HAND-SIZE VARIATIONS EFFECT ON MOBILE PHONE TEXTING SATISFACTION

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ABSTRACT

The effects of hand-size variations and gender on mobile phone users' texting satisfaction were investigated using structured questionnaire interviews with 110 subjects (18–23 years old). Focus was on text entry factors: speed, learnability, simplicity, navigation and special characters. Gender effect is significant for speed and special characters selection, with females being more satisfied than males. Hand-size effect is significant for speed, special character selections and navigation, with smaller hand-sized subjects being more satisfied than larger hand-sized subjects. Interaction effect of hand-size x gender was found to be significant for speed and special character selections. Gender, hand-size and hand-size x gender significantly affect subjects' overall texting satisfaction, with smaller hand-sized subjects being more satisfied than larger hand-sized subjects, regardless of their gender. It was recommended that an improved or new text entry mechanism would increase texting satisfaction, regardless of their gender and hand-sizes. Results confirm that hand-size variations and gender affect users' texting satisfaction, with regards to the text entry factors.

Keywords: Hand-size; gender; texting satisfaction; text entry factors

1 INTRODUCTION

Text messaging on mobile phones refers to the activity of composing short character based messages (160 characters) and exchanging it between mobile phone subscribers. The first text message is believed to have been sent to a mobile phone in 1992 [1]. Teenagers originally started the textual use of the mobile as a form of cheap and accessible social communication. Today text messaging is the most widely used mobile data service, with 72% of all mobile phone users worldwide at end of 2006, being active users of text messaging service [2]. The European average is nearing 2 text messages sent per day per user, the British send 6, the South Koreans send 10, the Singaporeans send 12 and the Filipinos send 15 [3]. Interestingly a survey conducted by an International IT service company (LogicalCMG) among 1,004 mobile phone users revealed that Malaysians send an average of 17 text messages in a day and spend an average of RM101.50 per month [4]. The Handphone Users Survey 2005 also reported that 84.9% of Malaysian mobile phone users sent at least one SMS per day and 49.6% sent at least five daily, based on a survey among 4,295 mobile phone users [5]. This is an interesting phenomenon to note in view of the limited capability of text entry mechanisms with mobile phones.

The popularity or success of text messaging with mobile phone users has heightened the interest in text entry research. Some researchers have done comparison studies based on the text entry methods [6, 7, 8, 9, 10] whereas others have tried to introduce new techniques to enter text via mobile phone's limited interface [11, 12, 13]. Mackenzie et al. explored the text entry rates for several variations of soft keyboards [14]. Literature reviews revealed no studies has been done to find if mobile phone users' hand-sizes influence their subjective satisfaction in text entry. Does this mean users' physical hand measurements are not being considered by mobile phone designers or do all the mobile phones cater to users' satisfactions, regardless of their hand and thumb sizes? This study aims to investigate if different hand-sizes influence mobile phone users' texting satisfaction with respect to the text entry factors, taking gender into consideration as well.

2 TEXT ENTRY METHOD

2.1 Multitap

The multitap is the most common style of text entry using a mobile phone's keypad that consists of between 12-15 overloaded keys. Text is entered via the keypads with one or two hands using one or two fingers or thumbs. Multiple key presses are made to enter a desired text. When a letter is entered successfully, users can proceed to the next letter if it's on a different key; else a short waiting period (1–2 seconds) is necessary before the next letter can be entered. Some phones use the "#" key to force to the next letter. For example, to enter "deaf", users need to type 3–332333 ("–" indicates a time–out), whereas with a next key, users need to type 3#332333 [15].

2.2 Predictive text entry

The predictive text entry method uses linguistic knowledge to predict the intended words of the user. Most mobile phones have licensed the T9 input method which uses a dictionary as the basis for disambiguation. Just like multitap, multiple letters correspond to the same key. However, each key is pressed only once. The phone will predict the word as it is being entered. A next key (e.g. "#") can be used to cycle through the potential words. The word "deaf" is entered with 3323, however, the first word to be guessed by T9 is "dead". Users need to press the next key to make the intended selections [15].

3 DESIGN OF STUDY

3.1 Text entry factors

The text entry factors used in this study are speed, learnability, simplicity, special characters and navigation. Table 1 shows the description for each of the text entry factors and Fig. 1 shows the theoretical framework. The effect of these factors on texting satisfaction is tested, based on two moderating variables: hand-size and gender.

