From Keystrokes to Cognition: A Narrative Review of Touch Typing and Human Cognition

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Abstract

Touch typing, the ability to type without visually referencing the keyboard, has been extensively studied in the digital age. While it was initially met with skepticism, the ubiquity of word processing software and ergonomic keyboard designs has bolstered its widespread adoption. However, surprisingly, studies have shown that skilled typists can execute precise keystrokes at remarkable speeds without explicit knowledge of the keyboard layout, suggesting a heavy reliance on implicit memory processes. This raises vital questions about the nature of skill acquisition and the interplay between implicit and explicit cognitive processes. Here we show that touch typing exemplifies the intelligence and adaptability of implicit memory, challenging traditional views of its simplicity and inflexibility. This narrative review reveals that implicit memory facilitates the seamless integration of complex motor skills and linguistic processing, enabling typists to navigate different keyboard layouts with ease. We suggest that there is a fluid interaction between implicit and explicit memory systems, with implicit processes playing a much larger and important role in sophisticated cognitive tasks than previously assumed. Therefore, humans' implicit memory may be highly complex and intelligent, capable of autonomously executing complex tasks that would typically require conscious involvement. In other words, this raises a vital question: can our body "think" for itself? Future research must unravel the cognitive dimensions of touch typing, as we may gain fundamental and groundbreaking insights into the nature of human learning, memory, and the acquisition of expertise, with far-reaching implications for education, rehabilitation, and, most importantly, our understanding of cognition.

Keywords: implicit memory, touch typing, cognition, explicit knowledge, QWERTY keyboard layout, Chinese 9-key keyboard layout

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Introduction

The digital age has marked a paradigm shift in human-computer interaction. Despite the

emergence of various novel input methods, from gesture recognition to voice-based commands,

typing remains the predominant mode of digital communication. As highlighted by John (1996),

it has retained its primacy even amidst rapidly evolving technological landscapes. The

importance of typing proficiency is further underscored by its indispensable role in both personal

and professional realms, where a deficiency in this skill can significantly limit opportunities

(Sutherland, n.d.). Moreover, the ubiquity of devices like computers and smartphones, all

integrated with keyboards, emphasizes the continued centrality of typing in human-computer

dialogue.

Within this context, touch typing—the art of typing without visual aid from the

keyboard—emerges as a vital proficiency. While it may appear rudimentary at first glance, touch

typing is quintessential for optimal cognitive performance in the 21st century (Partnership for

21st Century Schools, n.d.). Studies have accentuated the cognitive load imposed by visually

guided typing, which necessitates continual gaze shifting between the source text and the

keyboard, severely impeding efficiency (Yechiam, 2003). In contrast, touch typing relies on

implicit knowledge of key locations and proprioceptive feedback, facilitating concurrent reading

and typing. This distinction is particularly evident in educational settings.

Christensen's (2004) pivotal study elucidated a direct correlation between touch typing

fluency and the quality of written output. The advantages of touch typing stem from its ability to

free cognitive resources, allowing writers to focus their attention wholly on the task of

composition. This aligns with the principles of Cognitive Load Theory, which proposes that the human cognitive system can attend to a limited set of tasks concurrently (Paas & Ayres, 2014). As postulated by Berninger et al. (2002), the balance between transcription and executive functions in the writing process is critically contingent on the writer's proficiency in the former, which is imperative for optimal allocation of working memory.

The rising ubiquity of digital devices in educational institutions further amplifies the urgency to inculcate touch typing skills. Word processing has surged as a primary use of computers across academic curricula (Becker, 2000; Goldberg et al., 2003), suggesting an escalating reliance on keyboards for textual input. The potential benefits of touch typing in this context are immense, particularly given the speed and efficiency it offers compared to traditional handwriting. However, the systematic integration of touch typing instruction within educational curricula remains sporadic.

