

Role of Crosslinguistic Influence in L3 Learning Process Through Information Processing Insights¹

Er Xiao WANG², Jace HARGIS³

Abstract

Potential ways in which previous language knowledge could influence language learning and teaching is attracting increasing attention of researchers due to the developing multilingual phenomenon. However, a conversation between **crosslinguistic influence** in language education and information processing theories is still a rising topic. This study assesses the crosslinguistic influence of classroom third language learning and teaching from the scope of **psychotypology** and possible learning strategy from L3 romance language learners (n=90, L2 English L1 Chinese). Qualitative methods were utilized to extract insights from students' reflective elaboration. Findings show the diverse and dynamic nature of crosslinguistic influence in early language learners' perception. While psychotypology perception is most likely to be related to L2's facilitative role of declarative knowledge, the transfer of procedural knowledge from L2 to L3 seems not to be influenced by a psychotypological perception. Results were then discussed within the context of **information processing** and provided possible implications for instructors. Finally, this study hopes to draw further attention to the cognitive aspect of crosslinguistic influence and its application in education.

Keywords: Crosslinguistic Influence; Psychotypology; Modal Model of Memory; Control Process; Learner Strategy

Recommended Citation:

Wang, E., & Hargis, J. (2023). Role of Crosslinguistic Influence in L3 Learning Process Through Information Processing Insights, *International Journal on New Trends in Education and Their Implications (IJONTE)*, 14 (1), p. 21-34.

Introduction

When foreign language teachers walk into classrooms, they will easily find their students under the influence of previous language knowledge in one way or another. This phenomenon, termed crosslinguistic influence (CLI), is a long-standard and preventable issue in multilingualism with a variety of inter-tangled variables and discussions. In the third language (L3) classroom in a sino-american university in China where multilingualism is a normality, CLI becomes a salient factor in learning and teaching. Every semester, ten sections of romance language (Spanish and French) courses are offered with the instructional language as English. Questions that are commonly asked of these students include:

- How do they mark the closeness of languages?
- How do they make sense of a new language in relation to another language?

¹ A study investigating the role of crosslinguistic influence in L3 learning process through information processing insights.

² Corresponding author: Er Xiao Wang, B.A., Graduate Student Columbia University, New York City, NY USA, ew2750@tc.columbia.edu ORCID: <https://orcid.org/0000-0001-9589-8340>

³ Jace Hargis, PhD, Professor Kean University, Union NJ USA, jace.hargis@gmail.com ORCID: <http://orcid.org/0000-0002-9372-2533>

- How English-related knowledge is utilized during the learning process?

This study proposes a closer look at CLI from how learners create a new language schema of L3 by relating new knowledge to their existing second language (L2). The study will examine how the information processing theory offers insights to CLI and L3 learning. The approach will access the classroom CLI from a reflective students' point of view and ask two sub-inquiries within the general topics of CLI: psychotypology (students' perception of language closeness), and learner strategy (how they think the languages are similar) and hence take advantage of the implications.

Research Questions (RQ)

1. What is the student's perception of L2 closeness to L3?
2. How do students recognize their L2 knowledge influences L3 learning?
3. Is there a relationship between language perception and L2 influence during L3 learning?

Operational Definitions

- Information processing (IP) views learning as a flow of information. It is a study of how sensory input is transformed, reduced, elaborated, stored, retrieved, and used, based on the two-story memory model (Atkinson & Shiffrin, 1968).
- Attention is the focus on a stimulus (Hargis, 2001) that results in information being passed to short-term storage (STS).
- Rehearsal is a/n c/overt repetition of information (Atkinson & Shiffrin, 1971) in STS.
- Coding is the choosing of particular information to be rehearsed. It consists in adding chosen information from long-term storage (LTS) to a trace to be remembered and then rehearsing the entire complex (Atkinson & Shiffrin, 1971).
- Cross-linguistic Influence is knowledge (procedural and declarative) of one language that depends on use of another language (Faerch & Kasper, 1983).
- Psychotypology (Students' Perception) is the perception of language typology; the learner's recognition of congruent forms between a previously acquired language and target languages (Murphy, 2003).
- Learner Strategy is procedural knowledge of a language, "knowing how", such as the strategies and processes used to learn a new language (Faerch & Kasper, 1983).

Information Processing Model

Information processing (IP) approach is how sensory input is transformed, reduced, elaborated, stored, retrieved, and used, based on the two-story memory model (Swanson, 1987). The two-story memory model proposed by Atkinson and Shiffrin was published in *The Psychology of Learning and Motivation* in 1968. In their memory system model, three permanent structures were delineated: the sensory register (SR), the STS, and LTS, as shown in Figure 1:

Figure 1

Information Processing Model

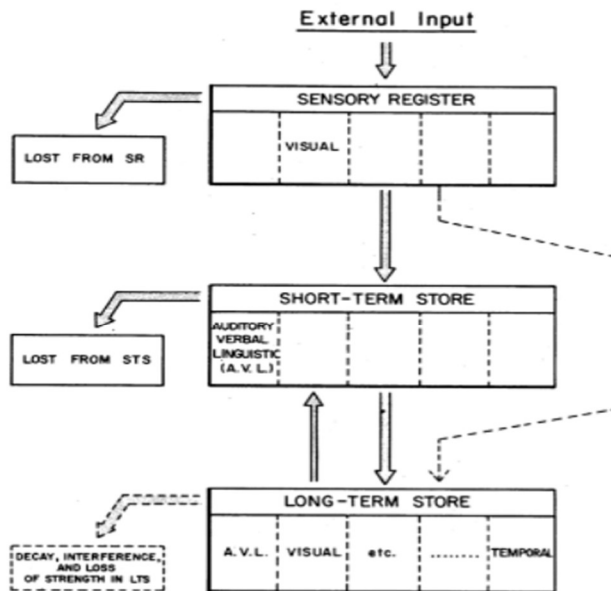


FIG. 1. Structure of the memory system.

