A Survey on Mobile Text Entry Handedness

How do users input text on handheld devices while nomadic?

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***Abstract*—This paper presents results of a survey that explored users' typing handedness in various mobile settings, such as while walking, while commuting, and while driving. Results show that a substantial number of users input text on their handheld devices while walking (48%) and while commuting (90%). About half of these users use both hands, while the rest half use either their dominant or non-dominant hand to type. Single-hand text entry users usually use their dominant hand to type. Most mobile text entry users continue inputting text in situations where they have only one hand available to type. In such situations, however, the number of users who prefer using their non-dominant hand increases significantly. About half of the users who drive (58%), frequently input text while driving. In this case, however, most users (92%) prefer using their dominant hand to input text.**

***Index Terms*—nomadic, mobile, text entry, handheld devices, handedness, mobile phones, survey.**

I. Introduction

Handheld devices have become an integral part of our everyday life and text input has become ubiquitous. Nowadays, we input text not only on stationary devices but also on handheld devices when we are in motion such as walking, commuting, or driving. Text entry while nomadic is generally slower compared to stationary [3, 9, 14]. Therefore, many new and modified versions of the existing techniques have been proposed and evaluated for nomadic text entry [1, 4, 14, 18].

Usually nomadic text entry techniques are evaluated in either of the two most common stationary positions – using both or the dominant hand. This is mainly because currently no data is available on how users type on mobile devices while on the move. It is also not clear whether they prefer using their dominant or non-dominant hand to input text while performing dual task. A better understanding of users' mobile text entry handedness is vital for the development and evaluation of these techniques as not only that dual-hand typing is significantly faster than single-hand [12] but also tapping with the dominant hand outperforms the non-dominant hand [17].

In an attempt to answer these questions, here, we present results of a survey that investigated users' mobile text entry handedness in various mobile settings, such as while walking, while commuting by buses, underground trains, etc., and while driving an automobile. We believe that the results of this survey will provide researchers and practitioners with a better understanding of how users input text while on the move. We believe that this will not only assist them with designing more efficient nomadic text entry techniques but also aid them to evaluate such techniques in more realistic mobile text entry settings.

II. Related Work

A. Mobile Interaction

Lin *et al.* [10] conducted a Fitts' law study of stylus tapping while walking that showed that tapping performance decreases for smaller targets. A subsequent study [9] confirmed that the subjective workload and overall task completion time of stylus tapping tasks increase while walking. Based on their findings they recommended designers to use substantially larger buttons for interfaces that are to be used in mobile settings compared to their immobile counterparts.

Mizobuchi *et al.* [14] investigated the possibility of using walking speed during mobile text entry as a secondary task measure for mental workload. For this, they studied nomadic text entry performance with different sized user interfaces on a Personal Digital Assistant (PDA) with a stylus. Results showed that performance decreased while walking and also with smaller user interfaces.

Mustonen *et al.* [15] examined the legibility of real text and random text on mobile devices while walking. Results showed that in both cases performance suffered from faster walking speeds. Barnard *et al.* [1] conducted a similar study where participants performed reading comprehension and text search tasks while in seated position and while walking on a treadmill. Interestingly, their results did not indicate any significant difference between the seated and the treadmill conditions in terms of task completion time. We speculate that this may be due to the fixed ambient environment on the treadmill.

MacKay *et al.* [11] compared different software navigation techniques on a PDA with a stylus while stationary and while nomadic. Results showed that users were significantly slower with all techniques while walking compared to while seated or while standing. Yatani and Truong [19] designed a two-handed virtual chorded keyboard for PDA that uses both a stylus and the thumb of the non-dominant hand to input text. They compared their new technique with the existing ones in both stationary and mobile settings. Results showed that mobility impacts text entry performance not only in terms of entry speed but also in accuracy and mental workload.

In a recent study Arif *et al.* [1] showed that providing users with real-time ambient information on their mobile devices not only improves the overall text entry performance but also reduces the possibility of collisions while walking and typing.

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B. Handedness in Mobile Interaction

Inkpen *et al.* [6] conducted a number of user studies to explore left-handed user interaction with right-aligned and left-aligned scrollbars on a mobile device. Results showed that left-handed users are able to select targets significantly faster using left-aligned scrollbars compared to right-aligned. Based on the results they concluded that mobile handedness is an important design consideration that could not be overlooked.