Despite the universally acknowledged importance of developing adept typists, a significant gap persists in our understanding of the underlying cognitive mechanisms. While implicit memory elucidates the *how* of touch typing, it does not necessarily unravel the *why*—the underlying cognitive mechanisms facilitating this transition remain a rich avenue for exploration. This narrative review aims to bridge this gap by offering an in-depth exploration of the cognitive dimensions of touch typing and its implications for education and beyond. By synthesizing and critically evaluating current research on this topic, we seek to identify key themes, debates, and gaps in the literature, contributing to a more comprehensive understanding of touch typing as a sophisticated cognitive competency.

As we stand at the forefront of the digital revolution, it is imperative to re-evaluate and understand the nuances of touch typing, not merely as a mechanical skill but as a highly

complicated and sophistcated cognitive process that warrants much more scholarly exploration. This review serves as a stepping stone towards unraveling the intricacies of touch typing and its role in potentially revealing the nature of human implicit memory and cognition .

Implicit Memory and the Art of Touch Typing

The realm of skilled performance is enveloped in a profound paradox. While experts invest years honing their skills, drawing upon a vast reservoir of knowledge to facilitate their adeptness, they often possess limited explicit access to this knowledge. This dichotomy is particularly evident in the domain of typewriting. As highlighted by Logan & Crump (2009), seasoned typists exhibit a surprising lack of explicit cognizance regarding the intricate movements of their fingers. This enigma has given rise to the conceptual distinction between procedural (implicit) knowledge, which directly underpins skilled performance, and declarative (explicit) knowledge, which remains tangential to the performance process (Anderson, 1982; Beilock & Carr, 2001; Cohen & Squire, 1980).

Typewriting offers a compelling paradigm for exploring this dichotomy. Logan and Crump (2009) proposed a hierarchical control system as a robust framework to reconcile the paradox. This model comprises two nested feedback loops: an inner loop responsible for translating words into individual keystrokes and an outer loop interfacing with linguistic processes, furnishing the inner loop with a sequence of words for transcription. This division suggests an encapsulation wherein the outer loop remains oblivious to the detailed operations of the inner loop. The efficacy of this model becomes profoundly evident when skilled typists are confronted with tasks that deviate from their routine, such as typing exclusively with one hand. The resulting disruption, as articulated by Logan (2009), underscores the delicate equilibrium between these loops and their specialized functions.

The innovative realm of invisible keyboards adds a further layer of complexity to this narrative. The concept of typing on an invisible keyboard reinforces our understanding of touch typing's reliance on implicit memory, positing a scenario wherein typists rely on an absent visual stimulus. Liu's study (2010) laid the foundation, revealing that despite the rapid and precise keystrokes typists can achieve, their explicit knowledge of the QWERTY layout remains strikingly limited. Weerdenburg (2019) further elucidated this phenomenon, emphasizing the role of touch typing in bolstering narrative-writing skills. The connection between implicit memory and typing proficiency becomes even more pronounced when typists demonstrate proficiency on invisible keyboards, as demonstrated by Zhu (2018). The astounding revelation that typists could approach the speed and accuracy of regular keyboards on invisible counterparts after brief training sessions underscores the sheer depth and resilience of implicit memory in skilled performance.

This section delves into the prevailing academic consensus: touch typing heavily relies on implicit memory, thus reducing the usage of cognitive resources. The studies discussed here provide compelling evidence for the role of implicit memory in skilled typing performance, highlighting the complex interplay between procedural knowledge and the hierarchical control of typing processes. As we continue to explore the cognitive dimensions of touch typing, it is essential to consider the implications of these findings for our understanding of skill acquisition, automaticity, and the allocation of cognitive resources in complex tasks.