Source: Adapted from "Human memory: A proposed system and its control processes" by Atkinson, R. C., & Shiffrin, R. M. (1968) *Psychology of learning and motivation* (Vol. 2, pp. 89-195).

The model consists of two conspicuous components: 1) structures, and 2) control processes. The structures are considered permanent. The external information was perceived and immediately registered by the learner's sensory memory. The decay of this memory was within "several hundred milliseconds" and was "subject to masking and replacement by succeeding stimulation" (Atkinson & Shiffrin, 1968, p.95). Certain registered information was then passed on to STS, which is proved with a limited, but longer duration and larger capacity than the SR (Marois & Ivanoff, 2005). Information in STS will be constantly transferred to the LTS. Information passed on to LTS was considered relatively permanent, although might be modified or temporarily irretrievable as interfered with other information (Atkinson & Shiffrin, 1968, p93). Control process is considered crucial in the transfer of information and the interaction between different components of the memory system. There are various kinds of control processes during different stages, some of the most discussed are: attention, rehearsal, coding, and retrieval.

Attention

In the SR stage, attention is the primary tool of the control process. Attention is used to select the information that SRs. In other words, external input moves through only when sensory input is present. While information is unlimited, attention is limited, which is central to explaining the limited nature of IP capacity (Marois & Ivanoff, 2005). Studies show several varieties of attention: selective, attention, and attentional vigilance (Ocasio, 2011). Selective attention refers to the process in which an individual "focuses on a specific set of stimuli at a time" and has to "choose which range of stimuli to attend to" (Ocasio, 2011 p1287). Selection mechanism is driven by data (bottom-up attentional processing) as well

as by subject (top-down attentional processing). Perception is considered as one aspect of top-down attentional processing. It is the process of mental grasp, awareness and decoding of previous information to select related new stimuli (Atkinson & Shiffrin, 1968). Attention initiates the first step of learning, but continuous attention also plays a role in later steps of IP.

Rehearsal and Coding

One of the major control mechanisms in STS is rehearsal, which serves two purposes to strengthen and transfer memory: 1) maintenance, elongates the duration that a piece of information stays in STS, during which time neurons connections build-up for LTS; and 2) elaboration which facilitates coding process to transfer it to LTS (Khalil & Elkhider, 2016). Coding is the "choosing of particular information to be rehearsed in STS" (Atkinson & Shiffrin, 1971 p.89). In such a case, the chosen information acts as a "probe". Coding process involves the retrieval of associated memory activated by the probe from LTS, but the maintenance and rehearsal of information is selective.

Retrieval

Coding with previous knowledge requires the search and retrieval of information from LTS. This process involves locating the traces (Atkinson and Shiffrin words for the neuron structures and connections). Raaijmakers and Shiffrin (1981) validated Search of Associative Memory (SAM) theory within the framework of retrieval theories. It is based on the previous principles that memory storage and retrieval structures are separate, while LTS is permanent, the retrieval process is noisy and probabilistic. The theory considered memory is stored in units of images, and the basis of retrieval is assumed to be the strength of associative relationship between the probe cues and the memory image (Raaijmakers & Shiffrin, 1981). However, the SAM model exclusively focuses on the recall process. Gillund and Shiffrin (1984) elaborated the retrieval model to include both recognition and recall. Their model bases recognition decisions on familiarity judgment. Familiarity, also termed as direct access to a certain memory, refers to "obtaining the information from LTS in one step" (p.6). They proposed that while the recall process always involves search, the recognition process could be faster and more direct. However, the faster process could generate positive and negative recognition, that is the retrieval of inaccurate memory.

Cross-Linguistic Influence (CLI)

In the early perspective, CLI were primarily defined in the view of linguistic features and typological congruence. Odlin's (1989) defined this term broad enough to encompass both facilitative influence and negative influence: "language transfer is the influence resulting from similarities and differences between the target language and any other language that has been previously acquired" (p. 27). However, in further CLI theoretical and empirical exploration, the focus of CLI has gone beyond the mere influence on linguistic features and reach interdisciplinary such as cognitive science and psychology (McManus, 2021).

