

Translanguaging learning strategies (TLS)

A novel proposal from learning Chinese

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Using the think-aloud protocol (TAP), the study investigates the strategies used by beginner and pre-intermediate learners of Chinese when studying Chinese characters through typing. Drawing on concepts from translanguaging, embodiment and LS (learning strategies), a novel notion of translanguaging learning strategies (TLS) and an innovative typology of TLS were proposed. The study found that the pre-intermediate group tended to resort to TLI (translanguaging interdependency) and IE (imagined embodiment) more often than the beginners. TLS for typing were also compared with those for handwriting. While CFL learners mainly relied on HE (haptic embodiment) when typing to learn, a wider range of TLS, including IE, TLI and TSI (trans-semiotising interdependency), were drawn from during handwriting. As a pioneer in situating learning strategies in a translanguaging framework, the study calls for further empirical research to validate the proposal of TLS and its typology.

Keywords: translanguaging, embodiment, Chinese character, typing, handwriting

1. Introduction: Shifting from handwriting to typing

Chinese characters consist of a three-tier orthographic structure: stroke, radical and character (Shen and Ke 2007). Several strokes function as building blocks to construct a radical, and one or more radicals are used to form a character. Handwriting supports establish the spatial configuration of strokes and radicals, along with a temporal sequence of motor movements associated with stroke composition (Zhang & Reilly, 2015). Graphic-motor planning is involved in the handwriting exercises (Lyu et al. 2021), which ultimately contributes to the retention of a character's shape in a learner's memory. Therefore, handwriting shows positive effects on character recognition and reading development (Cao et al. 2013; Guan, Perfetti, and Meng 2015).

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However, with the decreasing need for handwriting in the electronic world, there has been a call for the early introduction and employment of typing in learning Chinese characters – a writing mode which younger generations are accustomed to in the digital era (Allen 2008). The pervasive use of typing and the marginalisation of handwriting have become even more significant since almost every aspect of learning had to switch online due to Covid-19. Under these circumstances, the study investigated the impact of the shift of writing modality on potential variations in strategies employed in learning the Chinese script.

The aim of the study is to examine strategies used by CFL learners in the process of typing to learn Chinese characters. After a review of learning strategies (Henceforth LS) definition and previous LS in Chinese language research, the paper first highlights the need to step out of the conventional LS conceptualisation and typology, especially in the digital, globalised era. Situating LS in a translanguaging framework, the study proposes an innovative concept of translanguaging learning strategies (TLS). In addition, the study incorporates notions from embodiment to develop a new typology for TLS. The reformulated TLS and its classification are honed in on when analysing data collected from the think-aloud activities when typing to learn Chinese. The paper then discusses the possible variations in TLS between handwriting and typing, as well as the plausible reasons for such variations, through drawing results from a previous study conducted by the same group of researchers (Zhang et al., 2022).

2. Literature review

2.1 Learning strategies (LS) definition

While LS research situated in the SLA (Second Language Acquisition) framework is flourishing, a major critique is definitional fuzziness; without a clear definition of what LS are, LS research inevitably faces the question of how they can be measured (Rose et al. 2018). A “watershed moment” in the mid-2000s (Rose et al. 2018, 152) was an outburst of accumulated concerns regarding LS conceptualisation, a representative example being Dörnyei’s (2005) proposal to replace LS with the notion of self-regulation. While some studies have embraced self-regulation in LS research (Rose and Harbon 2013; Teng and Zhang 2016; Tseng, Dörnyei, and Schmitt 2006), Rose (2012) maintained that the issue of definitional fuzziness persists, as self-regulation is just as fuzzy as LS. For instance, a questionnaire developed to measure the self-regulatory tendency repeatedly uses the term “techniques” in the self-reporting statements (Teng and Zhang 2016, 700) without any

clarification on what ‘techniques’ refers to. Ambiguity in the wording may result in questioning the reliability of the data collected.

After adopting the grounded theory approach to scrutinise 33 LS definitions over the last four decades, Oxford (2017, 48) proposed a definition of L2 LS. The definition captures the essence of learning strategies and recognises their complexity, which is embedded in a larger complex ecological system (Oxford, 2017). Generally, four fundamental elements should be considered in any LS research.

First, mental aspects of LS are included in 97% of the 33 definitions analysed in Oxford’s study, indicating the importance of cognition in LS. Therefore, the study will incorporate embodiment – a concept examining cognitive process – when proposing translanguaging learning strategies (TLS; see Section 5). Second, LS as mental action or process is central to many LS definitions (Oxford, 2017). The emphasis on the ‘process’ aspect of LS rather than on ‘products’ inspired us to situate LS research in a translanguaging framework, which can highlight the ‘in process’ aspect of language use (see Section 3).

Third, LS are observable (Briggs 2015; Dörnyei and Skehan 2003; Oxford 2017). The potential observability of LS inspires the choice of the think-aloud protocol (TAP; see Section 4). While not all observable motor behaviours are strategic, actions that are guided mentally are LS. TAP prompts learners to devote their mental attention to the writing task. If a learner were distracted from the task, it could be observed from their articulation of thoughts. Therefore, data from TAP allow us to differentiate motor, mechanical behaviours from mentally guided actions – only the latter is LS.

Fourth, the context-dependent feature of LS implies the uniqueness of LS for studying Chinese characters. The study will scrutinise LS with reference to specific context and task: typing to learn Chinese characters, which avoids the ignorance of context as a meaning factor – a “typical shortcoming of traditional quantitative research” (Oxford 2017, 45). Since this context is different from previous LS research into English language learners, the study reformulated the LS by introducing the translanguaging framework. An innovative concept – translanguaging learning strategies (TLS; see Section 3) – and a novel classification of TLS (see Sections 5.1 and 5.2) are proposed to move away from any possible conformity or normalisation with English language learning.