Similarly, Perry and Hourcade [16] investigated whether it is vital to evaluate interactions with the preferred and the non-preferred hand. Results showed that users who used their preferred-hand outperformed the ones who did not. Based on that they concluded, it is essential to assess mobile interactions with both preferred and non-preferred hand.

Kabbash *et al.* [7], on the other hand, conducted a study to compare users' performance in pointing and dragging tasks using the preferred and non-preferred hand. They tested three different input devices: mouse, trackball, and stylus. Results showed that the preferred hand performs better for small distances and small-sized targets. However, the non-preferred hand performs reasonably well for larger targets and larger distances.

Silfverberg *et al.* [18] conducted a user study to measure text entry speeds on mobile devices. During the study users were asked to hold the device with one hand and then use their thumbs to input text. Two out of the twelve participants chose to use their non-preferred hand to type. This indicates towards the possibility that some users prefer using their non-dominant hand while interacting with a mobile device.

Karlson *et al.* [8] conducted a field study to investigate how users operate their mobile devices. Results showed that device-type influences users' interaction behaviour. Users of keypad-based devices use one-hand almost exclusively, where smartphone users favour using both hands, especially for text entry.

III. A Survey

A. Sampling Method and Participants

A voluntary sampling method was used for data collection. Requests to participate in an online survey were distributed via various e-mailing lists, online forums, community websites, etc. Participants then could voluntarily select themselves into the survey. However, the survey system screened them for the following factors:

1) *Age:* They are adults, that is, at least 18 years old.

2) *Devices:* They own at least one handheld device.

3) *Proficiency in the English Language:* They are fluent in the English language. To ensure this, volunteers who were not native speakers or did not spent at least five years in an English-speaking environment were eliminated from the survey.

We only considered users who are fluent in the English language as the survey mainly focused on English text entry behaviours. It is unlikely for users to input text in English when they are not fluent in the language. Instead, it is more probable that they input text in the language they are more comfortable with. As many non-English text entry techniques, such as a number of Asian gesture-based techniques, require the use of both hands to input text, permitting all users to participate in the survey could have contaminated the data by a confounding factor. We believe screening users for their fluency in the English language eliminated this possibility.

We also assured that they use English as the primary language on their mobile devices. In other words, we excluded users who do not use English as their primary interface language. This is also due to the assumption that it is rather unlikely for those users to input text in English on a regular basis.

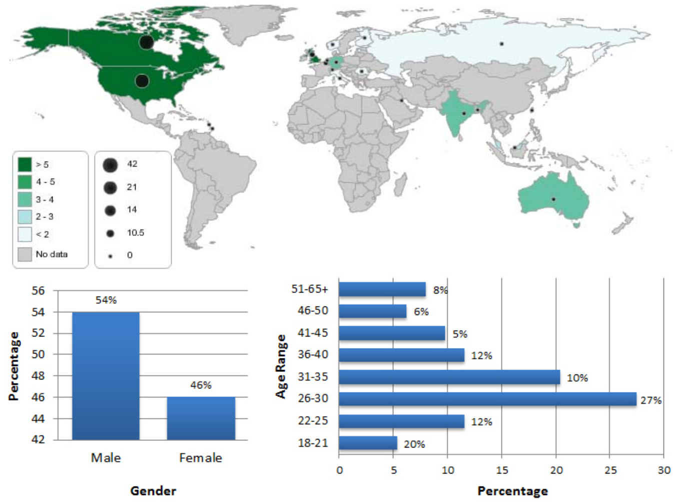

Fig. 1. Demographics of the sample population.

Our strict screening process filtered out a large number of volunteers. Finally, in total 113 volunteers from 20 countries (from 4 continents) participated in the survey. 17.3% of them were 18-25 years, 46.4% were 26-35 years, 21.8% were 36-45 years, and 14.5% were over 45 years old. Fig. 1 illustrates the sample demographics.

46% of our participants were female and 71% of them were touch-typists. Based on their responses, on average, they use their handheld devices for 3 hours a day. They also frequently send text messages, emails, and/or updated status messages on various community sites using their mobile devices, on average 26 a day. 90% of the users were right-handed, 7% were left-handed, and 3% were ambidextrous.

Though, theoretically, voluntary sampling cannot guarantee a representative sample, the diversity in our sample population suggest that the survey data do not suffer from a substantial selection bias.