The similarity and difference, or the degree of congruence between the source languages and the recipient languages is one of the earliest recognized variables in CLI. This factor is viewed two-sided, from a typology's view and a psychotypology's view. While typology describes the actual degree of congruence of languages' linguistic features (lexicon, structure etc), psychotypology describes the degree of typological congruence the language learner believes or perceives to exist. In Jarvis and Pavlenko (2008) book, the terms Objective similarity (and difference) and subjective similarity (and difference) are used in accordance with typology and psychotypology. This subjectivity causes an individual variable in the learning process. The recognition of subjectivity variables lead to the concept of transferability, defined by Kellerman (1983) as "the probability with which a structure will be transferred relative to other structures in the L1" (p. 117)". Therefore, psychotypology is also referred to as an active influencing factor to multilingual learning, which is individually specific and intertwines with students' comprehension level, confidence in performance and motivation (Zohra, Athmani & Boukhedimi, 2021).

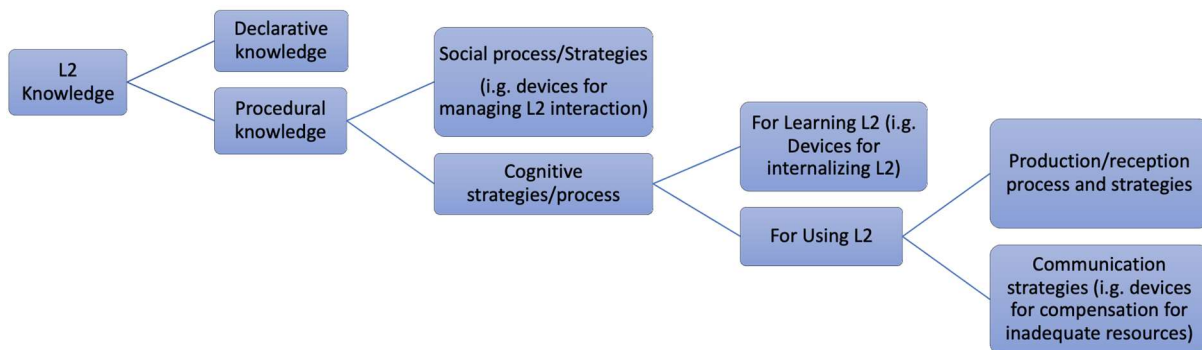
The (psycho)typology factor has often been brought up as a determining factor in L3 acquisition studies in general (Nelson et al., 2021), and also has been examined as an influencing factor in lexicon acquisition (Ecke, 2015), syntax processing (McManus, 2020) and literacy development (Testa, 2020). This influences the learning process because newly encountered forms are mentally matched and associated with already learned forms. Especially in an early stage, language forms that are closely related to the target language tend to be activated in the new language acquisition process and use (Lindqvist, 2015, p232). The CLI phenomenon in L3 acquisition comes with increasing dynamic and complexity given that three or more languages get in contact. Second language influence on a L3 is considered different from that of the L1. The L1 that is acquired during childhood is recognized with a special status whereas the L2 learning process qualitatively resembles a L3 acquisition (Ecke & Hall, 2014).

Types of Knowledge in Language Learners

According to Faerch and Kasper (1983), language learners have two types of knowledge: declarative and procedural knowledge. Declarative knowledge is “knowing that”, such as the rules and vocabularies in the language system. Procedural knowledge is “knowing how”, such as the strategies and processes used to learn a new language, which is also known as Learner Strategy. Procedural knowledge is further divided into cognitive strategies and social strategies. Ellis (1989) describes the social component of learner strategies as the interpersonal and behavioral skills that are used by the learner to manage interactional opportunities. The cognitive component of learner strategy involves both learning the language and using the language automatically. Ellis (1989) describes the former as “various mental processes involved in internalizing and atomizing new language knowledge” in conjunction with other language sources. The later component is defined as the attempts to use existing L2 knowledge efficiently and clearly with a minimum effort. Communication strategies are also a part of learners’ cognitive strategies. This is activated when the speaker is not able to achieve the intended communicative goal but is forced to speak (Figure 2).

Figure 2

Types of L2 Knowledge



Source: Adapted from *Understanding second language acquisition* (Vol. 31) by Ellis, R. (1989). Oxford: Oxford university press. p165.

In addition to the theoretical framework shown in figure 2, current theories added the affective aspect of strategies that helps students regulate their emotions, motivation, and attitudes (Cohen, 2011). In addition, affective strategies are used to reduce anxiety and provide self-encouragement, which is recognized as a crucial component in positive psychology in the Second Language acquisition (SLA) field.

Cross-linguistic influence as teaching and learner strategy

Brooks (1960) encouraged the teachers to focus their L2 teaching on the areas of difficulties that were believed created by the differences between L1 and L2, also referred to as negative transfer. Later scholars found that the difficulties and errors were not exclusively caused or can be predicted by comparing the languages. However, Ellis (1989) argued that the idea to reframe the “language influence” to “strategy” remains, the only question is to what extent and in what way.

In the SLA area, researchers found that L1 influence contributes to L2 learning strategy in various ways. Many studies focus on the learner’s activation of strategy on specific L2 tasks, such as reading, listening, speaking, writing and developing vocabulary (Cohen, 2011). Ho and Teng’s (2007) survey on Taiwan English as Foreign Language (EFL) learners found that the L1 compensatory strategy, namely translation, was the most used L2 reading strategy. Derakhshan et al. (2021) researched on college EFL learners from Iran and found that the social and cognitive strategies of using interlanguage were significant contributors to L2 speech act pragmatic knowledge. Manchón, Murphy and Larios (2007) summarized and discussed the use of the L1 in planning, writing, revising, and monitoring L2 writing as one of the main strategies used by L2 writers. However, in Gu and Johnson’s (1996) survey that among the many vocabulary learning strategies used by Chinese university EFL students, the role of L1 is not as highlighted as other strategies, such as contextual encoding and activation of newly learned words. Also, when the learner is experiencing difficulty in communicating an idea because of a lack of target language resources, L1 could be a make-up for achieving the communication.