2.2 LS research for learning Chinese

Research on LS for Chinese still follows Oxford’s typology of LS and relies on her Strategy Inventory for Language Learning (SILL) developed in the 1990s. These were initially designed for learners of English rather than of Chinese or Asian scripts (Fazeli, 2012; Oxford, 1996). Even “the third wind” of LS, which describes

“recent work – and future work we hope to see” (Thomas et al. 2022, 418), still consists of LS studies of only learners of English.

The Character LS Inventory – a self-reporting questionnaire developed from Oxford’s SILL (Shen 2005) – has been often adopted in LS research for Chinese (Sung and Wu 2011; Tam and Kim 2021; Wang, Spencer, and Xing 2009; Yan 2020). Frequent use of the Character LS Inventory indeed provides empirical data for comparison across language levels, nations and time to observe conditions of variations. Nevertheless, the predominance of questionnaire instruments and the transfer of SILL into other cultural settings or languages have raised methodological concerns for CFL LS research (Jiang and Cohen 2012). Importantly, it remains unknown what LS have been employed for different writing modalities in the context of shifting from handwriting to typing.

There have been numerous calls for qualitative methods (Briggs 2015; Rose 2015; Tseng, Dörnyei, and Schmitt 2006). Two studies (Grenfell and Harris 2015; Zhang, Lin, and Osborne 2022) have made efforts to deviate from the existing LS typology and quantitative methods. Both studies employed a think-aloud protocol (TAP) to report the common strategies used for memorising the meaning and form of written Chinese characters.

With the data from TAP and the follow-up questionnaire, Grenfell and Harris (2015) extracted three types of LS strategy: (a) focusing on the whole character, (b) focusing on strokes, and (c) using prior knowledge. As Grenfell and Harris’ study was not concerned with theorising the findings for the learning of other languages, Zhang et al. (2022) situated the LS research in the translanguaging theory to explore the potential of an innovative concept of translanguaging strategies which might be applicable across different linguistic systems. Three types of translanguaging strategy were identified: (a) embodiment, (b) translanguaging resemblance, and (c) hybrid.

The overlapping LS found in both studies are preference for the physical appearance of a character and drawing on learners’ existing knowledge funds. However, neither study investigated strategies employed when learning Chinese characters through typing. The small number of participants – 10 in Grenfell & Harris (2015) and 4 in Zhang et al. (2022) – limited the reliability and validity of the LS typology.

Globalisation and advances in technology have greatly expanded most people’s semiotic repertoire and enhanced multilingual communication that ranges between languages and modalities (Li & Ho, 2018). Instead of a static or monolingual linguistic landscape, the fluidity, hybridity and dynamics of multilingual practice are usually observed in the language learning process, which can be captured by translanguaging. Therefore, the study reconceptualised LS with a

translanguaging framework to challenge the conformist ideology manifested in previous LS research.

3. Translanguaging learning strategies (TLS)

Translanguaging takes an ecological view to consider human communication as an organic whole. It shifts away from the structuralist paradigm to break the segregation of linguistic systems or codes (Blackledge and Creese 2017; Li 2018). Instead, it emphasises the hybridity and fluidity of the multilingual communication process. Co-construction and dynamic configuration of a range of semiotic modes are therefore essential in translanguaging. By foregrounding the speaker rather than the linguistic system as the research focus, translanguaging empowers the analysis of heterogeneity of communication, including all available linguistic repertoires (García and Li 2014) and semiotic assemblages (Canagarajah 2018; Pennycook 2017). Lin (2015; 2019) consequently expands translanguaging theory into trans-semiotising, which underlines that a linguistic repertoire activated in communication consists of traditional linguistic features (lexical, morphological, syntactical, etc) and other meaning-making signs embodied in semiotic modes such as gestures, posture and broader semiotic practices of using technologies (Vogel, Ascenzi-Moreno, and García 2018).

The ‘*linguaging*’ embedded in translanguaging refers to “the *process* of using language to gain knowledge, to make sense, to articulate one’s thought and to communicate about using language” (Li & Zhu, 2013, p. 519; my emphasis). Giving prominence to the process of multilingual practices, translanguaging enhances our understanding of semiotic assemblages through a combination of qualities of both stasis and change (Pennycook 2017). Therefore, it concentrates on the language learning process rather than the static entity of languages, which is also core to LS. This study is the first to choose translanguaging as a framework to identify LS when typing to learn.

The LS in this study refers to the translanguaging thoughts and actions observed in the learning process. Specifically, translanguaging learning strategies (henceforth TLS) refer to the holistic engagement of one’s linguistic repertoire and semiotic assemblage to strategically guide the study of a foreign language. TLS therefore should demonstrate translanguaging and trans-semiotising features when being employed in the process of learning Chinese writing system.

While the notion of TLS was first proposed in the study of Zhang et al. (2022), translanguaging phenomena had been identified as early as Shen’s research on LS. For example, Shen (2005) and her followers (Sung and Wu 2011; Tam and Kim 2021; Wang, Spencer, and Xing 2009) found that orthographic knowledge is

applied in the encoding of Chinese characters from the visual mode of a radical to the aural mode, e.g., via a translanguaging and trans-semiotising process.

