Research on Phonetic Indexing Interface in *Xinhua Dictionary Based on* Differences of English and Chinese Letters

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Abstract. *Xinhua Dictionary* is an indispensable reference book in Chinese primary school teaching. However, through observation, it is found that due to the different pronunciations of English and Chinese letters, elementary school students who are beginners in language use the order of English capital letters as the phonetic index order. When using a Chinese character dictionary, phonetic confusion is easy to occur, which affects the retrieval efficiency. Based on the above questions, this paper combines the literature of linguistics and psychology to conduct an in-depth analysis around people, products and usage scenarios. A comparative study of letters and pronunciations that are easily confused between Chinese and English was conducted to explore the regularity of phonetic confusion. Experiment design was carried out on the preliminary summary of confusing phonetic sounds, to evaluate the prevalence of phonetic confusion problems, and to obtain pronunciations with higher confusion frequency. Integrate design elements and propose reasonable design solutions. At the same time, the redesign and usability test of the dictionary sequence retrieval interface are carried out. It is hoped that the research will shed light on the design improvement of user search interfaces in dictionaries and other reference books.

Keywords: English and Chinese phonetics · Syllable indexing · Dictionary retrieval · Human-computer interaction

1 Different Homonyms Between Chinese and English Letters Can Easily Cause Phonetic Confusion

In the early stage of the research, through direct observation, we observed 20 primary school students using the phonological indexing method to retrieve the example word '看' [kàn]. Through the 'User Journey Map' tool, the basic retrieval process of primary school students using the phonological indexing method can be summarized as 7 steps, as shown in Fig. 1.

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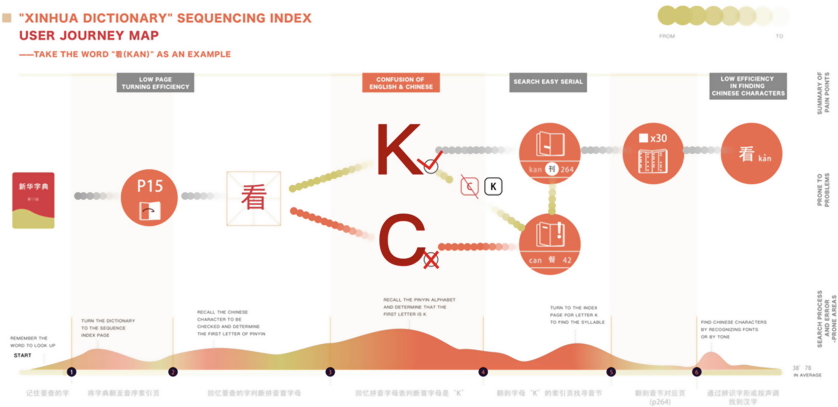


Fig. 1. User journey map of phonetic indexing in *Xinhua Dictionary* ——Taking the word '看' as an example.

Under the condition that the page turning efficiency is basically the same, the primary school students with slower indexing speed tend to lag behind in the third and fourth steps. This situation is mostly caused by 'recalling the first letter and judging the first letter of Pinyin' in the third step. There were mistakes in the link. The specific performance is that when they judge the pronunciation of '看', primary school students tend to confuse the Chinese pinyin letter 'k' with the letter 'C' which has /k/ pronunciation in English. Until they look for the syllable 'can' If the corresponding word is not found, the first letter of the pinyin is re-judged, and the initial letter 'K' in the pinyin is returned. To sum up, the English and Chinese phonetic confusion problem can easily lead to misjudgment of the first letter of the pinyin by primary school students, prolong the retrieval time, and affect the retrieval efficiency. Thus, it is preliminarily confirmed that the English and Chinese phonetic confusion will occur in the process of dictionary retrieval for primary school students.

2 Research on the Design of Retrieval Interface Based on Human-Computer Interaction Theory

Language is the only carrier of thinking, and 'speech or spoken language' is the acoustic image of language [1]. When conducting design research on the English and Chinese phonetic confusion in the phonological index and trying to improve it, it is bound to face the theoretical integration of linguistics, psychology, education and other disciplines. Human-computer interaction, as a comprehensive marginal discipline, can be combined with the theoretical knowledge and technical means of other basic disciplines, while combining the principles of visual communication design and interaction design to explore, so as to reveal the three elements of human, machine and environment. The law of the relationship between them [2]. Therefore, the researched literature information and pedagogical expert opinions are integrated, and the confusion problem is explored and summarized from the three aspects of users, products and usage scenarios.