Methods

Data Collection

This correlational study was conducted at a joint US-Sino University in China. The participants included 93 native speakers of Chinese, with L2 and instructional language of English. Participants were previously enrolled in a beginning romance language class (French or Spanish), after which they finished the survey and provided consent to participate in this research. Data was collected at the end of the fall semester of 2019, when the classes were conducted face-to-face (F2F). The survey was also completed in a F2F class. A demographic information is summarized in Table 1:

Table 1

Controlled Variables and Descriptions

Controlled Variables	Descriptions
Age	18-23 year old college students
Language repertoire	L1 Chinese Mandarin, L2 English, L3 Romance languages
Language proficiency	L1: Native, L2: proficient (TOFEL 79 and above, IELTS 5.5 and above), L3: beginning level
Respondents form	Face to face in-class survey

As shown in the table, we controlled the language based variables (all learners are native speakers of Chinese, L2 in English and learner of a L3 Spanish or French), and learner-based factors such as age and

language proficiency. Students are selected from a certain English proficiency level (College Entrance Examination score of 110 or above) and are all structured in sequenced ESL courses during their first year of college. All students who completed the survey were enrolled in Spanish or French beginning level courses. Students' psycho-typological decisions are first determined, then they are led to express their reasons to make such decisions. The following questions focus on inquiring students' reflection of L3 learning strategy based on the similarity or difference they perceived between L2 and L3.

Justification of the Questions

The design of the survey is a heuristic reflective structured survey, where participants answered three closed yes-and-no types of questions, each of them followed by an open-ended question. The three questions are worded corresponding to the research questions. The first survey question directly asks the first research question with an open-ended question allowing the researchers to collect qualitative data on students' evidence for psycho typological thinking. We referred to Lindqvist's (2015) choice of word "close" to ask about psychotypology. The second research question is designed to be investigated by the correlation between survey question 2 and 1. The third research question is designed to be investigated by the correlation between the survey question 3 and 1.

Data Analysis

A qualitative analysis was used to determine the influence of psycho typology on the L3 learning process.

1. Students' psychotypology decision is first specified with both Yes and No answers, with possible patterns for qualitative response.
2. Students' answers to the second survey question were analyzed through thematic analysis, with themes being extracted from the answers. Responses that did not answer the survey question were excluded from the analysis.
3. Within each theme, students' answers are viewed in relation to their psycho typological decisions.

Coding systems were developed for each analysis process.

1. Primary coding: Word level
2. Secondary coding: Semantic level
3. Validation: A different researcher who had used the same coding system and produced similar results.

In addition, to examine whether there is a relationship between L3 learning and psycho typological perception, a proportional analysis was performed. In each theme, a proportion-perception similar/total is calculated (range 0—1). The larger the number is, the more this theme is related to students' perception of language relatedness.

Results

1. RQ1: What is students' psycho-typological perception of L2 closeness to L3?

For the first research question, Table 2 below summarized the result of the closed-type question.

Table 2

Result of Students' Psychotypology Decision

Do you think L2 (English) is close to the L3 that you are learning? (n=90)

Item	Yes	No
Count (%)	65 (72.2%)	25 (27.8%)

As the number shows, around three times as many people found L2 is close to the L3 that they are learning. Further qualitative answers are being analyzed.

1.1 Overall decision or aspect-specific decision?

Students were led to provide further explanations regarding their psychotypological decision. The responses were distinguished between giving general descriptions with specific descriptions. Descriptions are defined as the participant providing recognition and thoughts to at least one linguistic or other specific aspect during the psychotypology decision (table 3).

Table 3

Sample Responses of Overall vs. Specific

Overall	Responses (n=13)	Specific	Responses (n=67)
Selective	There is something in common with English and French	Selective	Many words are similar or identical
	Sometimes they are quite similar		There are many French vocabularies that are close to English, and grammar is somewhat similar too.
	English and French are not very close, they have many differences		There are similar language structures and vocabulary.
	They have something different, and make me confused		Some common words they used together

As shown in table 3, despite additional cognitive efforts, a majority (74.4%) of the respondents specify at least one linguistic or other specific aspect that leads to the psychotypology decision. This question seems to have an immediate trigger on certain linguistic experiences for the participants. The list of identified aspects as evidence (triggered experience) of psychotypology decisions is listed in table 4.

Table 4

Count of Aspects That Students Referred to as Psychotypology Evidence

Aspects	Count
Lexicon in general	40
Spelling	10
Pronunciation	21
Semantics (words meaning)	3
Grammar	18

Orthography (alphabetic characters)	5
Pragmatic (language use)	1

As listed, Lexicon is the most mentioned aspect, scored 40. Spelling and grammar are the next popular aspects that are mentioned with "similarity", with counts of 21 and 18. Spelling is also a theme by 10 mentions.