One category of TLS recognised by Zhang et al. (2022) is the hybrid type accentuating dynamic flow between a vast array of semiotic resources. It suggests an integrated use of all available TLS to construct and store in memory multimodal representations of Chinese characters. This heterogeneous set of TLS would have the same critique for Shen's LS classification being too broad (Kan, Owen, and Bax 2018).

Therefore, the current study incorporates the concept of embodiment to further refine the classification of TLS, which allows us to step outside of the conventional typology of LS and offer a new perspective to pinpoint the categorisation of LS in the digital, multimodal and multilingual era. Pennycook (2017) has pointed out the common grounds between translanguaging and embodiment in a view of cognition being both embodied and situated. The integration of embodiment with translanguaging is a response to the call of Jusslin et al. (2022) for under-recognised dimension in language education that embodied learning approaches contribute to ongoing translanguaging trend in language education.

4. Methodology

4.1 Think-aloud protocol (TAP)

As a response to the call for "other micro-level, process-oriented methods" in LS research (Thomas et al. 2022, 3), the think-aloud protocol (TAP) was employed for in-depth qualitative analysis of all possible strategies used in learning Chinese characters when typing. As a concurrent method originated in psychology (de Jong 2005), TAP is widely used to measure cognitive process (Cotton and Gresty 2006). Building upon the assumption of accessing and verbalising information held in the short-term memory (Eccles and Aarsal 2017), TAP can be conducted in two ways: concurrent protocol and retrospective protocol (Bowles 2010; Cotton and Gresty 2006; Young 2005). The former refers to participants verbalising their thoughts *while* performing an assigned task, the latter produces verbal reports *after* completing the task (Bowles 2010, 13).

Because of the process nature of TLS, the TAP data in the study refers to the concurrent protocol produced continuously throughout the participants' engagement with a writing task. Another benefit of TAP as opposed to the self-reporting used in previous research is to observe these mentally guided actions in real time as opposed to replying on the learners' memory of what they did during the learning process.

The TAP task is typing to learn newly introduced Chinese characters (see Appendix A for the list of all characters). Since participants had to verbalise everything going through their mind while performing this task, their thoughts were driven to concentrate on the typing behaviour. So, the verbalised thoughts and observed actions have to be strategic for the purpose of carrying out the typing task, in line with the LS definition discussed earlier. The TAP tasks provide ample qualitative, empirical data that can be analysed to examine the newly proposed TLS. They also offer the micro details of learners' actions and thoughts in the process of learning Chinese characters, which may contribute to establish a novel TLS typology.

4.2 Participants and procedure of the study

Beginner participants refer to CFL learners who had almost no prior knowledge of Chinese language and were enrolled in a Chinese language course that geared towards HSK 1 (Hanyu Shuiping Kaoshi, standardised Chinese Proficiency Test; see also Osborne et al., 2022). Pre-intermediate participants had approximately one-year formal language learning. They were enrolled in a Chinese language course aiming for a proficiency level equivalent to HSK3.

Before starting the TAP tasks, all participants were provided with step-by-step instructions on typing Chinese and a guidance on TAP (see Appendix B). The wording of the TAP instruction is simple and general to avoid influencing the participants (Ericsson and Simon 1993). Because of the concurrent nature of TAP in the study, the participants were not prescribed to use a specific language in their verbalisation. Therefore, their freedom to use their language of choice to verbalise their thoughts allows us, to a large extent, to capture their spontaneous cognitive process. Since 78.13% of participants were native English speakers and 21.87% were near-native English speakers, all of them performed the TAP tasks mainly through English. Interestingly, 46.88% of participants were reported to be bilingual in English and another language. This means that, in comparison with monolingual learners, they may possess a larger multilingual pool for verbalising their thoughts, which was manifested in translanguaging interdependency (TLI, see Section 5.1).

Before TAP 1, ethical consent forms were gathered from participants, followed by a short training on TAP and a pilot of typing Chinese when thinking-aloud in the classroom with one of the researchers. This also offered an opportunity for participants to raise any questions in relation to the data collection, including technical issues when typing and/or recording. Later, each of four TAP tasks was designed as the participants' regular weekly exercises during their study of the

Chinese language course. Because the research was voluntary, not all students participated and subsequently completed the TAP tasks.

Table 1. Number of participants in each TAP task

	Tap 1	Tap 2	Tap 3	Tap 4	Total
Beginner	13	13	10	12	48
Pre-Intermediate	19	19	18	17	73
Total	32	32	28	29	121

While 32 CFL learners participated in the research (13 Beginner and 19 Pre-Intermediate), not all took part in every single TAP task, due to the voluntary nature of the project. Table 1 shows the number of participants in each of four TAP tasks. The total length of recordings from 48 beginner CFL learners are almost three hours (02:47:14), whereas about four hours recordings (03:44:02) were collected from 73 pre-intermediate learners.

5. Data analysis

The data were first analysed and coded using the working definition of TLS. As stated earlier, TLS mainly involve the holistic engagement of one’s (a) linguistic repertoire and (b) semiotic assemblage to strategically guide the study of a foreign language. Any references in the data featuring these were coded as TLS. The concept of embodiment was incorporated into the classification of TLS, which entails a fine-grained TLS typology.

5.1 Embodied TLS

Embodiment, or embodied cognition, embraces organism-environment mutuality to emphasise that “cognitive processes of all kinds are rooted in perception and action” (Craighero 2014, 51). In this sense, the conventional body-mind dichotomy is challenged. The body is “crucial for cognition” (Di Paolo and Thompson 2014, 68), as it “intrinsically constrains, regulates, and shapes the nature of mental activity” (Foglia and Wilson 2013, 319).