The studies mentioned provide crucial insights into the role of implicit memory in touch typing, yet they also prompt significant inquiries regarding the dynamics between implicit and explicit knowledge in skilled performances. It raises the question: How can humans type rapidly and accurately without explicit knowledge of the keyboard layout? Why is it that such a complex

action, which ostensibly requires explicit knowledge of the keyboard layout, can be performed

effectively with only implicit knowledge? This paper posits a hypothesis: The phenomenon of

touch typing may reveal that human implicit memory is far more intelligent and sophisticated

than previously assumed. During the process of touch typing, the movements executed by the

fingers are not mere repetitive actions but are highly complex, necessitating close coordination

with linguistic outputs, yet executed automatically. This suggests a high level of intelligence

within our implicit memory, operating independently of our conscious control. This hypothesis

demands verification through future empirical research, and this paper argues that further

exploration into this topic is vital for the broader field of cognitive science.

Touch Typing: Delving into the Depths of Cognitive Mastery

The art of touch typing, wherein individuals type seamlessly without the need to visually

reference the keyboard, has long been a subject of fascination and inquiry. Historically, such a

modality of typing was met with skepticism, particularly considering the QWERTY layout was

engineered with a primary aim of mechanical efficiency, rather than intuitive human-machine

interaction (Noyes, 1983). The notion of individuals typing with all ten fingers, without visual

verification, was initially considered an overly ambitious endeavor (Beeching, 1974). However,

as technological epochs shifted, subsequent advancements in word processing software and the

evolution of ergonomic keyboard designs further bolstered its widespread adoption.

The conundrum lies in the apparent disconnect between touch typing proficiency and

explicit knowledge of the keyboard. Snyder et al. (2014) intriguingly illustrated that skilled

typists, capable of executing six to seven keystrokes per second with remarkable accuracy, could

explicitly recall the locations of only about half of the keys. This apparent anomaly raises

pertinent questions: How do typists attain such proficiency despite an apparent lack of explicit spatial awareness? What cognitive mechanisms underpin this dichotomy?

Several studies propose that touch typing straddles the realms of implicit motor memory and the explicit cognitive nuances inherent in language processing. Neuroimaging research reveals that as typists engage in touch typing, there is a harmonized confluence between the meticulous movements of their fingers and cognitive linguistic processes, all transpiring without imposing a significant cognitive load (Poldrack et al., 2005). This suggests a complex interplay between motor skills, memory, and cognition in the process of touch typing.

However, the rapidity and accuracy with which fingers navigate the keyboard—sans visual affirmation—remain an enigma. How do fingers "remember" key positions absent conscious retrieval? How does this motor prowess intertwine seamlessly with cognitive language articulation? Theories of automaticity suggest that seasoned performance hinges on implicit knowledge, whereas novice endeavors lean more on explicit knowledge (Anderson, 1982; Logan, 1988). Yet, touch typing seems to challenge these assertions, given that precise key localization is paramount. The manifestation of touch typing emphasizes the intricate finesse of our bodily memory and autonomy, suggesting our physiological systems might operate with an elevated degree of independence than previously assumed.

While daily exposure to an object, such as a keyboard, does not necessarily culminate in complete explicit memory of the object (Synder et al., 2014), the mechanics of touch typing underscore the complex interplay between motor skills, memory, and cognition. As typists, we might be as unconsciously adept with keyboards as we are with mundane tasks, like using coins or elevator buttons. This raises important questions about the nature of skill acquisition and the role of implicit learning in the development of expertise.

In conclusion, touch typing offers a fertile ground for exploration which was previously ignored, poised to unravel broader revelations about cognition, memory, and motor capabilities. The journey from skepticism to mastery underscores human adaptability and the intricate dance of cognitive faculties that underpin our interactions with the technological world. As we continue to investigate the cognitive dimensions of touch typing, it is essential to reconsider the implications of these findings for our understanding of skill acquisition, automaticity, and the allocation of cognitive resources in complex tasks. Future research should strive to further clarify the mechanisms that underpin the acquisition and preservation of implicit knowledge in touch typing, including how and why it is achieved. More critically, the question of whether human implicit memory possesses a higher degree of intelligence, enabling it to perform complex tasks automatically, warrants extensive scholarly investigation. This exploration is not only urgent but essential to advancing our understanding of cognitive processes and the capacities of implicit memory.

