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Dual Route Model of Idiom Processing in the Bilingual Context

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Abstract

The dual route model predicts that idiomatic phrases show a processing advantage over matched novel phrases. This model postulates that familiar phrases are processed by a faster direct route, and novel phrases are processed by an indirect route. This thesis investigated the role of familiar form and concept in direct route activation. Study 1 provided norming evidence for experimental stimuli selection. Study 2 examined whether direct route can be activated for translated Chinese idioms in Chinese-English bilinguals. Bilinguals listened to the idiom up until the last word (e.g., draw a snake and add), then saw either the idiom ending (e.g., feet) or the matched control ending (e.g., hair); to which they made lexical decision and reaction times were recorded. Results showed evidence for dual route model and provided preliminary support for both familiar concept and lexical association as drivers of direct route activation.

Keywords

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1.1 Idioms and Bilingualism

1.1.1 Idioms as a Formulaic Language Trope

Formulaic language is defined as:

"A sequence, continuous or discontinuous, of words or other meaning elements, which is, or appears to be, prefabricated: that is, stored and retrieved whole from memory at the time of use, rather than being subject to generation or analysis by the language grammar (Wray & Perkins, 2000)."

Extensive corpus analysis found that formulaic language or recurrent lexical bundles occur 30% of the time in conversational corpuses and 21% in academic prose (Biber, Johansson, Leech, Conrad, & Finegan). The current paper will focus on one of the largest formulaic language tropes: idioms. Idioms are expressions whose meaning cannot be derived from a systematic or literal processing of the component words (Libben & Titone, 2008; Swinney & Cutler, 1979; Vespignani, Canal, Molinaro, Fonda, & Cacciari, 2010). Native speakers process idioms effortlessly. This fluency and idiomatic control of the language rests on the extensive knowledge of the close association between a culturally recognized concept and the idiomatic form. These familiar expressions can be retrieved directly from long term memory (Pawley & Syder, 1983).

1.1.2 Bilingualism

According to estimates, more than half of the world's population speak more than one language (Bialystok, 2017). Bilingualism is not only common, but also fascinating phenomenon. For instance, it can shape experience and lead to changes in cognitive processes (Jared, Poh, & Paivio, 2013) and brain structures. Li et al., (2014) found

differences in grey matter density and white matter integrity after just a short period of time of foreign language learning.

Recent investigations on bilingualism have been focused on discovering any cross-language interactions: When a bilingual processes information in one language, knowledge from another language may be simultaneously activated. Cross-language facilitation were shown through studies on reading (Dijkstra, Timmermans, & Schriefers, 2000), listening (Spivey & Marian, 1999), and speech production (Jared & Kroll, 2001; Jared & Szucs, 2002).

1.1.3   Idioms pose Challenges to Second Language (L2) Learners

It is often the case that even after years of intense active learning and extensive exposure to L2 in the country where that language is spoken, the learner still lags behind in many aspects of second language use. Native-like language use such as incorporating idioms effectively in speech is one prominent facet even advanced bilinguals have difficulty mastering (Cieślicka, 2006). Searle (1975) stated the importance of figurative expressions in natural discourse with the following quote 'Speak idiomatically unless there is some reason not to do so'. Knowledge of idioms not only gains bilinguals the access to native-like language patterns, it is also an essential aid to cultural adaptation (Qualls, O'Brien, Blood, & Hammer, 2003). Due to the lack of figurative competence in L2, speakers are likely to rely more on interpreting constituent words literally in L2 then shift to L1 conceptual representation to estimate idiomatic meaning (Kecskes, 2000). Therefore, previous L1 knowledge may contribute to L2 learners' interpretations of L2 figurative expressions. Cieślicka (2006) suggested that understanding the ways in which non-native speakers' process idioms should be put under the spotlight of psycholinguistic research.

1.1.4   Cross-Language Facilitation

Numerous studies have shown single word priming effects in bilinguals (Chen & Ng, 1989; de Groot & Nas, 1991). A joint activation theory was proposed to explain this facilitation effect (Judith F. Kroll, Dussias, Bice, & Perrotti, 2015). Joint activation

means constant competition between the known languages based on the shared underlying conceptual representation.

There is increasing evidence for cross-language effects that goes beyond the single word level. Ueno (2009) found that unrelated English word pairs were responded to faster by Japanese-English bilinguals when these were translated Japanese collocations (e.g., forgive marriage). Moreover, Swedish-English bilinguals showed cross-language facilitation in English for collocations that can be directly translated into Swedish over phrases that do not have direct translation in Swedish (Wolter & Gyllstad, 2011). These studies suggest non-target language activation during second language processing due to shared conceptual representations between the two languages, and this effect extends from single words to multi-words collocations. I wanted to test whether this language non-selective lexical association is true for even larger language units such as idioms.

