Punctuation on Touchscreen Keyboards

Analyzing Use and Evaluating Input Techniques

PROBLEM

A substantial amount of research has focused on touchscreen text input, but non-alphanumeric symbols are rarely considered.

APPROACH

1. Evaluate the frequency of punctuation symbols in two contrasting corpora: Twitter data and the Google n-gram corpus.
2. Conduct controlled lab experiment that compares two existing techniques for entering punctuation symbols on touchscreens.

SYMBOL FREQUENCY ANALYSIS

Corpora	Google N-Gram	Twitter Mobile	Twitter Desktop
Size	472,764,897 words	173,876 tweets	57,622 tweets
Characters	1.5 billion	8,669,649	3,165,357
Punctuation	4.5%	7.5%	7.6%

Letter	Twitter Mobile	Twitter Desktop	Google N-gram
e	9.34	9.52	11.58
a	9.15	9.25	7.52
o	7.09	7.36	7.07
t	7.04	6.82	8.57
i	6.52	6.44	7.08
n	6.15	6.02	6.74
s	5.19	5.26	6.15
h	4.60	4.51	4.71
l	4.38	4.35	3.82
r	4.24	4.37	5.86
m	3.18	3.15	2.38
d	3.12	3.14	3.55
u	3.10	3.17	2.55
y	2.74	2.64	1.55
g	2.60	2.41	1.75
c	2.02	2.09	3.13
k	2.00	2.00	0.52
w	1.95	1.86	1.55
b	1.85	1.75	1.40
p	1.64	1.72	2.00
f	1.42	1.48	2.23
v	0.80	0.87	0.99
j	0.57	0.54	0.16
z	0.27	0.28	0.09
x	0.27	0.29	0.22
q	0.09	0.15	0.11

Sym-bol	Twitter Mobile	Twitter Desktop	Google N-gram
.	1.694	1.748	1.151
@	1.221	1.258	0.000
!	0.940	0.813	0.013
'	0.550	0.446	0.200
_	0.527	0.499	0.001
,	0.401	0.532	0.000
:	0.381	0.344	0.087
#	0.377	0.350	0.000
?	0.338	0.362	0.032
"	0.205	0.110	2.284
-	0.185	0.193	0.217
)	0.181	0.228	0.140
<	0.095	0.100	0.001
>	0.094	0.106	0.002
(	0.089	0.087	0.140
*	0.075	0.072	0.008
&	0.055	0.044	0.005
;	0.048	0.051	0.096
/	0.042	0.046	0.019
^	0.017	0.023	0.003
=	0.016	0.025	0.002
~	0.013	0.020	0.001
$	0.010	0.012	0.005
|	0.007	0.007	0.001
\	0.005	0.003	0.001
+	0.005	0.006	0.001
%	0.004	0.004	0.006
]	0.002	0.005	0.010
{	0.002	0.001	0.000
}	0.002	0.001	0.000
[	0.002	0.003	0.010
`	0.001	0.002	<.001

Highly Frequent Symbols

Punctuation more common in the Twitter data than the Google corpus, particularly for mobile devices.

Punctuation more frequent than the least frequent letter (Q):

Google N-Gram

. – ‘ ( ) ;

Twitter (Mobile)

. @ ! ‘ _ , : # ? “ -) < >

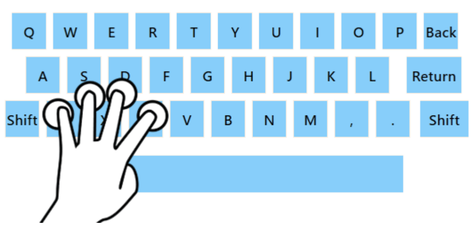
Twitter (Desktop)

. @ ! , _ ‘ ? # :) -

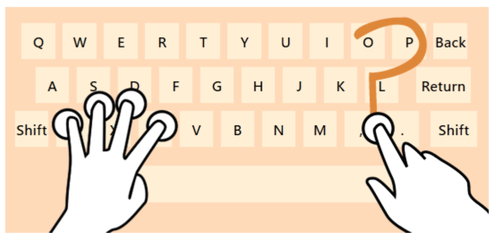
EVALUATING METHODS of PUNCTUATION INPUT

Interfaces

Gesture Keyboard

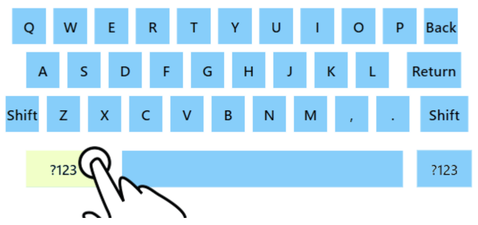


1. Place four fingers on the keyboard to enter gesture mode.

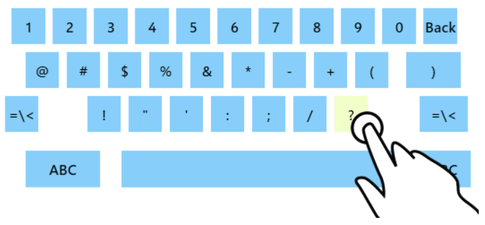


2. Draw the punctuation symbol.

Moded Keyboard



1. Tap the “?123” key to switch to the punctuation layer.



2. Tap the punctuation symbol.

Method

- Controlled lab experiment with 10 participants.
- 2x2 factorial design: *Keyboard* (gesture vs. moded) and *Task* (phrases vs. randomly generated words).
- 40 trials per condition.

Results (Phrase Task)

Metric	Gesture	Moded
Words per Minute	22.9	23.9
Uncorrected Error	0.37%	0.84%
Corrected Error	10.5%	9.1%
Mental Demand	12.1	12.1
Physical Demand	11.6	11.9
Temporal Demand	9.7	11.1
Performance	6.1	6.3
Effort	9.9	11.5
Frustration	8.2	9.9

Punctuation Mode Switching Costs

- Punctuation to letter: faster for gesture keyboard (letters always visible; less visual search).
- Punctuation to space: faster for moded keyboard (spacebar always visible).
- Punctuation to letter: poor performance on gesture keyboard (cognitive cost in going from drawing to tapping).

CONCLUSION

- Our findings motivate future work on punctuation input for touchscreen keyboards due to: (1) high frequency of punctuation use in one case of mobile text input and (2) the cost of switching between punctuation mark input and letters/spaces.
- Preliminary feedback suggests that users would appreciate having both options available in one keyboard.

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