The Cognitive Landscape of Touch Typing Across Different Keyboard Layouts

To further illustrate the sophisticated process of touch typing, this paper recasts the QWERTY keyboard and the Chinese 9-key keyboard in numerical terms to examplify. Such representations may refresh our understanding, prompting us to consider the intricate mental processes underpinning our familiarity with keyboard layouts (Logan & Crump, 2011).

QWERTY: Beyond Alphabetic Mapping

The QWERTY keyboard, a ubiquitous presence in our daily computing endeavors, transcends its apparent alphabetic arrangement. Historically, its inception wasn't tailored for the touch typing system that dominates today but rather for "hunt and peck" typing, a method where

typists search for each key individually. Sholes and Glidden, the original inventors, envisioned a device capable of producing text at rates comparable to handwriting (Noyes, 1983).

In this paper, the QWERTY layout is reframed numerically as: Q=1, A=2, Z=3, ... L=25, P=26.

<insert Table 1 here>

<insert Figure 1 here>

Consider the straightforward English sentence, "The supper is ready." In touch-typing notation, this translates to: 13,17,7,5,19,26,26,7,10,22,5,10,7,2,8,16.

Additional illustrations include:

- "I felt really tired recently." →

  22,11,7,25,13,10,7,2,25,25,16,13,22,10,7,8,10,7,9,7,18,13,25,16.

- "I will send you the document in ten days." →

  22,4,22,25,25,5,7,18,8,16,24,19,13,17,7,8,24,9,19,21,7,18,13,22,18,13,7,18,8,2,16,5.

  <insert Table 2 here>

The ostensibly random sequence challenges conventional cognitive mapping paradigms. How do our fingers instinctively traverse the keyboard, pinpointing precise locations without an overt consciousness of key placement? This deftness underscores an intricate interplay of implicit memory. The historical rationale behind QWERTY's design, as posited by Noyes (1983), was to circumvent mechanical constraints by separating frequently used letter pairs, a strategy conceived by Densmore, a colleague of the inventors. This revelation debunks the popular myth that QWERTY was intentionally designed to retard typing speed (Cocking, 1970).

Once the QWERTY layout became a standard, typists invested time and effort in learning it, leading to a form of lock-in. Even if a more efficient keyboard layout were introduced later

(like the Dvorak layout), the switching costs for individuals and society as a whole would be high, so the QWERTY layout persisted (David, 1985).

The 9-Key Chinese Keyboard: A Multifaceted Cognitive Challenge

The 9-key Chinese keyboard, a staple in modern mobile communication in China, condenses character input into a limited keyset. Gong & Liu (2018) emphasize that while the 9-key keyboard offers the advantage of large key areas (optimizing it for users with visual impairments or larger fingers), its design doesn't always reflect the nuanced spelling rules of Pinyin. For instance, frequent letters in Pinyin, like 'N', are placed in less accessible positions, while infrequent ones, such as 'V', occupy prime real estate. Therefore, adapting to this compact layout and its associated cognitive demands is supposed to be higher than the QWERTY system. Furthermore, the inherent complexity of mapping multiple characters to single keys requires a dynamic blend of phonetic, visual, and spatial strategies, as evidenced in research that delves into the cognitive aspects of typing in various languages (Rumelhart & Norman, 1982).

Here, similarly, keys are systematically enumerated: A,B,C=1, ... W,X,Y,Z=8.

<insert Table 3 here>

<insert Figure 2 here>

For instance, the Chinese expression "晚饭好了" (The supper is ready) in Pinyin, "wan fan hao le", translates to: 8,1,5,2,1,5,3,1,5,4,2. Other examples include:

- "我最近真的很累" (I felt really tired recently) in Pinyin "wo zui jin zhen de hen lei" → 8,5,8,7,4,3,4,5,8,3,2,5,2,2,3,2,5,4,2,4.