Table 1: Text entry factors

Text entry factors	Explanations
Speed	The speed in which a text can be keyed in using multitap or/and predictive text entry system [6 , 7, 8, 10]
Learnability	The ease in which users can learn the text entry mechanism [6, 7, 16]
Simplicity	The ease of using the text entry mechanism [16]
Special characters	The ease in keying in numbers, symbols (punctuations, exclamations, dollar signs etc.)[16]
Navigation	The ease in which key selections can be made while texting (opening, replying, deleting etc.) [16]

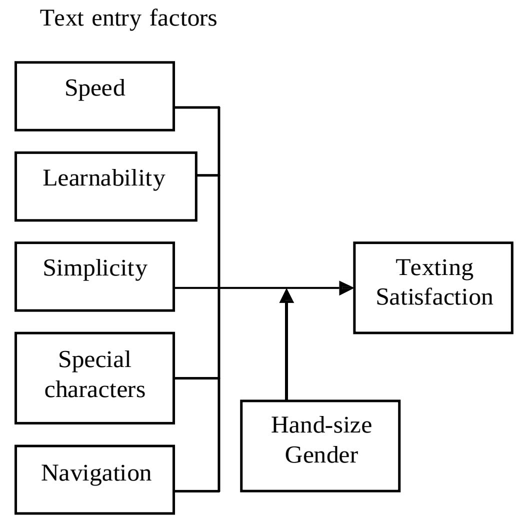

Figure 1: Theoretical framework

3.2 Subjects

A total of 110 Malaysians were interviewed, consisting of 55 males and 55 females, aged between 18 – 23 years old (mean = 21.5 years, SD = 1.64). The majority of them (84/110) were recruited from a local university and the rest were selected from public places (mall, public library etc.). All the subjects have used SMS before, with an average of 3.8 years of experience and SD = 1.19. All the subjects use their thumbs to compose messages. The majority of the subjects compose messages that are between 75-160 characters in average length (66.4%), followed by 26.4% between 25-74 characters. 80.9% (89/110) of the subjects use multitap for text entry, 11.8% (13/110) use both multitap and predictive text entry interchangeably and only 7.3% (8/110) use predictive text entry.

3.3 Hand-size measurements

The mobile phone is normally held in a single hand, gripped by fingers (in most cases with all five fingers) while it sits on the palm. Messages are composed by making key presses using the thumb. Users with large hands and thumbs might find it difficult to hold the small mobile phone and text via the tiny keypads. On the other hand, small hand-sized users might have to struggle holding a large mobile phone. Moreover, users with short thumbs might find it difficult to reach some of the keys on large phones. In order to determine the effect of hand and thumb sizes on users' texting satisfaction, four measurements were taken: hand breadth, hand length, thumb length and circumference. Hand breadth was measured at the distal ends of the metacarpal bones (the joints of index finger to the little finger) whereas the length of the hand was measured from the crease of the wrist to the tip of the middle finger, with the hand held straight and flat (Fig. 2). The length of the thumb was measured from the second joint of the thumb to the tip of the thumb whereas the circumference was measured at the widest point of the thumb (Fig. 3). All four measurements were taken using measurement tape based on the definitions used by Vasu and Mital [17].

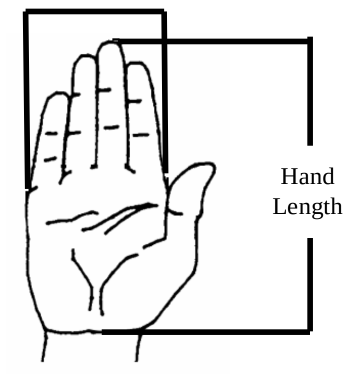

Figure 2: Hand breadth and length

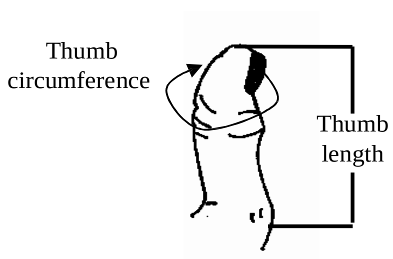

Figure 3: Thumb circumference and length

Table 2: Hand-sizes based on genders

Measurements (cm)	Male (N=55) Mean ± SD (Min–Max)	Female (N=55) Mean ± SD (Min– Max)
Hand length	18.5 ± 1.2 (16.5 – 23.0)	16.6 ± 1.1 (13.5 – 18.5)
Hand breadth	9.8 ± 1.4 (8.0 – 13.0)	7.5 ± 0.4 (6.0 – 8.2)
Thumb length	6.4 ± 0.8 (4.8 – 8.2)	5.4 ± 0.7 (4.2 – 8.0)
Thumb circumference	4.4 ± 1.9 (1.6 – 7.5)	3.5 ± 1.8 (1.5 – 6.5)

Note: Dominant hand measurements only. Independent t-test showed significant differences between genders for all measurements.