2.1 Exploration from the User's Perspective

The problem of phonetic confusion occurs when the user sees capital letters and their arrangement, which is disturbed by the second language. Therefore, such phenomena can be attributed to language transfer. The most authoritative of these is the view put forward by Odlin (1989), who argues that 'the influence resulting from similarities or differences between the target language that has been previously (and perhaps imperfectly) acquired.' [3] At the same time, according to Javis and Pavlenko (2008), the types of language transfer can also be divided into different latitudes, for example, from the perspective of direction, it can be one-way transfer of different languages, or two-way or multi-directional transfer. Or a migration within the same language. From the results, language transfer can be divided into negative transfer and positive transfer. [4] Positive transfer is what one language promotes the learning of another language. This enables users to easily spell out the 'b', 'p' and other letters in Chinese Pinyin that have similar pronunciation habits to English letters. While negative transfer, named mother tongue interference, is mainly caused by the misinterpretation because of differences between their mother tongue and the second language [5]. The phonetic index interface of *Xinhua Dictionary* is not only sorted in uppercase English alphabetical order, but also uses uppercase letters Forms represent syllables. For elementary school students who lack subjective critical thinking and pay attention to imitation and perception [6] at the initial stage of English learning, it is easy to cause interference, resulting in phonetic confusion and affecting second language learning. However, the current research on negative language transfer is mostly concentrated in the fields of linguistics and education, and the research objects of Chinese phonetic transfer mainly focus on high school students and college students. The influence of English pronunciation [7], Li si-si (2015), based on the perceptual magnet effect, studies and analyzes the phenomenon of negative transfer in English pronunciation learning, and analyzes the causes of negative transfer [8]. However, most of them stay at the theoretical level, and there is a lack of quantitative data and design application research on the specific problem of speech confusion.

2.2 Exploration from a Product Perspective

Where there is a reference book, there must be an index. An index is a tool, and an index of a reference book is a tool of a tool. Lin Yushan (1989) once emphasized in his paper that the arrangement of index content is particularly important for dictionaries [9]. Regarding the setting of the phonetic index catalogue of the *Xinhua Dictionary*, Li Gongyi (1989) mentioned that although the phonetic indexing method rearranges the 417-syllable Chinese characters in the order of 23 English alphabets, the retrieval level is more concentrated. However, due to the 'unordered' characteristics of Chinese characters, it is difficult to retrieve Chinese characters, resulting in short distances for regular retrieval, wide retrieval area, and large number of characters to be searched, which affects retrieval efficiency [10]. At the same time, the reason for the practice of arranging the Chinese Pinyin search order in English alphabetical order is only briefly explained in the early journals as considering that the English alphabetical order is 'the

easiest and most accurate arrangement in the world to find' [11]. It can be seen that at the beginning of the design of the phonological indexing method of *Xinhua Dictionary*, it did not take into account its own language characteristics and user needs. At the same time, it is not designed with the characteristics of user cognition.

2.3 Exploration from the Perspective of Usage Scenarios

Combining with the flow chart of human brain information processing proposed by Atkison & Shiffrin (1968), it can be found that when users use a dictionary to look up Chinese characters, they need to input the information of the Chinese characters they are looking up from the environment, and then enter the short-term memory after processing in the perceptual stage. [12] In order to prevent the loss of too much useful information from sensory memory, the brain will use the internal knowledge structure, such as general knowledge experience, cultural background, way of thinking and other subject factors to analyze and accept external stimuli [13] (Dember & Warm, 1979). However, the current usage situation is that when using the dictionary, the user needs to recall the phonetics of the searched Chinese characters and determine the initials. Then, recall the English alphabetical order and look for the first letter. Finally, associate Chinese phonetic sounds and judge syllables. In this case, the storage and processing of Chinese characters in short-term memory becomes very important.

3 Universal Assessment of English and Chinese Phonetic Confusion

Based on the above literature survey and expert consultation results, it further confirms the existence of English and Chinese phonetic confusion and its impact on indexing efficiency. The Dictionary phonetic indexing method has been in use since the 1950s, and there is no experimental data that can be cited to prove such a problem. Therefore, with the help of experimental research method, a quantitative study on the confusion of Chinese and English sounds in primary school students when retrieving dictionaries is carried out, and its universality is evaluated by the experimental results.

