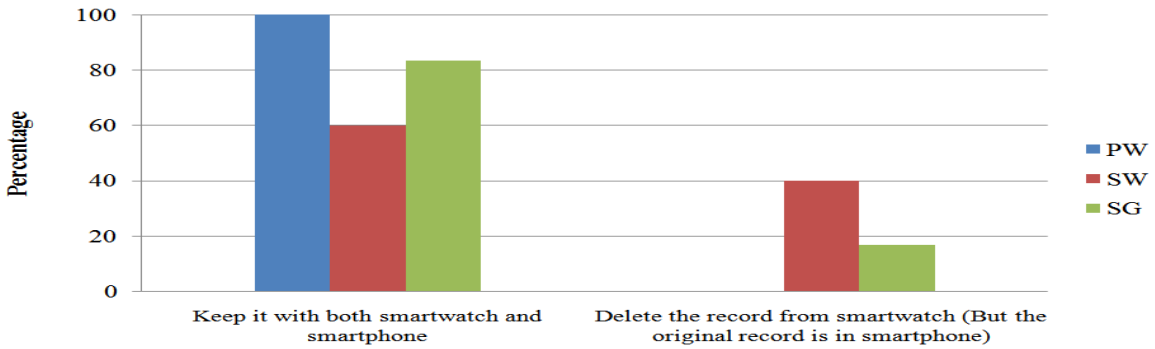

Figure 5: Message record management.

Perceived usefulness. In general, the participants felt that the message reading feature was useful (Figure 6); however, they had complaints. Most considered message notification rather than message reading as the most useful feature of the smartwatches (Figure 7).

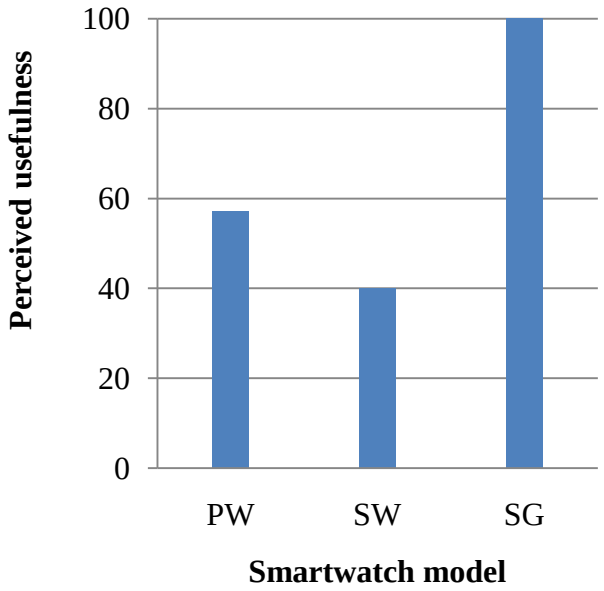

Figure 6: Perceived usefulness of the message reading feature.

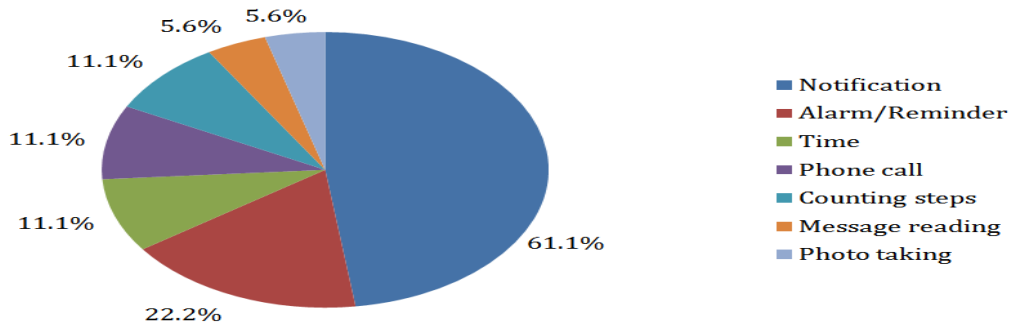

Figure 7: Perceived useful features of the three smartwatches.

Overall satisfaction.Regarding the message reading feature, the PW users were generally less satisfied with the message reading experience than the SG and SW users (Figure 8). SG users reported greater overall satisfaction with the message reading function. However, this could not encourage them to purchase a smartwatch. The participants in all three groups provided an extremely low evaluation for smartwatch purchase motivation based on the message reading feature (Figure 9). One of the concerns was that the participants had to use their smartphones to reply to the messages even if they read the message on the smartwatch. In addition, voice input and limited typing methods caused inconvenience. This greatly limited the usefulness of and satisfaction with the message reading function.

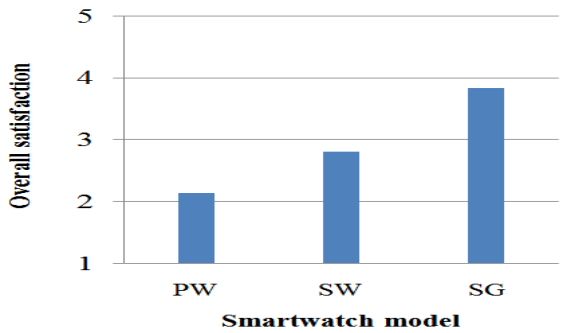

Figure 8: Overall satisfaction with the message reading feature.