Embodied cognition maintains that language understanding is grounded in the world, including our sensory experience and actions (Andrews, Frank, and Vigliocco 2014). When it comes to language learning, embodied cognition refers to the idea that one must “‘internally run’ or ‘simulate’ the corresponding production process” when understanding a physical stimulus (Bi, Han, and Zhang

2009, 1194). Instead of conceptualising language as internalised symbols in the mind, embodiment argues language comprehension is an amalgamation of people's sensory experiences and actions in their physical environment (Louwerse and Jeuniaux 2008; Atkinson 2019).

Embodied cognition emphasises the connection between language comprehension and a learner's previous sensorimotor experiences (Scorolli 2014). With handwriting in particular, the motor movement and hand-eye coordination can consolidate the corresponding simulation of a physical stimulus – a Chinese character in this case. Typing requires finger movements on a keyboard to spell the pinyin of a Chinese character and then choose the intended one from a list of characters with the same pronunciation generated by the input system. The bodily movements of pressing keys can also consolidate the learner's sensorimotor experience with the typed character, ultimately contributing to the memorisation of the character (Zhang Forthcoming). As a result, embodiment, which brings action and cognition together, is a useful and appropriate concept to further classify TLS since LS in nature are “dynamic thoughts and actions” (Oxford, 2017, p.48), as discussed earlier.

Lu (2011; see also Lu et al., 2013) specified five types of instructional embodiment which are tightly linked to computer technologies for learning Chinese characters: Direct embodiment (DE), Surrogate embodiment (SE), Reflective embodiment (RE), Haptic embodiment (HE) and Imagined embodiment (IE). Appendix C outlines these five types and their applications in teaching Chinese characters using computers. Based on the explanation of each embodiment, DE and SE are unlikely to be involved in typing to learn Chinese as they engage with either an agent or surrogate.

Zhang et al. (2022) identify a large number of TLS with corporeal, kinaesthetic features when handwriting. Since typing is also a kind of physical movement that can be mentally stimulated and activated to assist the study of typed characters, HE is likely to be found in TLS. Importantly, although embodiment initially focuses on the crucial role of body – especially physical body – played in cognition, recent literature points out that “embodied activity goes beyond visible, bodily activity (i.e., actual movement) to also account for inner bodily sensations, experiences, and physiological changes” (Jusslin et al. 2022, 2). The study takes this extensive conception of embodiment, to investigate motor actions embodied in learning, as well as multimodal, multi-semiotic and multisensory engagement of social and material surroundings. Therefore, HE and IE are likely to be found in the process of typing to learn, either through learners' fingers hitting a keyboard or activating one's imagination of bodily activities. Instead of an umbrella category of TLS in Zhang et al. (2022), embodiment is now refined into HE and IE for later classification of the TLS identified in the TAP data (see Table 2).

The hybrid type of LS (Zhang et al., 2022), also known as ‘creating a narrative’, is developed into RE (see Table 2) to capture the reflective thoughts that are drawn from embodied experiences grounded in a personal, social and cultural matrix. In this way, the overly extensive category of hybrid type from Zhang et al. (2022) is now ground down by a relatively narrow notion of RE. Importantly, not all reflective thoughts are categorised as RE. Only those referring to embodied activities are considered as RE. Example 3 displayed later shows that a reflective narrative that a learner had when learning the character 日. But this reflection mainly involves IE and TLI (translanguaging interdependency; see below) rather than RE. It is worth noting that RE in the current study is different from that in Lu’s study; the latter emphasises on the physical, reflexive actions that learners can see from a webcam.

Apart from HE, IE and RE, another two categories, i.e. trans-semiotising interdependency (TSI) and translanguaging interdependency (TLI), are introduced to coding (see Table 2). Both categories are derived from the symbol interdependency hypothesis (Louwerse & Jeuniaux, 2008). TSI refers to learning Chinese characters by virtue of activating and associating multi-semiotic resources. An example would be the large number of references found in Zhang et al. (2022) that learners identified the similarities between an object and a Chinese character. For instance, a learner described the top of the character 两 as a tall bridge. While this association seems to be between two symbols, the symbolic association becomes meaningful only if the learner comprehends a tall bridge through concrete entities that he/she encountered before. Thus, the study of the character is ultimately grounded in embodied experience.

TLI refers to learning Chinese characters through their association with other linguistic symbols. An example would be the translanguaging resemblance type of TLS found in Zhang et al. (2022). This type of TLS suggests that learners draw from their multilingual repertoire to associate a new linguistic symbol with that he/she has already possessed. For example, a learner spotted that the outside part of a character 送 is similar to the letter L, an alphabet the learner is familiar with (Zhang et al., 2022). The symbolic association indicates that the study of a new linguistic symbol – for example, the character 送 – depends on an acquired linguistic symbol, the letter L. Interdependencies of amodal linguistic symbols work as a shortcut for learners to achieve their learning goal “without any extensive [embodied] grounding being needed” (Louwerse and Jeuniaux 2008, 320).

5.2 Coding the data

All audio recordings were first transcribed by a researcher assisted by ‘Transcribe’ in MS Word 365. The transcriptions were then checked and proofread by the sec-

ond researcher. From a total of 121 audio files, approximately 31,389 words were transcribed from TAP tasks. After that, thematic analysis was conducted to identify the common TLS employed in the learning process. Two researchers read the transcription in depth and coded independently using five codes listed in Table 2. The proposed codes were reviewed, refined and finalised among the research team.