3.1 Experimental Procedure Design

Combined with the comparative research method, the phoneme comparison is carried out. To evaluate the universality of the pronunciation confusion of English and Chinese letters and summarize the easily confused letters and pronunciation, the pronunciation of English letters and Chinese pinyin letters, and the pronunciation of English letters in words are compared respectively, as shown in Table 1.

Table 1. Phonetic comparison of letters (Blue: Different phonemes. Yellow: Some phonemes are the same. Light Grey: Same Phoneme. dark grey: Not the first letter of Pinyin.)

Letters	Pinyin letters'pronunciation	English letters'pronunciation	The pronunciation of English letters in words			
Aa	/a/	/ei/	/ei/	/ai/	/ae/	/c/
Bb	/p/	/biː/	/b/			
Cc	/tsʰ/	/siː/	/s/	/k/	/tʃ/	
Dd	/t/	/diː/	/d/			
Ee	/ɤ/	/iː/	/iː/	/ie/		
Ff	/f/	/ef/	/f/			
Gg	/k/	/dʒiː/	/d3/	/g/		
Hh	/x/	/eɪtʃ/	/h/			
Ii	/i/	/aɪ/	/i/			
Jj	/tɕ/	/dʒeɪ/	/dʒ/			
Kk	/kʰ/	/keɪ/	/k/			
Ll	/l/	/el/	/l/			
Mm	/m/	/em/	/m/			
Nn	/n/	/en/	/n/	/n/		
Oo	/o/	/əʊ/	/eu/	/c/	/A/	/uː /ː
Pp	/pʰ/	/piː/	/p/			
Qq	/tɕʰ/	/kjuː/	/k/			
Rr	/z/	/ɑː(r)/	/r/			
Ss	/s/	/es/	/s/	/tʃ/	/z/	
Tt	/tʰ/	/tiː/	/t/	/tʃ/	/θ/	
Uu	/u/	/juː/				
Vv	/u/	/viː/				
Ww	/w/	/ˈdʌbljuː/	/o/			
Xx	/ɕ/	/eks/	/z/	/ks/	/gz/	
Yy	/j/或/i/	/waɪ/	/j/	/ai/		
Zz	/ts/	/zed/	/z/			

Different phonemes | Some phonemes are the same | Same phoneme | Not the first letter of Pinyin

Subsequently, through the circular chart, the pronunciation of the 23 pinyin initials in the dictionary phonetic index table was disassembled in Chinese and English. In the inner circle, in the form of a string diagram, summarize the confusion relationship between the first letters of the pinyin, and mark the single and complex vowels, initials and overall recognized syllables with similar pronunciations in different colors (the gray part is not easy to confuse the pronunciation). In the outermost circle, the number of rings indicates the easily confused frequency between the first letters of each pinyin, as shown in Fig. 2. And summarize the extracted information, see Table 2.

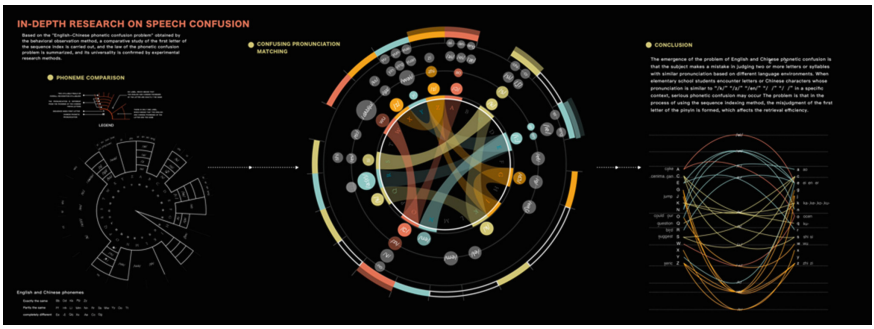


Fig. 2. Similar pronunciation induction

Table 2. A summary of confusing letters and sounds

Initials	Confused syllables	pronunciation	Confusing words
Aa Ee	ei	/ei/	cake
Aa Oo	ao	/ɔ/	our
Ee Nn	en	/en/	——
Ee Rr	er	/ɛ:/	bird
Cc Ss	shi	/ʃ/	ocen
Cc Ss	si	/s/	cenima
Cc Kk	ka-,ke-,ko-,ku-	/k/	can
Qq Kk	ku-	/k/	question
Ww Oo	wu	/u:/	could
Zz Gg Jj	zhi	/ʤ/	suggest, jump
Zz Xx	zi	/z/	xeric