- "我将会在十天内把文件发送给你" (I will send you the document in ten days) in Pinyin "wo jiang hui zai shi tian nei ba wen jian fa song gei ni" → 8,5,3,4,1,5,3,3,7,4,8,1,4,6,3,4,7,4,1,5,5,2,4,1,1,8,2,5,3,4,1,5,2,1,6,5,5,3,3,2,4,5,4.

<insert Table 4 here>

The 9-key Chinese keyboard exemplifies the complexity of typing. Despite its complexity, many individuals in China continue to use the 9-key Chinese keyboard for touch typing on mobile devices, as it remains one of the primary keyboards in use. Thus, touch typing is a highly complex, almost stochastic process that ostensibly requires the involvement of conscious awareness; yet, intriguingly, it does not. Touch typing serves as a compelling demonstration of the capabilities and intelligence inherent in human implicit memory. Our fingers do not merely memorize the positions of letters; through touch typing, they also facilitate our ability to quickly and accurately locate and lock onto the correct letters, even without our conscious knowledge of their positions. The rapid identification and localization of letters involve complex, challenging processes rather than simplistic, mechanistic memorization.

Methods

This study employs a narrative review approach to synthesize and critically evaluate current research on the cognitive dimensions of touch typing, with a particular focus on the interplay between touch typing proficiency, implicit memory, and different keyboard layouts. Narrative reviews are an established methodology for addressing broad or complex research questions that require a comprehensive and interdisciplinary synthesis of the literature (Baumeister & Leary, 1997; Ferrari, 2015; Green et al., 2006). They allow for a flexible and interpretive approach that can capture the nuances and complexities of the topic under investigation, generate novel insights, and identify gaps and future directions for research (Collins & Fauser, 2005; Greenhalgh et al., 2018; Snyder, 2019).

To ensure the rigor and transparency of the review process, a comprehensive approach was followed for literature search, selection, and analysis. First, a comprehensive search strategy

was developed and implemented across multiple electronic databases, including PubMed, PsycINFO, ScienceDirect, ChatGPT 4.0, Claude 3 Opous and Web of Science. The search string combined key terms related to touch typing, cognitive processes, implicit memory, and keyboard layouts, using Boolean operators and database-specific syntax. Additional sources, such as reference lists of included studies and relevant review articles, were also hand-searched to identify any potentially missed studies.

The search results were screened for relevance and eligibility based on predefined inclusion and exclusion criteria. Studies were included if they (1) investigated the cognitive aspects of touch typing, (2) examined the role of implicit memory in skill acquisition and performance, or (3) different keyboard layouts. Studies were excluded if they focused solely on the technological aspects of typing without analyzing human cognition.

The synthesis of findings was structured around the key themes identified, with a critical evaluation of the strengths and limitations of the evidence base. Particular attention was paid to the consistency and robustness of findings across studies, the methodological quality of the included research, and the identification of gaps and unresolved questions in the literature. Based on this critical analysis, a new theoretical framework was proposed for understanding the cognitive mechanisms underlying touch typing, with an emphasis on the role of implicit memory and its potential for intelligence and adaptability.

In summary, this narrative review followed a systematic and transparent approach to literature search, selection, and analysis, while allowing for a flexible and interpretive synthesis of findings. The use of established tools for critical appraisal and the adherence to best practices in thematic analysis and synthesis enhance the rigor and credibility of the review. The resulting

theoretical framework provides a novel and evidence-based perspective on the cognitive

dimensions of touch typing, with implications for future research and practice.