Table 2 shows the summary of hand-sizes statistics based on the genders. It can be noted that generally the males have larger hands and thumbs than females; hence it is also important to determine if gender significantly influence users texting satisfaction. Three hand-size groups (small, medium and large) were defined for each gender based on [18]: for males, <8.8 cm is small, 8.8–9.2 cm is medium and >9.2 cm is large; for females, <7.3 cm is small, 7.3–7.7 cm is medium and >7.7 cm is large. The number of subjects is as follows: for males, 14 small, 18 medium and 25 large; for females, 14 small, 23 medium and 16 large.

3.4 Questionnaire

An interview questionnaire was designed based on Sinclair's guidelines [19]. The questionnaire was developed in English and had two major sections: Section A to obtain the demographic profile of the subjects (gender, hand measurements, hand used to text etc.) whereas Section B is for the subjects to rate their satisfaction/dissatisfaction levels to statements using Likert's five-point scale, whereby 1 means 'Strongly dissatisfied', 2 means 'Dissatisfied', 3 means 'Neutral', 4 means 'Satisfied' and 5 means 'Strongly Satisfied'.

3.5 Interviews

Face-to-face interviews were conducted using the above questionnaire on a one-to-one basis, beginning with the subjects filling in their background information, which includes their age, gender, finger(s) used in composing SMS and so forth. The interviewer then measured the hand-sizes (palm and thumb). Subjects were encouraged to give comments, opinions and suggestions. All verbal comments were recorded by the interviewers. Each interview session lasted for about 30 minutes. Three interviewers participated in these exercise that took almost eight weeks to complete. All interviews involved one interviewer and one subject at the same time.

4 RESULTS

Statistical Package for the Social Sciences (SPSS) software was used to test the statistical significant difference(s) of variables gender, hand-size groups and the hand-size x gender interactions against text entry factors. Analysis of variance (ANOVA) and Tukey Post-Hoc analysis were used to analyze the collected data. All results are considered significant at $p < 0.05$ level.

Table 3: ANOVA test for text entry factors satisfaction, based on gender

Text Entry Factors	F	p
Speed	4.638	0.033*
Learnability	3.463	0.065
Simplicity	2.641	0.107
Special Characters	8.893	0.004*
Navigation	3.187	0.077

F: F statistic; p: p-value; *: significant at $p < 0.05$

Table 3 shows that there is a significant effect of gender with respect to users' satisfaction towards speed and special characters selection. The females were found to be more satisfied (mean = 3.7 and mean = 4.1) than males (mean = 3.3 and mean = 3.5) for speed and special character selections respectively.

Table 4: ANOVA test for text entry factors satisfaction, based on hand-size

Text Entry Factors	F	p
Speed	3.339	0.039*
Learnability	0.872	0.421
Simplicity	0.596	0.553
Special Characters	15.657	0.001*
Navigation	15.149	0.001*

F: F statistic; p: p-value; *: significant at $p < 0.05$

In Table 4, hand-size was found to have significant effect with users' satisfaction towards speed, special characters selection and navigation. Tukey Post-Hoc analysis revealed that small hand-sized users are more satisfied with the speed of text entry than large hand-sized users (p = 0.03). They are also more satisfied with the special characters selection and navigation than medium (p = 0.04 and p = 0.001, respectively) and large hand-sized users ($p < 0.001$ for special characters selection and navigation).

Table 5: ANOVA test for text entry factors satisfaction, based on hand-size x gender

Text Entry Factors	F	p
Speed	2.796	0.021*
Learnability	1.245	0.294
Simplicity	0.991	0.427
Special Characters	11.491	<0.001*
Navigation	1.353	0.319

F: F statistic; p: p-value; *: significant at $p < 0.05$

Table 5 shows that the interaction effect of hand-size x gender was found to be significant for speed and special character selection factors.