1.2 Ambivalence in answers

Within each aspect, we could find responses in opposite polarities (Table 5).

Table 5

Samples of Opposite Responses

Type	Similar	Different
Grammar/ vocabulary	There are many French vocabularies that are closed to English, and grammar is somewhat similar, too	Much different in grammar, vocabulary, pronunciation
Pronunciation	Some pronunciation is similar between English and French	Alphabets are mostly similar, in spite of difference in pronunciation

Furthermore, in a qualitative answer, rather than the yes and no decision on the psych-typological perception, a more ambivalence attitude could be found within a students' answer ([table 6](#)).

2. RQ 2: How does (students' perception of) language similarity relate to L2's positive influence on L3 learning process?

After providing opinions on how their L2 is similar or different from the L3, students were led to think about this closeness/similarity in connection with the L3 learning process. The question asks how they reconcile the advantage of having had certain English knowledge when learning L3. This question is then analyzed by a correlation between survey Question 1 and 2 ([table 7](#)). Four categories will be presented in regard with students' answers.

2.1. Similarity in general as an advantage in L3 learning

Primary coding: similar/close/familiar

Secondary coding: respondents directly express that the languages share similarities in technical level which is helpful somehow.

Qualitative analysis found 33 responses that reported L2 as an advantage in learning L3 because of the similarity between L2 and L3. Positive feedback for language similarity, the respondents agree L2 L3 similarity is an advantage for L3 learning ([Table 8](#))

2.2 L2 English as a bridge for L3 declarative knowledge processing

Primary coding: 1) remember/memorize; 2) understand; and 3) predict/guess

Secondary coding: Respondents express that English acts as a cognitive source for processing declarative knowledge in L3, and facilitating processes such as remembering, understanding and predicting, etc. ([Table 9](#)).

2.3 L2 English as a bridge for L3 procedural knowledge

Primary coding: skill/ experience

Secondary coding: Respondents express that English-related skills or experiences would be a source for imitation of learning methodology (Table 10).

2.4. L2 is a facilitative tool of L3 learning.

Primary coding: communicate/ professor/ use English

Secondary coding: respondents directly express that English acts as a social tool to get more instruction in L3 (Table 11).

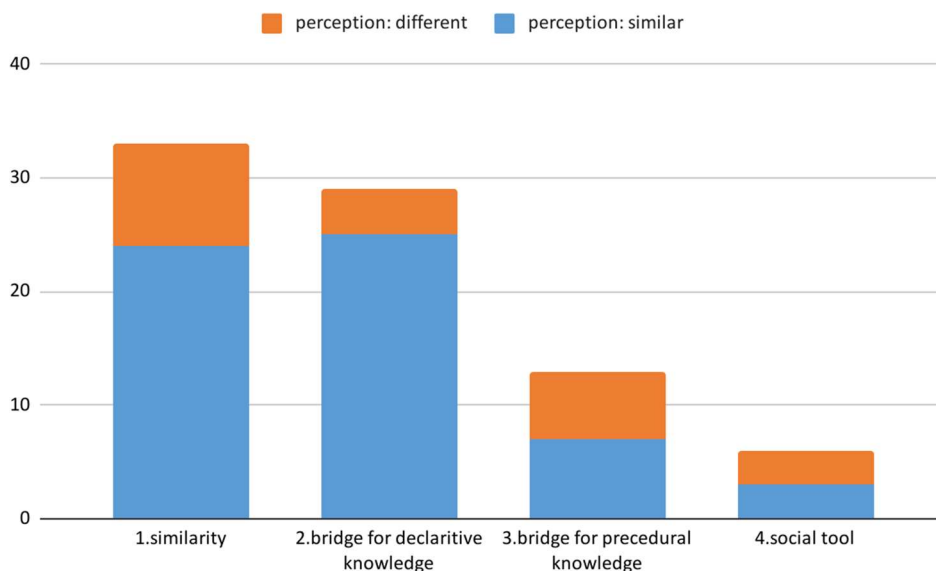
This portion of response reflects students who consider English as a communicating tool with the instructor in terms of getting better access to knowledge. This view is originally unexpected because it diverges from our purpose to examine the content relation between L2 and L3, but it is also presented to show the whole picture of students' response.

3. RQ 3: Is there a relationship between language perception and L2 influence during L3 learning?

In the end, we horizontally related students' answers to RQ1 and RQ2, and plotted it in Figure 3. The color distinction shows the answer students give in RQ1 (psychotypological judgment), and X-axis shows the four themes emerge from students' response to RQ2.

Figure 3

Psychotypology Proportion in Each Theme



As shown in the proportion disposition, the theme "Bridge for declarative knowledge" scored highest (Proportion = 0.86), followed by "Similarity" (Proportion = 0.73). Whereas "Bridge for procedural knowledge" (Proportion = 0.53) and "social tool" (Proportion = 0.5) both scores are around 0.5. This means theme 1 and 2 has more correlation to students' psychological judgment, while theme 3 and 4 do not.

Discussion

1.RQ1: What is students' psycho-typological perception?