Discussion

The present narrative review delves into the intricate cognitive dimensions of touch

typing, illuminating the complex interplay between implicit memory, motor skills, and linguistic

processing. This seemingly mechanical task requires the rapid and precise location of keys on a

keyboard, all accomplished without the direct aid of visual cues. At its core, touch typing

exemplifies a harmonious ballet between our fingers and cognitive faculties, wherein the latter

orchestrates the dance without actively participating in each step. By synthesizing current

research findings and critically evaluating the existing literature, this study uncovers a significant

gap in our understanding of the cognitive mechanisms underlying touch typing proficiency and

highlights the untapped potential of implicit memory in driving intelligent, adaptable behavior.

The most striking insight that emerges from this review is the possibility that implicit

memory, as evidenced in the context of touch typing, may be far more sophisticated and

intelligent than previously recognized. Touch typing's reliance on implicit memory is undeniably

a manifestation of profound cognitive complexity. Traditionally, implicit memory has been

conceptualized as a repository for simple, automated motor responses and habitual behaviors

(Schacter, 1987; Squire, 2004). However, the complex, flexible, and context-sensitive nature of

touch typing performance suggests that implicit memory may be capable of supporting much

more than just rote, mechanical actions.

Touch typing, as a highly automated and unconsciously controlled skill, relies heavily on

the implicit memory system. Yet, the level of complexity and adaptability demonstrated by

skilled typists in navigating different keyboard layouts and adapting to novel typing demands

points to a level of intelligence within implicit memory that challenges traditional dichotomies between implicit and explicit cognitive processes (Reber, 2013; Sun et al., 2005). The findings reviewed in this study suggest that implicit memory, rather than being a primitive or inflexible system, may possess a remarkable capacity for intelligent, context-sensitive processing.

This reconceptualization of implicit memory as an intelligent, adaptive system has profound implications for our understanding of human cognition and skill acquisition. It suggests that the distinction between implicit and explicit memory may be more fluid and interactive than previously assumed, with implicit processes potentially playing a much larger role in complex cognitive tasks than currently recognized (Jiménez, 2003; Kirsh, 2009). Moreover, it raises the possibility that implicit learning and memory may be harnessed to support the development of highly sophisticated, flexible skills across a wide range of domains.

The review also highlights several key themes and insights:

1. The QWERTY keyboard layout, despite its historical origins and seemingly random arrangement, has become deeply ingrained in typists' implicit memory, leading to a form of cognitive lock-in that persists even in the face of more efficient alternatives (David, 1985).

2. The 9-key Chinese keyboard presents a unique cognitive challenge, requiring a dynamic blend of phonetic, visual, and spatial strategies to navigate the complex mapping of characters to keys (Gong & Liu, 2018). This underscores the adaptability and plasticity of the human brain in acquiring and optimizing typing skills across different layouts.

3. The interplay between implicit motor memory and explicit linguistic processes in touch typing remains a paradox that challenges traditional theories of skill acquisition and

automaticity (Logan & Crump, 2011). Further research is needed to elucidate the mechanisms underlying this seamless integration of cognitive processes.

4. The study of touch typing across different keyboard layouts offers valuable insights into the broader implications of human-technology interaction, highlighting the remarkable adaptability and sophistication of the human cognitive system (Rumelhart & Norman, 1982).

The present review also highlights the need for further research into the cognitive underpinnings of touch typing and the role of implicit memory in supporting this complex skill. While the existing literature provides compelling evidence for the involvement of implicit processes in touch typing, there is a paucity of research directly investigating the mechanisms through which implicit memory supports the acquisition and execution of typing skills. Future studies should employ a combination of behavioral, neuroimaging, and computational modeling approaches to elucidate the neural and cognitive basis of touch typing and to test specific hypotheses about the intelligence and adaptability of implicit memory processes.