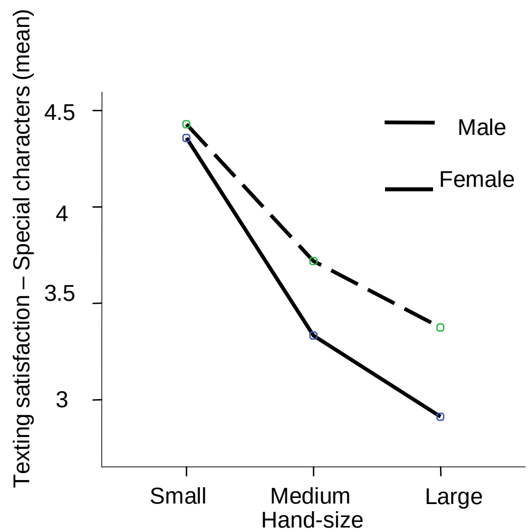

Figure 4: Interaction effect of hand-size and gender on special characters

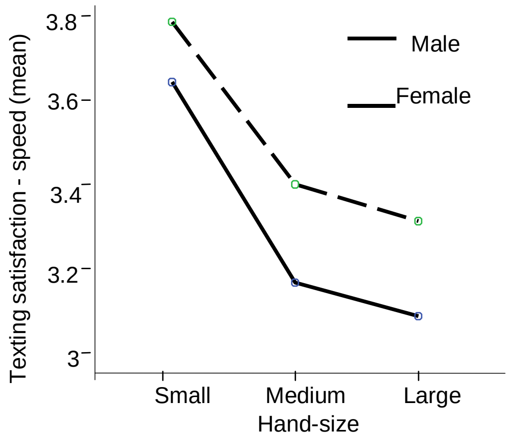

Figure 5: Interaction effect of hand-size and gender on speed

Fig. 4 shows a clear gender difference in subjects with medium and large hand-sized users, with the females being more satisfied with the special character selection than males. The difference is not very prominent for subjects with small hand-sizes. This result tallies with the speed of text entry satisfaction (see Fig. 5) too, as the females were found to be more satisfied than males regardless of their hand and thumb sizes. However, the differences are clear for all the hand-size categories.

Table 6: ANOVA test for overall text entry satisfaction

Variables	F	p
Gender	4.190	0.043*
Hand-size	3.518	0.033*
Hand-size x gender	2.513	0.034*

F: F statistic; p: p-value; *: significant at $p < 0.05$

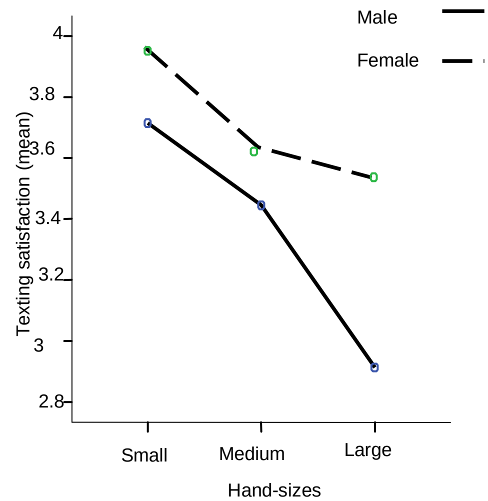

Figure 6: Interaction effect of hand-size x gender on the overall text entry factor satisfaction

Table 6 indicates that the effect of gender, hand-size and the interaction between hand-size x gender are significant for overall users' satisfaction for text entry factors. As expected, the females (mean = 3.7) were found to be more satisfied with the text entry factors compared to males (mean = 3.3). Tukey post-hoc analysis revealed that small hand-sized users are more satisfied than large hand-sized users (p = 0.032). As for the interaction effect, Fig. 6 indicates that differences exist between the genders in all the hand-size groups, with the females being more satisfied than males. However, the difference is more prominent between the females with large hand-size and males in the same group.