It can be seen that the problem of English and Chinese speech confusion is due to the user's misjudgment of two or more letters or syllables with similar pronunciation based on different language environments. Not all letters will have phonological confusion, nor is it that English and Chinese letters with the same phoneme will not have phonological confusion (such as K). The emergence of English and Chinese phonetic confusion is partial, connected, and conditional. Therefore, the design of the experiment must be based on specific users and meet the usage scenarios of different language environments to evaluate the universality of the English and Chinese pronunciation confusion. The experimental process is shown in Fig. 3.

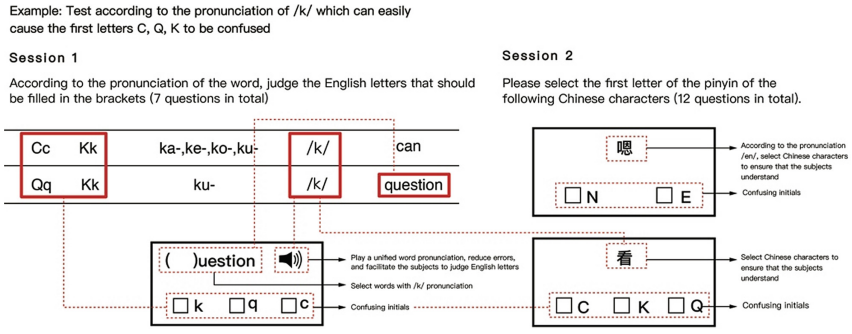


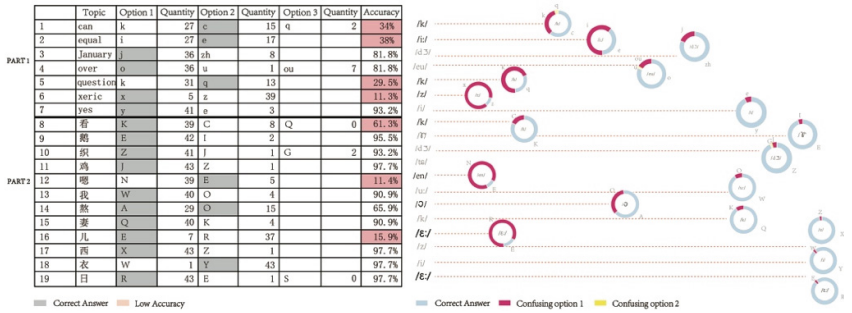
Fig. 3. Experimental procedure

3.2 Participants

The experiment was carried out in the No. 2 Experimental Primary School in Fangshan District, Beijing in May 2021. A total of 44 s-grade students who were receiving primary school Chinese teaching and who had mastered the phonological indexing method of *Xinhua Dictionary* participated in the experiment as subjects. The subjects included 21 boys and 26 girls, ranging in age from 7 to 9 years old. Before the experiment, each subject read the range of Chinese characters that may appear in the experiment (to ensure that they are familiar with the pronunciation) and was informed of the experimental procedure and points of attention.

3.3 Analysis of Results

After the experiment was carried out according to the above process, the experimental data were sorted out, and the experimental results were obtained as shown in Fig. 4.



		Topic	Option 1	Quantity	Option 2	Quantity	Option 3	Quantity	Accuracy
PART 1	1	can	k	27	c	15	q	2	34%
	2	equal	i	27	e	17			38%
	3	January	j	36	zh	8			81.8%
	4	over	o	36	u	1	ou	7	81.8%
	5	question	k	31	q	13			29.5%
	6	xeric	x	5	z	39			11.3%
	7	yes	y	41	e	3			93.2%
	8	看	K	39	C	8	Q	0	61.3%
	9	鹅	E	42	I	2			95.5%
	10	织	Z	41	J	1	G	2	93.2%
	11	鸡	J	43	Z	1			97.7%
PART 2	12	嗯	N	39	E	5			11.4%
	13	我	W	40	O	4			90.9%
	14	熬	A	29	O	15			65.9%
	15	妻	Q	40	K	4			90.9%
	16	儿	E	7	R	37			15.9%
	17	西	X	43	Z	1			97.7%
	18	衣	W	1	Y	43			97.7%
	19	日	R	43	E	1	S	0	97.7%