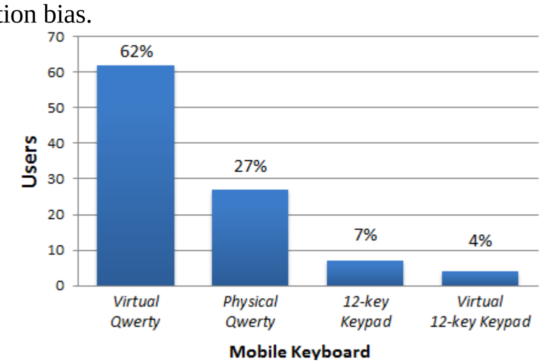

Fig. 2. Percentage in which the four mobile keyboards are used by our participants.

IV. DEVICES AND MOBILE KEYBOARDS

89% of our participants owned a smartphone. This indicates towards the fact that smartphones are becoming more popular over time. 89% users responded that they use either a *physical* or a *virtual* Qwerty keyboard on their mobile devices. The rest use either a *physical* or a *virtual* 12-key mobile keypad. Fig. 2 illustrates the percentage in which these keyboards are used.

V. RESULTS – MOBILE TEXT ENTRY HANDEDNESS

The survey data were non-parametric. Therefore, we used a Kruskal-Wallis One-Way ANOVA for all analysis. Also, we excluded the 3% ambidextrous users, as it was not possible for us to determine their most preferred hand from the data.

A. Text Entry while Walking

The survey results showed that 48% users frequently input text on their mobile devices while walking. 50.9% of them were male and 49.1% were female. An ANOVA on the data did not identify a significant effect of *gender* on this choice ($H_1 = 0.65$, ns). However, there was a significant effect of *age* ($H_3 = 6.44$, $p < .0005$). A Tukey-Kramer test revealed that the 18-25 age group was significantly different from the other age groups. Evidently, 18-25 years old younger users are more into inputting text while walking than comparatively older users. TABLE I and TABLE II present the percentage of users who frequently input text while walking by gender and age group, respectively. There, the numbers inside the brackets denote the percentage of users relative to the entire population.

TABLE I. TEXT ENTRY WHILE WALKING, BY GENDER

Gender	Walk and Type 100% (48.0%)
Male	50.9%
Female	49.1%

TABLE II. TEXT ENTRY WHILE WALKING, BY AGE GROUP

Age Group	Walk and Type 100% (48.0%)
18–25	84.2%
26–35	51.0%
36–45	29.2%
45+	25.0%

1) Mobile Handedness

Most users (54.7%) responded that they prefer using both hands to input text while walking and typing. 36.0% said that they prefer using their dominant hand, while the rest 9.3% said that they prefer using their non-dominant hand to input text. An ANOVA did not find a significant effect of *handedness* on users' preferred mobile handedness ($H_1 = 0.03$, ns). Expressly, both right- and left-handed users prefer using either their both hands or the dominant hand to input text while walking. There was also no significant effect of *gender* ($H_1 = 1.79$, $p > .05$) or *age* ($H_3 = 0.88$, ns).

2) Hand Availability

88.7% users who input text while walking responded that they continue inputting text when they find themselves in situations where they have to carry something, i.e. a coffee cup, shopping bags, etc., with one hand and use the other hand to type. 49% of these users were male and 51% were female. An ANOVA on the data did not identify a significant effect of *gender* ($H_1 = 1.03$, $p > .05$) on this choice. However, there was a significant effect of *age* ($H_1 = 8.80$, $p < .00005$). A Tukey-Kramer test revealed that the 18-25 age group was significantly different from the other age groups. Apparently, 18-25 years old younger users are more open towards inputting text with one hand, when the other hand is occupied, than comparatively older users.

TABLE III. TEXT ENTRY HANDEDNESS, WHILE WALKING

While Walking (48.0%)	Hand Availability	
Typing Handedness	***Both Hands* 100% (48.0%)**	***One Hand* 88.7% (42.7%)**
Both hands	54.7%	×
Dominant hand	36.0%	78.7%
Non-dominant hand	9.3%	21.3%

TABLE IV. TEXT ENTRY HANDEDNESS BY GENDER, WHILE WALKING

While Walking (48.0%)	Hand Availability				
Gender	***Both Hands* 100% (48.0%)**			***One Hand* 88.7% (42.7%)**	
	Both Hands	***Dominant***	***Non-dominant***	***Dominant***	***Non-dominant***
Male	*22.6%*	*22.6%*	*5.7%*	*31.9%*	*17.0%*
Female	*32.1%*	*13.2%*	*3.8%*	*46.8%*	*4.3%*