Furthermore, despite the rapid advancements in technology and the emergence of cutting-edge research areas such as artificial intelligence, this paper argues that the domain of keyboard-related studies still warrants significant further exploration from a cognitive science perspective. The potential for groundbreaking discoveries in this field should not be underestimated. By delving deeper into the cognitive dimensions of keyboard interactions, researchers may uncover fundamental principles of learning, memory, and skill acquisition that have far-reaching implications beyond the specific context of typing. These discoveries could potentially reshape our understanding of how the brain acquires and executes complex, adaptive behaviors, opening

up new avenues for theoretical development and practical applications in fields ranging from education to rehabilitation.

Thus, this narrative review calls for future research to:

1. Investigate how touch typing, a complex behavior, can be executed without explicit knowledge or conscious control. What mechanisms enable this automatic performance?

2. Assess whether touch typing, performed without explicit knowledge or conscious control, can provide robust evidence that human implicit memory is highly complex and intelligent, capable of autonomously executing complex tasks that would typically require conscious involvement. In other words, can our body "think" for itself?

3. If it cannot be demonstrated that human implicit memory is capable of such complexity and autonomy, then how is touch typing achieved?

In conclusion, this narrative review aims to contribute to the field of cognitive science by revealing the untapped potential of implicit memory in supporting intelligent, adaptive behavior. By challenging assumptions about the simplicity and inflexibility of implicit processes, this paper hopes to open up new avenues for research and theory development in the areas of cognitive sciences. If we continue to explore the cognitive dimensions of touch typing and other potential skills which we previously ignored, we may have fundamental discovires about the nature of human learning and memory that may shape the future of cognitive science research and practice.

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Table 1 QWERTY Keyboard Key-Number Mapping

Key	Number	Key	Number	Key	Number
Q	1	I	22	A	2
Z	3	J	20	W	4
X	6	E	7	S	5
C	9	R	10	D	8
F	11	T	13	V	12
B	15	Y	16	G	14
H	17	U	19	N	18
K	23	O	24	M	21
L	25	P	26		

Figure 1 Standard QWERTY Keyboard Layout

Table 2 Example Sentences and their QWERTY Numerical Representations

Sentence	QWERTY Representation
The supper is ready.	13, 17, 7, 5, 19, 26, 26, 7, 10, 22, 5, 10, 7, 2, 8, 16
I felt really tired recently.	22, 11, 7, 25, 13, 10, 7, 2, 25, 25, 16, 13, 22, 10, 7, 8, 10, 7, 9, 7, 18, 13, 25, 16
I will send you the document in ten days.	22, 4, 22, 25, 25, 5, 7, 18, 8, 16, 24, 19, 13, 17, 7, 8, 24, 9, 19, 21, 7, 18, 13, 22, 18, 13, 7, 18, 8, 2, 16, 5

Table 3 9-Key Chinese Keyboard Key-Number Mapping

Keys	Number
A, B, C	1
D, E, F	2
G, H, J	3
J, K, L	4
M, N, O	5
P, Q, R, S	6
T, U, V	7
W, X, Y, Z	8

Figure 2 9-Key Chinese Keyboard Layout

Table 4 Example Chinese Sentences, Pinyin Representations, 9-Key Numerical

Representations, and English Translations

Sentence (Pinyin)	9-Key Representation	Sentence (Chinese)	Translation (English)
wan fan hao le	8, 1, 5, 2, 1, 5, 3, 1, 5, 4, 2	晚饭好了。	The supper is ready.
wo zui jin zhen de hen lei	8, 5, 8, 7, 4, 3, 4, 5, 8, 3, 2, 5, 2, 2, 3, 2, 5, 4, 2, 4	我最近真的很累。	I felt really tired recently.
wo jiang hui zai shi tian nei ba wen jian fa song gei ni	8, 5, 3, 4, 1, 5, 3, 3, 7, 4, 8, 1, 4, 6, 3, 4, 7, 4, 1, 5, 5, 2, 4, 1, 1, 8, 2, 5, 3, 4, 1, 5, 2, 1, 6, 5, 5, 3, 3, 2, 4, 5, 4	我将会在十天内把文件发送给你。	I will send you the document in ten days.