Fig. 4. Experimental results

4 Application Principles of Dictionary Search Interface Redesign

From the perspective of human-computer interaction design, the dictionary is the 'machine', and the phonetic index table is the 'human-computer interface'. Humans (users) need to interact with the 'man-machine interface' to complete the operation and control of the 'machine'. Therefore, in order to solve the English and Chinese phonetic confusion problem, we should start from the 'search interface' of the phonetic index. Through the application of the design method, users can use the product quickly and efficiently [14] and achieve the expected purpose. The redesign of the dictionary retrieval interface should follow the following design principles.

4.1 Retrieval Interface Content Should Deliver Information Quickly and Accurately

'Reading' is the process of obtaining information from visual materials [15]. The design of the retrieval interface is the process of visualizing information and making it easy

to communicate. As a Chinese learning reference book, the content in the phonetic sequence retrieval interface of *Xinhua Dictionary* is mainly composed of Chinese pinyin letters, syllables, corresponding words and page numbers. Therefore, Pinyin letters can be redesigned with reference to the sorting characteristics and expression forms of Chinese Pinyin while satisfying the legibility and identification, focusing on the visual and sorting order to guide the user's indexing method, so that users can reduce the number of English letters. sequence association, so as to better integrate into the Chinese context. At the same time, in the selection of words corresponding to syllables, it is necessary to combine the cognitive range of primary school students. For confusing letters or syllables, visual codes such as size, color, and shape can be used to distinguish them, so as to enhance the recognition of the retrieval interface and alleviate the negative transfer of language.

4.2 The Principle of Proximity and Similarity

There are a total of 417 syllable combinations in Chinese Pinyin, and the current method of classifying and combining syllables with English initials is prone to confusion of English and Chinese pronunciation, and there are also problems such as serial indexing and low page turning efficiency. The principle of proximity and approximation are essentially the organizing principles for simplifying and integrating perceptual objects, that is, when people simplify cognitive objects, they tend to combine similar and close elements for cognition as a whole [16]. Therefore, in the design of the retrieval interface, it is possible to explore and try new alphabetical rules and arrangement sequences. While combining the psychological cognition and behavioral characteristics of users, it is necessary to have a logical and clear information structure and an easy-to-master retrieval process. Thereby, the syllable retrieval method is more effectively integrated, and the retrieval efficiency is improved.

4.3 The Principle of Consistency

Consistency has a direct impact on the user's mental ease of memory and load. Also, it is the source of the efficiency of product control [17]. In the process of designing, it is necessary to refine a theme or framework, and design through visual features and auxiliary elements to ensure that the structure, interface, style, operation of the *Xinhua Dictionary* retrieval interface is consistent with the user's mental model, so as to realize the retrieval process. systemic and complete. At the same time, in terms of style, redesign should be carried out around the psychological characteristics of primary school students, such as their strong curiosity, fondness for many colors, and memory characteristics based on mechanical memory and specific image memory [18]. On the premise of ensuring a clear and consistent search interface style and layout Next, pursue a certain artistic beauty. It can even further meet the higher-level needs of users, that is, emotional interaction, aesthetic taste, cultural belonging and added value needs.

5 Prototype Design and Usability Evaluation of Dictionary Search Interface

5.1 Retrieval Interface Content Should Deliver Information Quickly and Accurately

The dictionary was redesigned and prototyped by incorporating design elements. The improvement process is mainly divided into the following steps:

Alleviate Negative Language Transfer. By replacing English letters with Chinese pinyin letters and replacing the English arrangement order with pinyin order, the impact of negative English transfer of primary school students in the process of querying dictionaries is alleviated.

Improve Fault Tolerance. By refining the combination of Chinese pinyin letters (as shown in Fig. 5), the original five-page catalog was reduced to one page. At the same time, the order of the pages is rearranged, and the directory on the eleventh page that was originally located is placed on the cover of the dictionary, as shown in Fig. 6.