Based on the notion that perception is one aspect of attention, a primary psycho typological decision would make a difference in students' IP at the stage of transfer from sensory memory to STS. Similar to selective attention, perception is top-down selective by the subject because it is "mental grasp, awareness and decoding of information based on previous knowledge" (Hargis, 2001), in our case, learners' knowledge in English. In this aspect, those who perceive L2 and L3 are similar may pay more attention to the similarity between the two languages, likewise, those who perceive two languages as different may pay more attention to the L3 aspects that are significantly different from their L2. However, in both cases, there is assumed to be a linkage between L2 and L3 during the early stage of L3 learning, as L2 is the language of learning in the class. In further study, efforts can be made to validate this linkage and investigate the nature of the link (e.g. the ECM and TCM model of learning).

The foundation of research question (RQ) 1 shows that students respond to psycho typology in both ways and also in some ambivalence ways. While typology is an objective variable that could be quantitatively measured, Murphy (2003) included that psycho typology is a learner-based variable with much subjectiveness. It is not right or wrong for the students to perceive the two languages as similar or different. More likely, it is a personal character or habit to be more interesting similarity between things, or difference. Therefore, the finding shows that L3 instructors could/should attend to both language properties that are similar to their L2 and the significantly different features. In theory, both ways can enhance the attention filter and pass more information to the STS.

Moreover, we found that the majority (74.4%) of the responses based their psycho-typological decision on several specific aspects or properties of the language, such as lexicon and grammar congruence. This finding shows a contradiction to Nelson et al.'s (2021) distinction that psychotypology "works at a holistic level of the overall impression of proximity between languages." A further finding shows that the most mentioned language property is at the lexicon level, including phonology (pronunciation), semantics (meaning), and orthography (spelling). Two possible explanations could be responsible for this contradiction and lexicon focus. One reason could be the bilingual learning environment. Murphy (2003) notes that lexicon transfer is more acceptable in a bilingual context. Another explanation is the language learning habit of this particular group of Chinese beginning language learners. This focus indicates that the beginning learner group might have the habit of accessing a new language from its vocabulary, therefore, not yet form an overall impression of a language. Therefore, psychotypology is not likely to be a clear-cut, fixed opinion in language learners' minds, with possibilities to be developed and interfered with along the learning process.

Lexicon is the most mentioned language property (40 times) in this study, followed by grammar (18 times). This result resonates with Lindqvist (2015) finding that grammatical CLI is less common than lexicon CLI. It is less likely to be the first strategy that a student thinks of when in the arena of CLI. Also, in Hall (2002) Parasitic Hypothesis, he stated that in early stages of vocabulary development in a L3 is "automatically exploit existing lexical material in the L1 or L2 to establish an initial memory representation". In their further establishment of Parasitic Model of L2 and L3 vocabulary acquisition (PM), Hall and Ecke (2003) pointed out that lexical acquisition is mapping all domains of linguistic acquisition, including phonological, orthographic, semantic and grammatical. Therefore, when students referring to "vocabulary" or "words" it is difficult to specify which linguistic domains they identified as similar. Nevertheless, this number does show the complex and fundamental role of lexicon acquisition in students' linkage to previous knowledge. In conclusion, we found that students tend to perceive their L2 and L3 are similar (75%). Their decision is made mostly with specific evidence of language properties (74.4%), rather than overall impression (14.4%).

2.RQ 2: How does (students' perception of) language similarity relate to L2's positive influence on L3 learning process?

Results show that "similarity between English and the target L3 as an advantage for learning" is the most prevalent response. Similarity means two objects share some common features, so that one could remind people of the other. In this context, similarity refers to the shared linguistic properties and features between English and romance L3, and a piece of knowledge in one language could provoke the thinking of a "similar" piece of knowledge in the other language. English as L2 is usually students' existing knowledge, which is stored in LTS, and L3 is the new information that students received in class. According to Atkinson and Shiffrin (1971), the L3 information is the "probe" information and the "similar" L2 knowledge is "activated" and "retrieved". This majority indicates that most students are sensitive to this associative memory activation process and respond positively (advantageously) to the new information pieces that can be related to existing knowledge.

Crosslinguistic awareness has long been considered as the bridge between languages (Mayr, 2021), but the different types of source knowledge were always discussed together. The following two themes express a sense of English knowledge as a bridge for language learning, but a distinction could be made by the type of knowledge-declarative and procedural. In the former case, three feature processes stand out, which included memorization, understanding and prediction. Of the 11 responses in this theme, 10 specifically pointed to lexicon learning. This may indicate that lexicon cognate pairs are formed, which could smooth the learning curve (Vanhove & Berthele, 2015). Lexicon pairs facilitate learning most likely in the coding (elaborative rehearsal) process. When a new vocabulary enters STS and starts to rehearse, the related vocabulary in English will also be activated. According to Atkinson and Shiffrin (1971), the two will be rehearsed together as a whole.

Responses in this theme provide proof that additional similar and familiar information in English could readily help the transfer of its pair in L3 by facilitating elaboration and coding. However, the direction of association needs to be considered. By direction of association, it means a hierarchy of familiarity. In normal cases, students are more familiarized with English, so new French vocabulary is "attached" to a known English vocabulary. However, since English is also a learned language of this group, it is not always the case that English is the "familiar knowledge." It is recognized that lexicon learning based on language typological similarity is not linear. Ecke (2015) discussed the complexity and multiple variables in his "parasitic vocabulary acquisition model." He concludes that L2 status, proficiency and L2 to L3 proximity could all contribute to CLI patterns and examination of the L3 learning process.