5 DISCUSSION

5.1 Gender differences

According to the p-values in Table 3, females were found to be more satisfied with the text entry speed and special character selections than males. The majority of the males (31/55) feel multitap can be time-consuming, especially when the need to compose messages fast arises. This is especially true for selection of special characters (symbols, punctuations etc.) as additional key presses are required. These may include repetitive presses on the same key or on different keys. This result is consistent with Balakrishnan and Yeow [20] who found that the males are less satisfied with the speed of text entry than females. However, the results are based on a very small sample of 18 subjects. Multitap technique is often criticized for being slow. An experiment using a mobile phone found that experts and novices reached about 8 words per minute (wpm) with multitap [8]. In 2003, the world's fastest mobile texter typed 29 wpm using multitap technique, which is more than six times slower than the Guinness record of 192 wpm for the desktop QWERTY keyboard [15]. Slow text entry mechanism has also been cited as one of the usability issues of mobile phones by Axup et al. [21]. Eight users who use both the text entry techniques interchangeably prefer to use multitap than predictive text entry as no unnecessary interruptions take place while messaging using the former mechanism. Predictive text entry can be frustrating and slow especially when the words being entered are not recognized by the mobile phone. This is especially true among the youngsters who frequently use abbreviations and dialects in their text. For example, it is a common practice to type "c u" instead of "see you". Moreover, it is also common for the subjects to text in a language other than English, like Malay or Chinese. Predictive text entry was found to expedite messaging, only when one really knows how to use it. Compared to multitap, predictive text entry was used by novices at 9.1 wpm and experts at 20.4 wpm. However, all these results were based on English-based text only [8]. Another study also identified text entry speed and predictive text entry mechanism as some of the factors affecting SMS users' satisfaction; however the results are based on 30 subjects only. Moreover, they did not take gender and hand-sizes into consideration [22]. Thirteen of the males mentioned that it is so much simpler to make a phone call instead of struggling with predictive text entry or multitap during an urgency period.

Statistics from Table 2 show that females have smaller hands and thumbs than males; hence this could be another reason for their higher level of satisfactions than the males for both speed and selection of special characters. Having smaller hands and thumbs enables them to make multiple key presses and to select special characters with less error and faster. Moreover, females tend to write longer and complex messages that include a lot of emoticons to express their feelings than the males; hence they are more familiar with the mapping of the keys to the appropriate characters and this result in them being more satisfied with the special character selections. Males on the contrary, prefer to write short and simple messages [23].

5.2 Hand-size differences

Smaller hand-sized subjects are more satisfied with the text entry speed, special character selections and navigation than larger hand-sized subjects (Table 4). These can be contributed to the keypad designs as well. Mobile phones with the standard 4 x 3 keypad layout have limited or no space at all in between the keypads. Moreover, the size of the keypads is tiny and this largely causes dissatisfaction to users with larger hands and thumbs. Large hand-sized users find it difficult to make multiple key presses fast and without any or lesser errors to enter both text and special characters. Situation becomes more difficult when there is a need to text in a hurry or while in motion (walking or talking to someone else). 46.3% (19/41) of the large hand-sized users also mentioned that navigation affects their satisfaction as some mobile phone software requires many key presses to navigate through the menus. For example, three Samsung SGHA800 users specifically mentioned that they need to make separate navigations to key in alphabets, numbers and symbols. Multiple navigations sometimes causes frustration and they minimize or do not use special characters at all ("(", "@" etc.). This statement was concurred by Motorola C261 users, who stated that texting can be cumbersome as it involves many key presses and navigations (e.g. five different key presses and one navigation key to reply an existing message in the inbox). Moreover, they also mentioned that it can be real tedious to locate an intended special character while texting. For example, it takes seven continuous key presses on key-1 to type a "," symbol, 12 key presses to type ":" and 16 key presses for "(". These are some of the common symbols used by mobile phone users to express their emotions, e.g. ":(" means sadness. However, having to make so many key presses hinders the users from including these types of emoticons. Moreover, it becomes real frustrating to users with larger hands and thumbs, as making repetitive key presses on the tiny key pads is not an easy task. Problems become worse when they accidentally make erroneous key presses as the whole cycle of pressing the key has to be repeated. Though different mobile phone brands use varying software, most of them still require users to make multiple key presses and navigations for special character selections. Mapping of the appropriate navigational keys to the desired object was also found to be cumbersome by a study conducted among middle-aged users, e.g. locating the key to access the 'ABC' (non-predictive) menu that allows a user to change from different character input types, i.e. from numerical to alphabetical is not a straight-forward and clear process. However, this finding is solely based on Samsung T400 model [16].