Table 2 outlines the codes using the categories proposed above: HE, IE, RE, TSI and TLI. A brief explanation and quotations from the TAP transcription are also provided as examples for each code. After the first round of coding, a few issues were identified to differentiate TSI from IE and RE.

The main difference between TSI and IE & RE is that the former does not involve embodied aspect. For instance, a learner may link the Chinese character 目 with an eye or a blinking eye. These references can be categorised into IE since it engages with physiological sensations. However, if a learner compares the character with the shape of a ladder, it should be grouped into TSI; or if it is connected with another character in a similar structure, e.g. 目, the reference should be coded under TLI. Similarly, when a reflective thought does not include any embodied elements, it was excluded from RE. For example, a learner may say “this character reminds me the leaves [from a tree] in the autumn”. This reference is coded as TSL rather than RE.

Table 2. Codes in the study for TLS

Code name	Brief explanation	TAP context and quotation *
HE (Haptic embodiment)	Indicate the finger movement on a keyboard, such as spelling out the pinyin of a character, or pressing on keyboard to select a character.	When the participant was typing to learn the character 同 (tóng, meaning the same), the participant said the following in TAP: “It’s the first option that appears [on the computer screen] when I type the initial T and the final o-n-g into the keyboard.”
RE (Reflective embodiment)	Engaging one’s reflective thoughts with physiological experiences and sensations for language learning.	When the participant had completed typing two characters and just proceeded to next one, the participant found the typing exercise in general was straightforward, but it may not encourage memorising the whole character composition: “So that’s easy as well. And I’m just used to typing in Chinese, because I like text my boyfriend and stuff, so I don’t like think about, oh, how am I going to remember [the character]? I kind of just trust the keyboard to know what I’m saying then.”

Table 2. (continued)

Code name	Brief explanation	TAP context and quotation *
IE (Imagined embodiment)	Engaging one’s imagination to simulate or visualise physical experiences, sensations and emotions for language learning.	When the participant was typing the character 风 (fēng, meaning wind), his/her imagination was engaged to visualise the composition and meaning of the character: “And for the next word, I’ll be typing out is 风, which means wind. I feel like when I actually pronounce the word 风, it feels like the air is flowing out of my mouth while also the... the cross in the middle is like... a breeze of wind trying to push against this enclosure that is around it... which kind of reminds me of wind blowing.”
TSI (Trans-semiotising Interdependency)	Activating one’s multi-semiotic resources to establish associations between them for language learning.	When the participant was typing to learn the character 学 (xué, meaning to study), he/she linked the character with an object — desk — which is often seen in a school: “...but the top bit of it, kind of... looks like a desk, which would be, which would be at schools.”
TLI (Translanguaging Interdependency)	Activating the associations between two or more linguistic symbols in one’s multilingual repertoire for language learning.	When the participant was typing to learn the character 女 (Nǚ, meaning female), he/she associated the character with the left part of a character previously learned 好 (hǎo, meaning good): “When I think about it, it’s like... female and... kind of how it’s also in the... same character as like as 好.”

Note:
* Any ellipsis used within a quotation from the TAP data indicates pauses made by a participant him/herself. Since participants were encouraged to speak out loud whatever went through their mind during the TAP tasks, the speeches transcribed from the TAP data are naturally not always coherent or fluent.

After the clarifications between TSI, IE and RE, a second round of coding was carried out. A certain level of overlaps between codes were identified. Usually, a short narrative is categorised into a code while some segments within the narrative can be grouped into another code (See examples in Appendix D).

Figure 1 shows the overall results. The number of references in HE is the highest ($N=361$), followed by that in TLI ($N=227$). The code of RE contains the smallest number of references ($N=46$), whereas IE ($N=88$) and TSI ($N=68$) consist of moderate number of references.

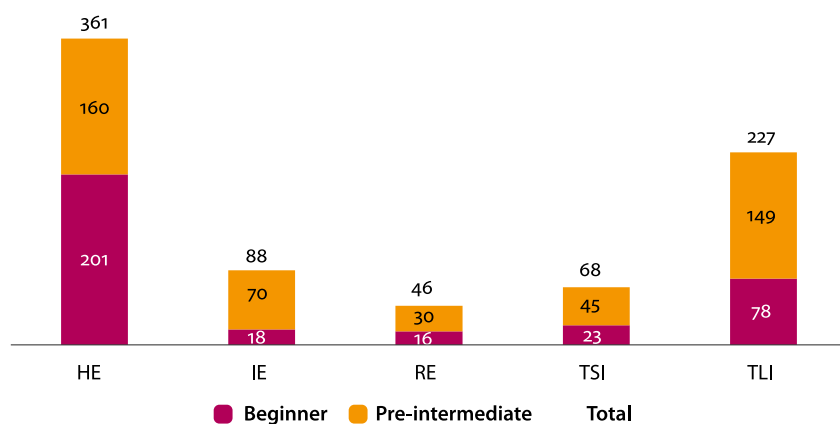


Figure 1. Number of references according to five codes

The main difference between the CFL beginner and pre-intermediate groups is in the frequency of HE. With 73 pre-intermediate participants and 48 beginners, more transcriptions were consequently collected from the pre-intermediate, but far less HE references were identified in the pre-intermediate group strategies ($N=160$). Another difference is in the frequency of IE and TSI. While IE is the third most employed strategy by the pre-intermediate group ($N=70$), it is much less used by the beginners ($N=18$). Instead, TSI is the third most employed among beginners ($N=23$).