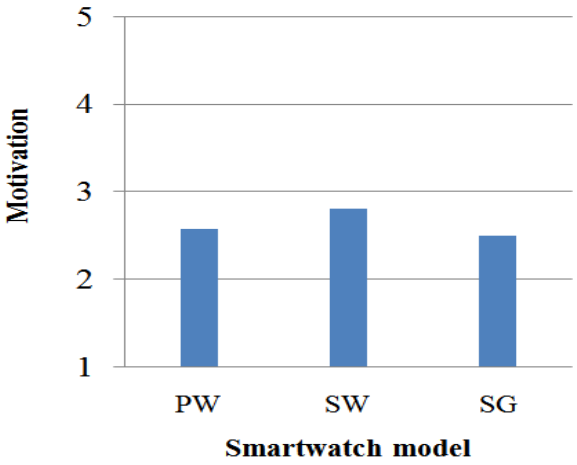

Figure 9: Overall motivation for smartwatch purchase based on the message reading function.

V. DISCUSSION AND DESIGN CONSIDERATIONS

The results from the user tests provide smartwatch design considerations that could be applied in future product development. The participants preferred a large display over a color display; however, the size of the display should be determined according to the manner in which users read text messages: they briefly read messages on the smartwatch and reread them on a smartphone. This implies that the size preference is not related to size usability. Because users do not rely on a smartwatch for reading a complete message and, instead, use it as a notification tool, the display size should be large enough to display the initial information, that is, the notification icon, sender name, and message title. On the basis of the content amount to be displayed, not only the size of the display screen but also the optimal vertical and horizontal display ratio should be determined. In addition, the text size must be considered for visibility. Moreover, because the product is worn on the wrist, the participants preferred not to read full texts or long messages because of the inconvenient reading pose; instead, they preferred quickly glancing at a notification and then reading the full text on a smartphone.

Because notification display is the main feature of a smartwatch, new product feature development may require consideringnotification use. a) A smartwatch could be used to manage notifications on a smartphone. Currently, even when users delete unwanted notificationson the smartwatch after reading, a duplicate notification remains on the smartphone, and users must repeat the same task tomaintain a clean smartphone interface. Hence, users must be able to delete unwanted notifications on both the smartwatch and smartphone through one action. b) Indicators of senders' demand level could be incorporated into notification. Similar to the notification features that e-mail applications offer, that is, attention indicators such as "important," "flag," and "star," senders' attention request levels can be incorporated into smartwatch notification, with preset vibration patterns, sounds, and display flashing indicating different levels of importance. Users could respondto the notifications accordingly and are free from the obligation of reading all received text messages.

The use of hard keys as a means of navigating to a message was acceptable to the participants;nevertheless, PW scored low in overall satisfaction. Because few control actions are required for reading text (i.e., scroll up and down and enter), hard keys outside the screen provide sufficient control, whereas touch screen control could cause the screen to be blocked by the fingers and thus lead to unwanted selection. Although PW has a smaller screen than those of SG and SW, the PW users expressed less desire for a larger screen than the participants in the other two groups did. Hence, hard keys located outside the screen with an intuitive operation similar to touch control would be ideal for reading text.

A major challenge in using the smartwatches was replying by text. Most users reported that without a reply feature, the usability of a smartwatch is limited to receiving notifications only. Although users can create personal prewritten templates for replying to received messages and calls, this function is very limited compared with the variations of user's reply in real situation. Users desire to easily retrieve and read past messages or e-mails on a smartwatch, implying that users seek to use a smartwatch as an independent device and not only as a smartphone companion. To satisfy users' needs for smartwatches, a message input technology with higher accuracy and convenience must be developed.

VI. LIMITATIONS

In this study, a user test was conducted to evaluate the usability of the message reading features of three smartwatches. The test participants evaluated their experience with the message reading features only and did not provide their detailed smartphone usage information. However, demographic variables such as occupation, and smartphone using behavior could have influenced the participants' responses. Second limitation pertains to features of smartwatches other than message display such as cameras, health and fitness apps, and the charging method. These features could have positively affected the overall perceived product value. Finally, the product outlook could be a limitation in fair assessment. Because smartwatch is a wear-and-use product, the product aesthetics could be an influential factor as well.

VII. CONCLUSION

The usability of the message reading feature of three smartwatches, namely PW, SG, and SW, was evaluated. The study involved administering questionnaires and conducting interviews to collect information and opinions from all participants in four major categories: simplicity, comprehensibility, perceived usefulness, and overall satisfaction. The results showed that 83.3% of the participants experienced difficulty in checking and reading messages. Factors causing inconvenience were ranked from highest to lowest as follows: screen size, text size, accessing messages, reading angle of the wrist, language availability, and display color. The small screen size was the largest problem hindering message reading. When receiving a notification, more than 50% of the participants checked the sender and read the notification on the smartwatch. However, most participants (62.1%) briefly read messages and e-mails on the smartwatch and then reread them on their smartphone, and 26.5% of participants read messages by using their smartphone only. Although no participants believed that the message reading function of smartwatches is sufficient for replacing smartphones, 66.7% of the participants believed that

the message reading function was useful. Most participants thought that the most useful function of the smartwatch was notification. Regarding overall satisfaction, PW and SW obtained dissatisfactory ratings, and only SG received a higher rating than neutral. The message reading feature could not highly motivate the participants to purchase the smartwatch.

The major problems with message reading on the smartwatches, according to the participants' complaints, were related to the small screen size, which makes reading text messages, particularly long messages, difficult. Therefore, the participants preferred to read their messages on their smartphone. Users favored the notification function alerting them of a new message and briefly read the sender information from social network apps. Further development of message notification features could constitute a new design direction for the message reading function of smartwatches.

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