A number of respondents mentioned guessing and predicting as a strategy of active learning. Most of the responses in this are also at the lexicon level because "guess" is most commonly followed by "meaning". Vanhove and Berthele (2015) studied 95 multilinguals performing item-related vocabulary guessing and found out that "Levenshtein distance" is the most prominent influencing factor. Levenshtein distance uses a scale to compare two words "letter-by-letter," find out letter deletion, insertion and substitution, and calculate the overall formal distance. This indicates that a formal similarity plays an important role in students' activation of lexicon pairs.

A portion of participants viewed English as a tool for better communication with instructors. A sense of language knowledge connection was not found in this pattern of description. English is the language of instruction and the common language between students and instructor, naturally this statement makes sense.

3.RQ3: Is there a relationship between language perception and L2 influence during L3 learning?

The proportional results seem to show a contrast between theme 2 and 3. Both themes emphasize a sense of L2 knowledge as an IP bridge to L3 knowledge. However, a distinction was made between procedural and declarative knowledge. Results show that 86% of people in theme 2 (recognize L2 declarative knowledge as a bridge to L3) have a positive psycho typological perception (perceive two languages as similar). In contrast, 53% of people in theme 3 (recognize L2 procedural knowledge as a bridge to L3) received a positive psycho typological perception. This finding seems to indicate a relationship between awareness of the declarative knowledge bridge, and a positive psychological perception. However, theme 3 has fewer samples than theme 2. Also, some qualitative answers might not be of the equal value for quantitative analysis. Therefore, follow up research would be helpful in addressing student responses versus time to examine the effect on quality.

Suggestions for educators

In this paper, we investigated the Chinese-English bilingual learner's psychotypological perception of a L3 Romance language in college classrooms. This may provide implication for instructors and educators in several ways:

- Students' attention to cross linguistic typology aspects could be incorporated in teachers lesson plan, such as similarities in lexicon and pronunciation. Instructors could take advantage of this attention and relation with previous knowledge to guide students' cognitive thinking to achieve more efficient classroom outcomes.
- This study revealed some L2 and L3 connections through procedural knowledge. Instructors could attend to the natural information processing to resituate new linguistic or cultural declarative knowledge, as well as attend to their strategic knowledge in processing the new language.
- Students show emotional responsiveness to the ability to connect new L3 knowledge to previous knowledge in one way or another, which inspires instructors to design such tasks in prediction (such as guessing game or word information pair) as motivation for students' learning process.
- One last common caution for the educators in bilingual settings is the access of knowledge. To our surprise (out of the purpose of this study), several students mentioned English ability as an imbalanced learning resource that advanced/dis-advanced their learning process. Educators in bilingual settings through elementary to higher education should consider education equity in such a setting in terms of supporting students' development to the largest extent.

Acknowledgements. We would like to thank Dr. Joaquin Lopez Mugica and Dr. Celine Doucet from Wenzhou-Kean University for permitting this survey data and their inspiration.

References

- Atkinson, R. C., & Shiffrin, R. M. (1968). Human memory: A proposed system and its control processes. In *Psychology of learning and motivation* (Vol. 2, pp. 89-195). Academic Press. [https://doi.org/10.1016/S0079-7421\(08\)60422-3](https://doi.org/10.1016/S0079-7421(08)60422-3)
- Atkinson, R. C., & Shiffrin, R. M. (1971). The control of short-term memory. *Scientific American*, 225(2), 82-91. <https://www.jstor.org/stable/24922803>
- Brooks, N. (1960). *Language and learning: Theory and practice*. Harcourt Brace. New York.
- Cohen, A. D. (2011). Second language learner strategies. In Hinkel, E (Eds.), *Handbook of research in second language teaching and learning*, 2 (Part V), 681-698. Routledge.