The next section first discusses these two main differences in the frequency of TLS employed in learning Chinese characters due to varied language proficiency. It then compares the TLS identified in typing with those recognised in handwriting in Zhang et al. (2022).

6. Discussion

While it seems natural to spell out the pinyin to guide the finger movements on a keyboard when typing Chinese, CFL beginners tend to employ HE far more frequently than pre-intermediate learners. A plausible explanation is that the pre-intermediate group went beyond the bodily motor activities to engage their imagination with grounding a newly learned Chinese character in embodied experience (namely, IE), or employing their multilingual repertoire for correlations among linguistic symbols (i.e., TLI).

Previous research (Li 2006; Q. Zhang and Min 2019) found that typing usually supports higher-order thinking. Consequently, a writer's attention can be devoted to the meaning of a writing composition rather than the action of writing

itself. The large number of IE and TLI identified among the pre-intermediate group suggests that learners with improved language proficiency can allocate their mental space for higher-order thinking, including comparatively indirect embodied experiences by the route of imagination or connections among linguistic symbols. In contrast, the frequent use of HE among beginners indicates that the beginner group may concentrate on their physical movements when typing to learn.

The relatively large number of TLI ($N=149$) also indicates that the pre-intermediate learners are in possession of a bigger Chinese linguistic fund compared to the beginners, which consequently allow them to use TLI far more frequently than the beginner group ($N=78$). Despite the fairly smaller linguistic fund of beginners, they bypass this disadvantage through adopting TSI which is the third most used strategies. By means of detouring the multi-semiotic, multi-modal and multisensory resources, they managed to ground Chinese characters new to them in their embodied experiences and sensations.

Next, we will compare the TLS used in handwriting with those in typing. While the classification of TLS proposed in the research of Zhang et al. (2022) has been refined in the current study, the categories overlap considerably and are subsequently presented in Table 3 for a comparison. Both the raw frequencies and percentages of frequencies in each study are listed in Table 3.

Table 3. Classification of TLS in two writing modalities*

Handwriting (Zhang et al., 2022)			Typing (current study)		
TLS categories	No. references and percent		TLS categories	No. of references and percent	
Link to animated motion	153	13.00%	HE	361	48.52%
Link to body parts	324	27.53%	IE	88	11.83%
Link to objects (excluding body parts)	301 [#]	25.57%	TSI	68	9.14%
Link to other characters	339	33.90%	TLI	227	30.51%
Link to Roman alphabet shape	60				
Total	1177	100.00%	Total	744	100.00%

Note:

* ‘Creating a narrative (CN)’ (also named the hybrid type of TLS) in Zhang et al. (2022) is excluded from the comparison since it is narrowed down into RE in the current study. CN is a broader category than RE and consequently cannot be compared with RE.

[#] This number of references was calculated based on the total number of ‘Link to other objects (LO)’ minus the number of ‘Link to body parts (LbP)’: $625-324=301$. Details can be found in Zhang et al. (2022, 14).

The main difference in TLS between handwriting and typing is the varied frequency of use of HE and TSI. While HE seems to be most frequently adopted in typing (48.52% of all TLS for typing), it is actually the least used TLS when handwriting (13.00% of all TLS for handwriting). HE in typing mostly consists of finger movement on a keyboard to type the pinyin of a character, which suggests that CFL learners tend to aurally engage with Chinese characters when typing.

In contrast, TSI and TLI seem to dominate in handwriting (25.57% and 33.90% respectively). Even the frequent use of IE in handwriting (27.53%) was named as ‘Link to body parts’, indicating that learners linked the shape of a Chinese character with similar corporeal representations, such as leg, hair or smiley face (Zhang, Lin, and Osborne 2022). This finding suggests that the TLS for handwriting mostly rely on an association between a Chinese character and a symbol with similar shape or structure, regardless of the symbol being linguistic, corporeal, or material. Indeed, the earliest Chinese writing script is pictographs which depicts “shapes and images of real-life and abstract objects” (Liu 2021, 34). The pictographic origin might be the plausible explanation for the reliance on symbols when handwriting to learn Chinese characters.

The varied TLS for typing and handwriting seems to signify a tendency of auditory or visual learning between two writing modalities. Handwriting contains a relatively straightforward encoding process (see Figure 2). Visual engagement is initiated immediately when handwriting to learn. The visual input is encoded visually via drawing with pen and paper, to also produce a visual output – a Chinese character. The constantly visual process entails the heavy dependency on symbolic similarities when choosing TLS.

However, auditory learning primarily remains at the initial stage of typing. The visual input – a Chinese character – needs to be auditorily encoded in order to access its pinyin, which entails motor encoding to produce it visually (see Figure 2). As a result, CFL learners mainly sought out HE which are auditorily initiated. Interestingly, the transmodal nature of typing unlikely prompted the CFL learners to choose a wide range of TLS, such as TSI and IE, to learn characters.

A possible explanation is that transmodal typing may take up considerable amounts of cognitive load. Because of the multiple steps involved, typing Chinese is not “as simple as imagined” (Wong, Chai, and Gao 2011). When learners have to allocate attention to shifting between auditory and visual modes, less attention can be given to the variations in TLS. The complexity of typing can also explain the varied TSL between beginner and pre-intermediate learners, as discussed earlier. This finding seems to contradict the claim that typing is likely to reduce the physical and cognitive workload compared to handwriting (Zhang and Min 2019). It is worth noting that typing in this study exclusively refers to key presses of individual Chinese characters. When it comes to a text composition, e.g. essay writing, the potential benefit of reduced workload of typing may be visible.