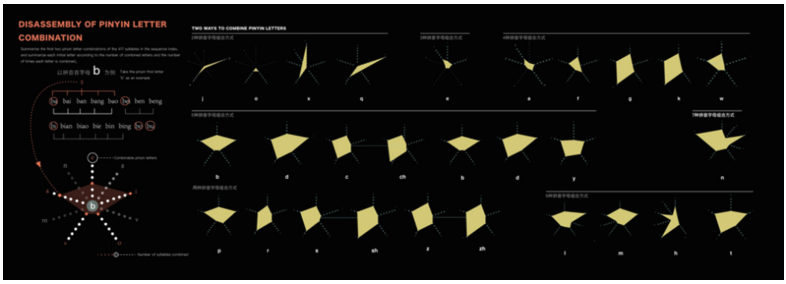


Fig. 5. Disassembly of pinyin letters' combination

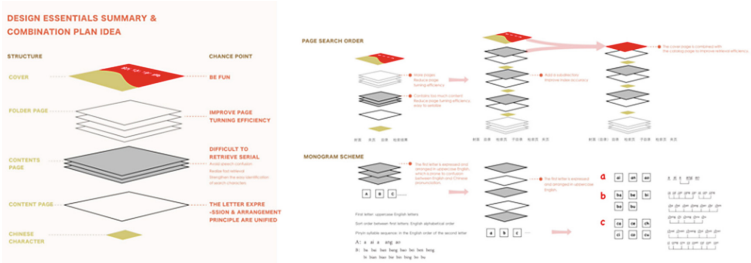


Fig. 6. Arrangement scheme design

While improving the indexing efficiency, it also reduces the time needed to turn to other pages due to speech confusion and improves the fault tolerance rate of negative language transfer. At the same time, in order to further verify the reading order with

high retrieval efficiency, a variety of layout types of cover designs, such as left-to-right, top-to-bottom, and serpentine order, are carried out. Prepare for the next experimental session. Based on the above design process, a prototype of the dictionary is obtained, as shown in Fig. 7, and is ready for preliminary usability testing.

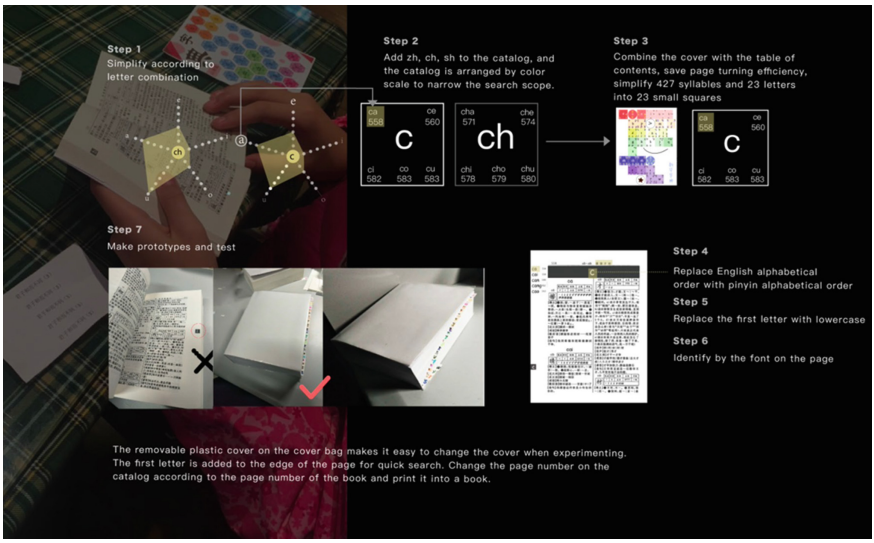


Fig. 7. Dictionary prototyping process diagram

5.2 Participants

The experiment was carried out in the No. 2 Experimental Primary School in Shijingshan District, Beijing in September 2021, and a total of 32 primary school students participated in the experiment. The subjects included 15 boys and 17 girls, ranging in age from 8 to 9 years old. Before the experiment, a dictionary retrieval test was performed on each participant, and the range of Chinese characters that may appear in the experiment was read (to ensure that they were familiar with the pronunciation of Chinese characters), and they were informed of the experimental process and points of attention.