TABLE V. TEXT ENTRY HANDEDNESS BY AGE GROUP, WHILE WALKING

While Walking (48.0%)	Hand Availability				
Age Groups	***Both Hands* 100% (48.0%)**			***One Hand* 88.7% (42.7%)**	
	Both Hands	***Dominant***	***Non-dominant***	***Dominant***	***Non-dominant***
18–25	*20.8%*	*1.9%*	*7.5%*	*27.7%*	*6.4%*
26–35	*28.3%*	*7.5%*	*13.2%*	*34.0%*	*14.9%*
36–45	*1.9%*	*0%*	*11.3%*	*10.6%*	*0%*
45+	*3.8%*	*0%*	*3.8%*	*6.4%*	*0%*

78.7% users reported that they prefer using their dominant hand to input text in such situations. The rest 21.3% said that they prefer using their non-dominant hand. An ANOVA on the data did not identify a significant effect of *handedness* on users' preferred hand for text entry ($H_1 = 0.03$, ns). This means, both right- and left-handed users prefer using their dominant hand to input text. However, a Chi-squared test revealed that in such situations the percentage of users (21.3%) who prefer using their non-dominant hand increases significantly ($X^2_{(1)} = 16.23$, $p < .0001$). A significant effect of *gender* ($H_1 = 5.24$, $p < .05$) was also found. 65% male and 92% female users responded that they prefer using their dominant hand to input text. This indicates towards the fact that in such situations female users feel more comfortable using their dominant hand than male users. An ANOVA on the data failed to identify a significant effect of *age* ($H_3 = 1.11$, $p > .05$). TABLE III presents the percentage of users who input text while walking. TABLE IV and TABLE V categorize the data by gender and age group, correspondingly. There, the numbers inside the brackets denote the percentage of users relative to the entire population.

B. Text Entry while Commuting

Results showed that 90% mobile users frequently input text on their mobile devices while commuting. 51.5% of them were male and 48.5% were female. An ANOVA on the data did not identify a significant effect of *gender* (H_1 = 2.37, $p > .05$) or *age* (H_3 = 1.88, $p > .05$) on this choice. This means, users' decision of inputting text while commuting is not influenced by their gender or age in a significant manner. TABLE VI and TABLE VII present the percentage of users who input text while commuting by gender and age group, respectively. There, the numbers inside the brackets denote the percentage of users relative to the entire population.

TABLE VI. TEXT ENTRY WHILE COMMUTING, BY GENDER

Gender	**Commute and Type 100% (90.0%)**
Male	51.5%
Female	48.5%

TABLE VII. TEXT ENTRY WHILE COMMUTING, BY AGE GROUP

Age Group	**Commute and Type 100% (90.0%)**
18–25	18.2%
26–35	45.5%
36–45	22.2%
45+	14.1%

1) Mobile Handedness

Based on the survey data 53.5% users use their both hands and 46.5% use their dominant hand to input text on their mobile devices while commuting. Interestingly, none of them use their non-dominant hand. An ANOVA did not identify a significant effect of *handedness* on users' preferred mobile handedness (H_1 = 0.96, ns). This means, both right- and left-handed users prefer using either their both hands or the dominant hand to input text while commuting. There was also no significant effect of *gender* (H_1 = 0.85, ns) or *age* (H_3 = 1.13, $p > .05$).

2) Hand Availability

85.8% users who input text while commuting reported that they continue typing when they find themselves in situations where they have to use one hand to carry something, i.e. a coffee cup, shopping bags, etc., or to clutch on to something to maintain balance, i.e. a strap in a bus, a handrail, etc. 50.5% of them were male, 49.5% were female. An ANOVA did not identify a significant effect of *gender* (H_1 = 2.37, $p > .05$) or *age* (H_3 =1.88, $p > .05$) on this choice. Hence, it can be said that, most users prefer to continue inputting text in such situations regardless of their gender or age.