The problem of tiny mobile phones with tiny keypads further reduces the users' satisfaction towards text entry, in terms of both speed and accuracy, especially for large hand and thumb sized users. Only two large hand-sized subjects (2/41) use multitap and predictive text entry interchangeably. However, they stated that they only use the latter technique to send short and simple messages. They reasoned that cycling through the possible words can be frustrating as it also means additional key presses and navigations. Moreover, texting in a language other than English becomes almost impossible with predictive text entry. As for the rest of the subjects, using multitap seems to be the more feasible and preferred method compared to predictive text entry. Mobile phone users have to learn to use predictive text entry before being able to use it properly. This factor seems to hinder most of the subjects from adapting or switching to predictive text entry. As one subject stated (statement rephrased in standard English): "My phone has automatic text entry but I have never used it, as I don't know how to use it!!!". This is an interesting point to note as large hand and thumb sized mobile phone users seem to prefer the slow multitap than the supposedly faster predictive text entry. An experiment comparing multitap and predictive text entry found similar results, whereby a long training or learning time leads to frustrations among subjects even though predictive text entry is faster [24]. These experiments, however, did not take gender and hand-sizes into consideration.

5.3 Hand-size x gender differences

The interaction effect between hand-size x gender was found on text entry speed and special character selections (Table 5). Medium and large hand-sized females are more satisfied with the special character selections compared to males from the same hand-size categories (Fig. 4). They were also found to be more satisfied with the text entry speed than males, regardless of their hand-size (Fig. 5). Females have smaller hands and thumbs compared to the males (see Table 2) and this enables them to make multiple key presses at a faster speed. The majority of the males (44/55) commented that the current multitap mechanism requires too many key presses to be made in order to enter a single character, especially when the intended characters are placed on the same keypad. This problem is further aggravated when some software requires additional navigations for them to make a special character selection. This is due to key overloading whereby a single keypad supports more than one letter in most of the mobile phones today [8, 9, 11, 25]. The subjects also commented that perhaps a new mechanism is needed to make the multiple key presses faster as this seems to be a better solution than increasing the number of keypads. This was agreed by 66.3% (73/110) of the subjects who also stated that an improved text entry mechanism coupled with larger keypads would be the preferred solution, especially for the larger hand and thumb sized mobile phone users.

5.4 Overall text entry satisfaction

Finally results in Table 6 shows that gender, hand-size and the interaction effect of hand-size x gender significantly affect users' texting satisfaction. Interaction effect shows that females are more satisfied with the text entry factors than males, for all the different hand-size categories (Fig. 6). As results shown in Table 3, females were found to be more satisfied than males with regards to text entry speed and special characters selection. Generally it was also found that smaller hand-sized subjects are more satisfied than larger hand-sized subjects (Table 4). Females have smaller hands and thumbs than males, and this enables them to make repetitive key presses on the tiny keypads faster and with lesser errors. The tendency to accidentally press a neighbouring key due to having a large thumb is also reduced or eliminated altogether. On the other hand, the larger hand-sized males have to struggle pressing the keys, especially when the text entry software requires multiple key presses just to select a single letter or character. These factors cause dissatisfaction to these mobile phone users while texting.

6 CONCLUSION

The results from structured questionnaire interviews with 110 Malaysian youth on mobile phone text entry satisfaction, based on hand-size variations and gender were presented. Hand-size measurements which include hand breadth, length, thumb length and circumference were measured for this purpose. Focus of this study was mainly on text entry factors: speed, learnability, simplicity, special character and navigation. Females were found to be more satisfied with the speed and special character selections of text entry mechanism (multitap or predictive text entry) than males. Smaller hand-sized subjects are more satisfied with the text entry speed, special character selections and navigation than subjects with medium and large hands and thumbs. Significant interactions between hand-size x gender were observed for speed and special character selections as well, with the females being more satisfied than males, for all hand-size categories. However, the difference is not prominent between the genders with small hand-size for special character selections. Finally, it was found that males are less satisfied with texting than females, regardless of their hand-sizes. This study revealed that hand-size variations and gender do influence texting satisfaction among mobile phone users. Two major factors that were found to significantly affect their satisfaction are speed and special character selections. These factors were prominent among subjects with larger hand and thumb sizes as it becomes cumbersome to repetitively make key presses in order to text or to select special characters (" : ", " @ " etc.). Subjects also stated their preference to use multitap instead of predictive text entry as the latter involves cycling through possible words to make selections, causing them to be frustrated. An enhanced text entry mechanism, coupled with larger keypads is seen as the preferred solution, especially among the larger hand and thumb-sized users. Mobile phone designers should look into incorporating other possibilities of text entry mechanisms that caters to specific targets, for example users with larger hands and thumbs.

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