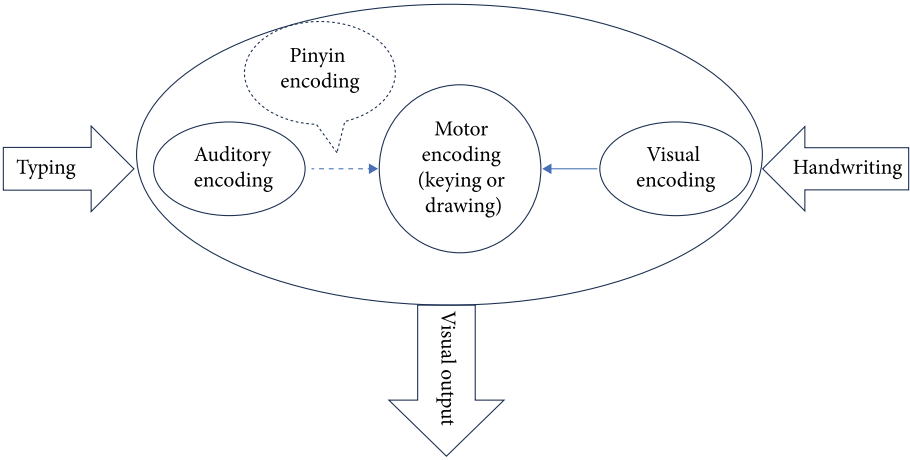


Figure 2. Auditory and visual encoding in typing and handwriting (adapted from Zhang and Reilly 2015)

7. Limitation

Theoretically, the study is the first to identify LS for typing to learn while using a translanguaging framework. Although the concept of TSL was substantiated using TAP data, more empirical research is needed to validate this pioneering proposal.

Methodologically, TAP itself involves limitations. The first relates to participant’s verbal ability. Cooke and Cuddihy (2005) pointed out that some participants are not proficient at verbalising their thoughts, in spite of being trained prior to the task. It is commonly seen when participants simply stay silent or fill “the silence with verbal placeholders (e.g., ‘umms’ and ‘ahhs’)” (Cooke and Cuddihy 2005, 653). It is equally possible for participants to successfully perform TAP while their verbatim data shows no engagement of thought processes (Young 2005). The current study also identified various gaps of silence in the transcriptions, while the sound of keyboard tapping can be heard. Several participants only read out loud the pinyin of characters they were typing throughout all the four TAP tasks, without any deliberation or reflection.

In addition, the potential effect of participant’s reactivity for veridicality is another concern with the validity of TAP (Bowles 2010; Young 2005; Zhang and Zhang 2019). It is indeed unnatural to verbalise one’s thoughts and hear one’s own voice during an activity usually undertaken silently, which may be cause for amusement. Furthermore, as outlined in the informed consent form, participants are made aware that the TAP data will be listened and analysed by researchers afterwards. Participants may not ‘think’ and subsequently verbalise their thoughts in the same way they normally would due to the observational effects (Cotton

and Gresty 2006). Cotton and Gresty stated a few artefact of statements to exemplify the influence of observational set-up, e.g., “I think I’ll go back to that” (2006, p.50). Likewise, statements such as “hello” at the beginning and “thank you”, “I think that’s all” at the end of a TAP task in the current study demonstrate the participant’s reactivity affected by the idea of being observed.

A variety of researchers have put forward advice on tackling these limitations, including pre-task training and clear instructions (Bowles 2010; Cotton and Gresty 2006; Young 2005; Zhang and Zhang 2019). The study has followed these recommendations with a pilot study prior to the data collection. Interestingly, there have been trends of combining TAP with eye-tracking, especially in usability evaluation (Cho et al. 2019; Sivaji and Wan Ahmad 2014). Godfroid and Spino (2015, 897) maintain that these “two measures provide complementary information [...] and therefore may lend themselves to triangulation, or use within the same study”. This methodological pair has been gradually gaining attention in translation studies (Garipova and Latypov 2019; Zheng and Wang 2020) or applied linguistics (Bilici, Subasi, and Dolgunsoz 2023; Smith 2012; Zhang and Zhang 2019).

Scholars (Rose 2015; Rose et al. 2018; Thomas et al. 2022) have been calling for the use of eye-tracking in LS research. This would avoid total reliance on TAP, through a comparison between what participants say and what they actually do based on scrutinising eye-tracking data. An eye-tracker was available and tested for the current study. However, typing by learners at beginner or pre-intermediate level usually involves regularly shifting their eyes between the screen and the keyboards, which would significantly affect the validity of data collected by an eye-tracker. With the hope of eye-tracking technologies advancing in near future, an integration of TAP and eye-tracking may be used to enhance our understanding of strategies in language learning.

8. Conclusion

At the frontier of LS (learning strategies) research, the study proposes TLS (translanguaging learning strategies) to capture the strategic thoughts and actions taken by learners when studying Chinese characters. It pioneers the incorporation of embodiment with translanguaging to introduce a novel typology of TLS consisting of HE (haptic embodiment), IE (imagined embodiment), RE (reflective embodiment), TLI (translanguaging interdependency) and TSI (trans-semiotising interdependency).

With this classification, findings drawn from TAP (think-aloud protocol) data show some variations in TLS employed in two writing modalities – handwriting

and typing. While CFL learners mainly relied on HE when typing to learn, a wider range of strategies, including IE, TLI and TSI, were drawn from during handwriting. A plausible explanation is that typing activates auditory encoding, which prompts learners to focus on finger movements on a keyboard. Handwriting, on the other hand, goes straight from visual input to visual encoding, which cues learners to draw from their knowledge fund for symbolic and physiological similarities. The study spotlights the TLS employed in two writing modalities, thus contributing to the advancement of Chinese pedagogy with TLS-informed instruction appropriate to specific tasks. With the TLS-informed instruction, learners can be made aware of TLS use and choose the form suitable for his/her learning style (Oxford 2017).