85.9% users replied that they prefer using their dominant hand to input text in such situations. The rest 14.1% prefer using their non-dominant hand. An ANOVA on the data did not find a significant effect of *handedness* on their preferred hand for inputting text (H_1 = 0.00, ns). This means, both right- and left-handed users prefer using their dominant hand to input text. However, in such situations, users' preference in using the non-dominant hand elevated from 0% to 14.1%. A Chi-squared test found this to be significant ($X^2_{(1)}$ = 170.71, $p < .0001$). An ANOVA identified a significant effect of *gender* (H_1 = 6.30, $p < .05$) as well. 76.7% male and 95.0% female users replied that they prefer using their dominant hand to input text in such situations, which is comparable to the trend observed in walk-and-type users. No significant effect of *age* was identified (H_3 = 1.56, $p > .05$). TABLE VIII presents the percentage of users who input text while commuting. TABLE IX and TABLE X categorize the data by gender and age group, correspondingly. There, the numbers inside the brackets denote the percentage of users relative to the entire population.

TABLE VIII. TEXT ENTRY HANDEDNESS, WHILE COMMUTING

While Commuting (90.0%)	**Hand Availability**	
Typing Handedness	***Both Hands* 100% (90.0%)**	***One Hand* 85.8% (77.3%)**
Both hands	53.5%	×
Dominant hand	46.5%	85.9%
Non-dominant hand	0%	14.1%

TABLE IX. TEXT ENTRY HANDEDNESS BY GENDER, WHILE COMMUTING

While Commuting (90.0%)	**Hand Availability**				
Gender	***Both Hands* 100% (90.0%)**			***One Hand* 85.8% (77.3%)**	
	Both Hands	***Dominant***	***Non-dominant***	***Dominant***	***Non-dominant***
Male	*25.3%*	*26.3%*	*0%*	*38.8%*	*11.8%*
Female	*28.3%*	*20.1%*	*0%*	*47.1%*	*2.3%*

TABLE X. TEXT ENTRY HANDEDNESS BY AGE GROUP, WHILE COMMUTING

While Commuting (90.0%)	**Hand Availability**				
Age Groups	***Both Hands* 100% (90.0%)**			***One Hand* 85.8% (77.3%)**	
	Both Hands	***Dominant***	***Non-dominant***	***Dominant***	***Non-dominant***
18–25	*11.1%*	*7.1%*	*0%*	*15.3%*	*5.9%*
26–35	*26.3%*	*19.2%*	*0%*	*38.8%*	*5.9%*
36–45	*8.1%*	*14.1%*	*0%*	*20.0%*	*2.3%*
45+	*8.1%*	*6.0%*	*0%*	*11.8%*	*0%*

C. Text Entry while Driving

75% users responded that they either own or have access to an automobile that they drive regularly. 54.2% of them were male and 45.8% were female. Interestingly, 57.8% of these users, 54% male and 46% female, admitted that they frequently input text on their mobile devices while driving. An ANOVA did not find a significant effect of *gender* (H_1 = 0.62, ns) or *age* (H_3 = 2.29, $p = .08$) on this choice. Hence, this can be said that the decision of inputting text while driving is not influenced by users' gender or age in a significant manner. TABLE XI and

TABLE XII display the percentage of users who input text while driving by gender and age group, respectively. There, the numbers inside the brackets denote the percentage of users relative to the entire population.

1) Mobile Handedness

Results showed that most users (91.7%) use their dominant hand to input text while driving. The rest 8.3% use their non-dominant hand. An ANOVA did not find a significant effect of *handedness* on users' preferred hand for typing ($H_1 = 0.28$, $p = .08$). This means, both right- and left-handed users prefer using their dominant hand to input text while driving. There was also no significant effect of *gender* ($H_1 = 0.74$, ns) or *age* ($H_3 = 0.67$, ns).

TABLE XI. TEXT ENTRY WHILE DRIVING, BY GENDER

Gender	Drive and Type 100% (57.8%)
Male	54.2%
Female	45.8%

TABLE XII. TEXT ENTRY WHILE DRIVING, BY AGE GROUP

Age Group	Drive and Type 100% (57.8%)
18–25	18.2%
26–35	45.5%
36–45	22.2%
45+	14.1%

Interestingly, the percentage of users who prefer using their dominant hand to input text is much higher while driving (91.7%) than while walking (78.7%) and while commuting (85.9%). A Chi-squared test found the first to be extremely significant ($X^2_{(1)} = 10.19$, $p < .005$). However, no significance was found for the latter ($X^2_{(1)} = 2.99$, $p = .08$). TABLE XIII presents the percentage of users who input text while commuting. TABLE XIV and TABLE XV categorize the data by gender and age group, correspondingly. There, the numbers inside the brackets denote the percentage of users relative to the entire population.