5.3 Test Process Design and Result Analysis

On the basis of the dictionary prototype, in order to further explore the design key points of retrieval efficiency and the processing of pinyin letter coding types, three groups of experimental procedures were designed, and data was collected and analyzed. Before the start of the experiment, first select a sentence and let the participants spell it to test whether they can use the *Xinhua Dictionary* phonetic index method to search, after passing the test. Lead the participants to briefly sort out vowels, consonants, and overall recognition of syllables, and briefly familiarize themselves with the newly designed

dictionary interface and usage process. After finishing the pre-experiment preparations, three groups of comparative experiments were carried out.

Experiment 1: Cover recognition comparison. Take out the three new retrieval interfaces arranged in different reading orders (from left to right, from top to bottom, and serpentine), and perform cover identification and comparison. By comparing the speed of indexing the same sentence, select the fastest retrieval interface A. By letting the subjects choose independently, the most popular dictionary cover B was counted.

Experiment 2: directory sorting comparison. Then, according to the order of unifying the reading order of the retrieval interface to A (the interface with the fastest retrieval speed), compare the retrieval speed of the two covers sorted by English alphabet and alphabetical order of Chinese Pinyin, and select the fastest average speed among them. Quick interface C.

Experiment 3: Indexing speed comparison. Compare B and C with the original *Xinhua Dictionary*, count the retrieval time, and compare the retrieval speed.

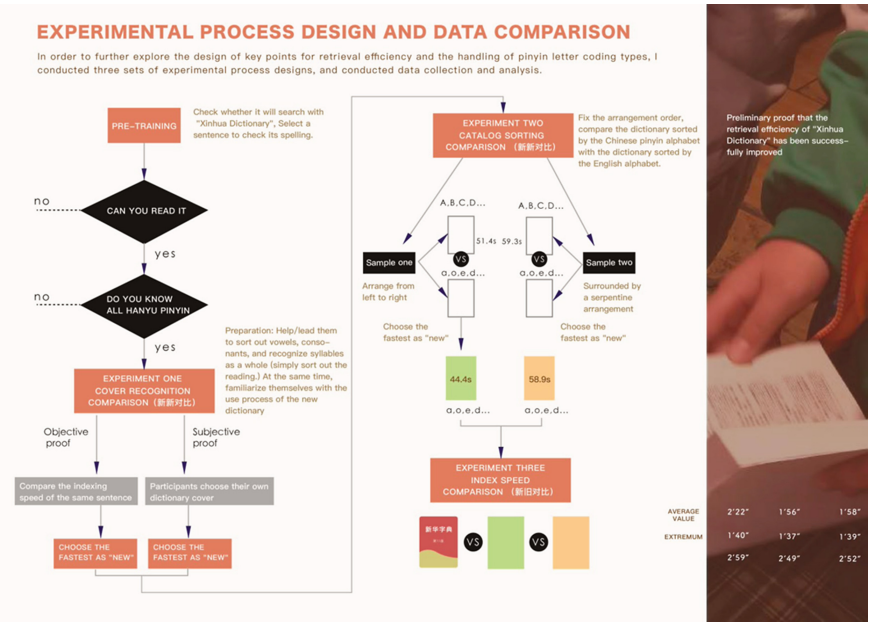


Fig. 8. Experimental process and data results

The above experimental process and the corresponding experimental results, as shown in Fig. 8, the user's favorite cover is the cover arranged in a serpentine structure, and the fastest retrieval speed is the interface with the reading order from left to right sorted by Chinese Pinyin, and the average retrieval time of this interface is shorter than that of *Xinhua Dictionary*, which preliminarily confirms the effectiveness of the design content.

6 Epilogue

English and Chinese phonetic confusion is a common but often overlooked problem in the phonological indexing method of *Xinhua Dictionary*, which affects the retrieval efficiency of primary school students for a long time. Scientific research methods lack in-depth research on the personality, age, and behavior of primary school students aged 6–12, and their application methods are also out of the essence of primary education [19]. Therefore, the viewpoints and experimental process proposed in this paper are not only the discovery and proof of potential pain points, but also a bold attempt to analyze and solve problems by combining multidisciplinary theoretical knowledge and using design tools. There is still room for improvement and improvement in its theoretical methods and experimental ideas. It is hoped that through analysis and research, it will play a positive role in the language learning process of primary school students and will have a certain role in improving the retrieval methods of dictionaries and other reference books for users. Inspirational meaning.

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