Language proficiency also plays a role in the frequency of TLS adopted in typing. Because of a relatively larger linguistic repertoire, the pre-intermediate group can resort to TLI more often than the beginners. Improved language proficiency also allows this group to carry out higher-order thinking rather than concentrating on the action of writing itself, which is evident in the higher frequency of IE.

RE is a new category that is examined for the first time in the study. It therefore cannot be used to compare the results of handwriting with that of typing. Future research is needed for a comprehensive scrutiny of the variations in TLS between two writing modalities. In addition, the novelty of TLS and the innovative typology of TLS will need to be validated with further empirical data. The limitations of TAP stated above would need to be addressed in future research, especially in combination of eye-tracking to leverage methodological triangulation.

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Appendix A. Chinese characters for each TAP task

Tap order	Tap 1	Tap 2	Tap 3	Tap 4
Chinese proficiency				
Beginner	同; 女; 四; 谁; 学	你; 月; 口; 写; 心	会; 说; 人; 日; 包	医; 大; 看; 国; 饭
Pre-Intermediate	目; 风; 冰; 声; 刀	国; 风; 新; 完; 日	围; 斤; 别; 牙; 爱	口; 后; 秋; 前; 一

Note: The five characters chosen for the study in each of four TAP tasks include a representative of these structures: integral, left-right, top-down, half-surround and full-surround. In this way, the TLS identified in the study would not be centred on a particular structured character. It would stem from learning characters in all different structures.

Appendix B. Guidance and instructions for TAP

Guidance on think-aloud method

The study asks that participants employ the think-aloud method when practicing typing each of the five characters weekly. In a nutshell, the think-aloud method involves verbally articulating your thoughts and commentary when typing. More information can be found below.

- You should begin the audio recording as soon as you begin the task
- The purpose is to record what you are **thinking** and **doing** as you carry out the task
- You might begin with a prompt such as: “the first character I am going to type is...”

- You can describe anything that comes to mind when typing, such as the character sound, shape, meaning, related topics etc.

Instructions for four think-aloud exercises

- Four think-aloud exercises over four separate weeks
- Type each of five characters out a total of ten times
- Using your phone, record yourself thinking aloud all thoughts that come to mind when typing the characters
- Send the (1) typed characters and (2) your recording to [\[email of language instructor\]](#)
 - If your phone allows the speech-to-text function, please record using this and send both the audio and transcript
- Worth [weighting out of 100%] of your coursework (Homework)

Appendix C. Lu's (2011) classification of embodiment for learning Chinese characters

Type	Definition	Application
Direct embodiment (DE)	DE refers to an agent acting as or embodying a being or robot, which is often used in robotics research.	Learners obtain proprioceptive experience by meaningfully moving their torsos and thus fully-bodily enacting what they are learning, such as embodying Chinese characters that contain 'water' or 'fire' radical.
Surrogate embodiment (SE)	SE refers to physically manipulating an agent, which has been designed to represent a particular object or person.	The use of surrogate's actions to replace torso movements; yet, it is effective in language teaching and learning. In practice, teachers may create different radicals' manipulatives as surrogates for learning activities.
Reflective embodiment (RE)	RE refers to the use of a webcam in the process of embodiment in which learners are able to see themselves move on the computer screen when they interact (mostly using their hands) with the computer in a game.	Teachers of CFL may design animation-based or interactive games to allow learners use RE for learning different Chinese characters. For example, RE can be used in a word discerning game for word recognition or character differentiation.
Haptic embodiment (HE)	HE refers to the sense registry through haptic channel such that learners use their hands to write, touch, or click a mouse.	When teaching CFL using HE, teachers can provide selected Chinese characters on a Smart Board, computers, or on cards as stimulation, and then ask

Appendix C. (continued)

Type	Definition	Application
		learners to self-generate and group common morphemes (ex. radicals) or common phonemes.
Imagined embodiment (IE)	IE refers to consciously engaging one's imagination to mentally picture movement or action.	For example, during the beginning learning phase of a class, teachers of CFL can ask learners to encode (after seeing certain words) then decode (by thinking and imagining quietly without seeing these words) these characters.

Appendix D. Three examples of overlapping codes

Example 1: I remember this one because... And we were learning how to write this one in class. This was the first time that I realized <u>whenever there is a box in any of the characters, you can't... You have to finish everything that's inside the box shape before closing it up.</u> To write it in the proper order.	The whole narrative is RE, but the sentence underlined is coded as IE since it describes the similarity of the character's shape as a box.
Example 2: I'm trying to find it [the character 学] now. When I type it in the keyboard... Cannot find it. Oh no, I found it. <u>I had to type in 学生 the whole thing to get the one character.</u>	The whole narrative in Example 2 is RE, whereas the part underlined is TLI since it links the character 学 with 学生 is TLI.
Example 3: [The character] 日. There is a character that I think it follows after like in the Analects. Before any quote is like 孔子 something [日] and it looks very similar to and. <u>It's like shorter. And fatter.</u> but otherwise look basically the same.	TLI is used in Example 3 to show the similarity between 日 (meaning day) and 日 (meaning to speak). However, IE is also involved for the part describing 日 is 'shorter and fatter'.

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