VI. DISCUSSION

There was no significant effect of *gender* on the choice of inputting text while walking, commuting, or driving. There was also no significant effect of *age* on the choice of inputting text while commuting or driving. However, a significant effect was found while walking. Results showed that 18-25 years old younger users are more into inputting text while walking than comparatively older users. Also, more users prefer using their devices to input text while commuting than while walking. This may be because the latter requires frequent attention swap between tasks, such as typing, navigating throw the crowd, etc., which often compromises user comfort [1, 3].

No significant effect of *handedness* was found on mobile text entry handedness. That is, both right- and left-handed users prefer using either their both hands or the dominant hand to input text while nomadic. This highlights the importance of considering both positions while evaluating a nomadic text entry technique. It is clear that users who input text on the go are a special group with special needs. Hence, it is imperative that those needs are addressed, for such text entry technique to be acceptable.

The survey results showed that almost all users frequently find themselves in situations where they have to use one hand to hold or carry something. While a small number of users responded that they do not input text in such situations, most of them responded that they do. No significant effect of *gender* was found on this choice. Nevertheless, results showed that 18-25 years old younger users are more into inputting text while walking and holding something than comparatively older users. We did not find a significant effect of *handedness* on users' preferred hand for text input. That is, both right- and left-handed users prefer using their dominant hand to input text. However, in such situations, the number of users who prefer using their non-dominant hand increases significantly. Results also showed that female users prefer using their dominant hand *more* than male users.

TABLE XIII. TEXT ENTRY HANDEDNESS, WHILE DRIVING

While Driving (57.8%)	One Hand Available 100% (57.8%)
Typing Handedness	***One Hand***
Both hands	×
Dominant hand	91.7%
Non-dominant hand	8.3%

TABLE XIV. TEXT ENTRY HANDEDNESS BY GENDER, WHILE DRIVING

While Driving (57.8%)	One Hand Available 100% (57.8%)	
Gender	***Dominant***	***Non-dominant***
Male	*47.9%*	*6.2%*
Female	*43.8%*	*2.1%*

TABLE XV. TEXT ENTRY HANDEDNESS BY AGE GROUP, WHILE DRIVING

While Driving (57.8%)	One Hand Available 100% (57.8%)	
Age Groups	***Dominant***	***Non-dominant***
18–25	*18.7%*	*4.2%*
26–35	*37.5%*	*2.1%*
36–45	*25%*	*2.1%*
45+	*10.4%*	*0%*

Roughly 58% users who drive responded that they often input text on their mobile devices while driving. No significant effect of *gender* or *age* was found on this choice. There was also no significant effect of *handedness*, *gender*, or *age* on their preferred hand for typing while driving. However, unlike while walking or while commuting, most users prefer using their dominant hand for typing.

We found the number of users who admitted to input text while driving (58%) quite surprising as almost all of them (95.6%) participated from countries where using a phone while driving is illegal, see Fig. 1. This is an indication of how devoted users are nowadays to inputting text on their mobile devices. This also uplifts the necessity of developing text entry techniques that are safe to use while driving.

VII. CONCLUSION

This paper presented results of a survey that explored users typing handedness in various mobile settings. Results showed that a substantial number of users input text on their mobile devices while walking, commuting, or driving. No significant effect of *gender* was found on this choice. However, 18-25 years old younger users are more into inputting text on the go than comparatively older users. Both right- and left-handed users prefer using either their both hands or the dominant hand to input text while nomadic. There was no significant effect of *gender* or *age* on mobile handedness.

Evidently, most users continue inputting text in situations where they have only one hand available to type. No significant effect of *gender* was found on this choice. However, 18-25 years old younger users are more into one-handed text input while walking than comparatively older users. Interestingly, in such situations the number of users who prefer using their non-dominant hand increases significantly. Results also showed that female users prefer using their dominant hand *more* than male users.

About half of the users who drive, frequently input text while driving. No significant effect of *gender* or *age* was found on this choice. Both right- and left-handed users prefer using their dominant hand to input text while driving.

VIII. FUTURE WORK

In future, we plan on conducting a field-study to further verify the findings of this survey. We would also like to evaluate the existing nomadic text entry techniques in more realistic settings to provide an overview of how efficient those techniques are in real-life scenarios. Finally, as the results of this survey established that users change typing handedness based on their surroundings, hand availability, etc., we would attempt to develop a text entry technique that accounts for this.

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