<https://doi.org/10.4324/9780203836507>

- Derakhshan, A., Malmir, A., & Greenier, V. T. (2021). Interlanguage pragmatic learning strategies (IPLS) as predictors of L2 speech act knowledge: A case of Iranian EFL learners. *The Journal of Asia TEFL*. <http://dx.doi.org/10.18823/asiatefl.2021.18.1.14.235>
- Ecke, P. (2015). Parasitic vocabulary acquisition, cross-linguistic influence, and lexical retrieval in multilinguals. *Bilingualism: Language and Cognition*, 18(2), 145-162. <https://doi.org/10.1017/S1366728913000722>
- Ellis, R. (1989). *Understanding second language acquisition* (Vol. 31). Oxford: Oxford university press. ISBN: 978-0-19-442201-7
- Faerch, C., & Kasper, G. (1983). Procedural knowledge as a component of foreign language learners' communicative competence. In H. Bolte and W. Herrlitz (Eds.), *Kommunikation im Sprachunterricht*. Utrecht: University of Utrecht, 169-200.
- Gillund, G., & Shiffrin, R. M. (1984). A retrieval model for both recognition and recall. *Psychological review*, 91(1), 1. <https://doi.org/10.1037/0033-295X.91.1.1>
- Gu, Y., & Johnson, R. K. (1996). Vocabulary learning strategies and language learning outcomes. *Language learning*, 46(4), 643-679. <https://doi.org/10.1111/j.1467-1770.1996.tb01355.x>
- Hall, C. J. (2002). The automatic cognate form assumption: Evidence for the parasitic model of vocabulary development. *International Review of Applied Linguistics in Language Teaching*, 2, 69-87. <https://doi.org/10.1515/iral.2002.008>
- Hall, C. J., & Ecke, P (2003) Parasitism as a default mechanism in L3 vocabulary acquisition. In Cenoz, J, Hufeisen, B and Jessner, U (Eds.), *The Multilingual Lexicon*. Dordrecht: Kluwer Academic Publishers, pp. 71–85. https://doi.org/10.1007/978-0-306-48367-7_6
- Hargis, J. (2001). Can students learn science using the Internet? *ISTE Journal of Research on Computing in Education*, 33(4), 475-487. <https://doi.org/10.1080/08886504.2001.10782328>
- Ho, P. Y., & Teng, H. C. (2007). A study of EFL reading strategies used by vocational high school students in Taiwan. In Leung, Y. et al. (Ed.), *Selected papers from the 16th International Symposium and Book Fair on English Teaching*. Taipei: English Teachers' Association, Republic of China (pp. 95-103).
- Jarvis, S., & Pavlenko, A. (2008). *Crosslinguistic influence in language and cognition*. Routledge. <https://doi.org/10.4324/9780203935927>
- Kellerman, E. (1983). Now you see it, now you don't. In Kellerman et al. (Ed.) *Language Transfer in Language Learning*, 54(12), 112-134. Rowley MA: Newbury
- Khalil, M. K., & Elkhider, I. A. (2016). Applying learning theories and instructional design models for effective instruction. *Advances in Physiology Education*, 40(2), 147-156. <https://doi.org/10.1152/advan.00138.2015>
- Larsen-Freeman, D. (1997). Chaos/complexity science and second language acquisition. *Applied Linguistics*, 18(2), 141-165. <https://doi.org/10.1093/applin/18.2.141>
- Lindqvist, C. (2015). Do learners transfer from the language they perceive as most closely related to the L3? The role of psychotypology for lexical and grammatical crosslinguistic influence in French L3. *Crosslinguistic Influence and Crosslinguistic Interaction in Multilingual Language Learning*, DOI: 232-251. 10.5040/9781474235884
- Manchon, R. M., Murphy, L., & de Larios, J. R. (2007). Lexical retrieval processes and strategies in

- second language writing: A synthesis of empirical research. *International Journal of English Studies*, 7(2), 149-174. <https://doi.org/10.6018/ijes>
- Marois, R., & Ivanoff, J. (2005). Capacity limits of information processing in the brain. *Trends in cognitive sciences*, 9(6), 296-305. DOI: 10.1016/j.tics.2005.04.010
- Mayr, G. (2021). Building bridges between languages: How students develop cross linguistic awareness in multilingual learning settings. *Multilingualism and third language acquisition*, 165. DOI: 10.5281/zenodo.4449782
- McManus, K. (2020). Crosslinguistic influence and L2 grammar learning: Proposed replications of Ellis and Sagarra (2011) and Tolentino and Tokowicz (2014). *Language Teaching*, 1-9. <https://doi.org/10.1017/S0261444820000270>
- McManus, K. (2021). *Crosslinguistic influence and second language learning*. Routledge. <https://doi.org/10.4324/9780429341663>
- Murphy, S. (2003). Second language transfer during third language acquisition. *Studies in Applied Linguistics and TESOL*, 3(2). <https://doi.org/10.7916/salt.v3i2.1625>
- Nelson, C. Krzysik, I., Lewandowska, H., & Wrembe, M. (2021). Multilingual learners' perceptions of cross-linguistic distances: A proposal for a visual psycho typological measure. *Language Awareness*, 30(2), 176-194. <https://doi.org/10.1080/09658416.2021.1897132>
- Ocasio, W. (2011). Attention to attention. *Organization science*, 22(5), 1286-1296. <https://doi.org/10.1287/orsc.1100.0602>
- Raaijmakers, J. G., & Shiffrin, R. M. (1981). Search for associative memory. *Psychological Review*, 88(2), 93. <https://doi.org/10.1037/0033-295X.88.2.93>
- Swanson, H. L. (1987). Information processing theory and learning disabilities: An overview. *Journal of Learning Disabilities*, 20(1), 3-7. 10.1177/002221948702000102
- Testa, M. (2020). Exploring the relation between psycho typologies and article acquisition. *Psycholinguistics*, 27(2), 252-289. <https://doi.org/10.31470/2309-1797-2020-27-2-252-289>
- Vanhove, J., & Berthele, R. (2015). Item-related determinants of cognate guessing in multilinguals. *Crosslinguistic influence and crosslinguistic interaction in multilingual language learning*, 95-118. DOI: 232-251. 10.5040/9781474235884
- Zohra A., & Boukhedimi, Y. (2021). Exploring Psychotypology as an affective factor of Cross-Linguistic Influence: Case of Algerian multilingual learners. *Arab World English Journal*, 12. Available at SSRN: <https://ssrn.com/abstract=3952953>