The cross-language effects have been observed between different pairs of alphabetic languages. Since the logographic principle of Chinese differ significantly from that of alphabetic languages, research on Chinese would further advance our knowledge on the extent of influence one language can have on a completely different language. The present studies intend to uncover any facilitation for Chinese idioms when they are presented in English to Chinese-English bilinguals.

1.1.5   Chinese Idioms

Ninety-five percent of Chinese idiomatic expressions (i.e., Chengyu) are four characters. The meaning of these quadra-syllabic idiomatic expressions (i.e., QIEs) tend to be compact due to the spacing limitation. The use of QIEs has been regarded as 'a mark of erudition in verbal communication' (Tsou, 2012) and a reflection of an individual's education. Effective writing often incorporates large number of QIEs for both elegant style and rhetoric power. Moreover, QIE is an integral part of formal education, by the time of completing primary school, students are expected to master around 1000 QIEs (Wang & Liu, 2006). Proper use of QIEs in one's writing or speech is a strong indicator of his/her overall language proficiency (Liu & Cheung, 2014) . The QIEs will be the

focus of the current discussion regarding Chinese idioms, any mention of Chinese idioms hereafter will be referring to QIEs.

A large proportion of Chinese idioms are based on the classic literature of historical anecdotes. For instance, the idiom yi-ri-san-qui (一日三秋, 'one-day-three autumns') refers to the earnest feeling that one day apart seems like three autumns. This expression came from the earliest collection of Chinese poems, Shi Jing (Book of Odes), written between the 10th and 7th centuries BC. In addition, ancient Chinese characters and grammars are still embedded in commonly used idioms but are otherwise seldomly used in modern communication. Since the idiomatic meaning of Chinese idioms are deeply rooted in Chinese history and culture, in-depth cultural exposure and extensive formal education is required. Chinese idioms are ideal candidates for investigating cross language effects in bilinguals, because of the high degree of familiarity to Chinese speakers and semantic opacity to non-Chinese speakers.

Furthermore, Chinese idioms have fixed formulaic expressions that allow no semantic substitution or syntactic flexibility (Zhou, 2004). Native Chinese speakers process Chinese idioms in a similar fashion as how native English speakers processed English idioms (Liu, Li, Shu, Zhang, & Chen, 2010; Zhang, Yang, Gu, & Ji, 2013). Therefore, the syntactic constraints can be used to examine the idiom processing advantage.

1.2   Evidence of Dual Route Model

1.2.1   Dual Route Model

In the idiom processing literature, three classes of theories have been proposed. The two early classes of theories have considered idioms as a homogenous group. The first class of theory contends that idioms are represented as single entries in the lexicon, therefore, supports the noncompositional approach (Bobrow & Bell, 1973; Swinney & Cutler, 1979). The second class of theory postulates that an idiom's constituent words are critical in understanding idiomatic meaning, thus, adhering to the compositional view (Abel, 2003; Raymond W. Gibbs, Nayak, & Cutting, 1989; Hamblin & Gibbs, 1999; Nunberg, 1978). In contrast, the more recent class of theory deciphered the heterogeneity among

idioms and holds a hybrid approach that takes in features from both compositional and noncompositional view (Cacciari & Tabossi, 1988; D. A. Titone & Connine, 1999). This view accounts for both direct retrieval of familiar idioms, as well as the compositional analysis of less familiar or unpredictable idioms for figurative meaning. This offers explanations for the processing advantage of familiar phrases over novel phrases.

A dual route model was suggested based on the theoretical background of the hybrid approach (van Lancker Sidtis, 2012; Wray, 2002; Wray & Perkins, 2000). It has been applied to idiom comprehension research in native speakers. This model postulates that idioms are processed based on an individual's familiarity to them. Specifically, two approaches are available to speakers: the 'retrieval' route and the 'computation' route; these two routes are also referred to as 'direct' and 'indirect' route, respectively. These terms will be used interchangeably throughout this paper. Familiar phrases or formulaic expressions are stored in long-term memory and can be retrieved holistically, and novel phrases have to be calculated word by word for meaning. The direct route is activated when a familiar idiom is encountered (Carrol & Conklin, 2014). The indirect route is used when the encountered phrase is unfamiliar, thus, meaning must be computed rather than directly retrieved. Subjective familiarity is crucial in determining which route is more efficient for processing (Tabossi, Fanari, & Wolf, 2009). The two routes can be seen as a race rather than an either/or situation. For unfamiliar expressions, only the indirect route is available, thus resulted in slower processing time compare to matched idiomatic phrases. The labels for the two routes are merely convenient shorthand to describe the processing advantage of idioms over novel phrases. This advantage could either be due to 'holistic retrieval' or as Wray (2012) suggested, due to simultaneous activation of all constituent words or priming of multiple phrasal possibilities via the base component. In the current paper, direct route activation refers to the processing advantage for familiar phrases versus matched control phrases. Figure 1 shows a representation of the dual route model for the English idiom 'Take the bull by the horns' (meaning 'deal bravely and decisively with a difficult, dangerous, or unpleasant situation').
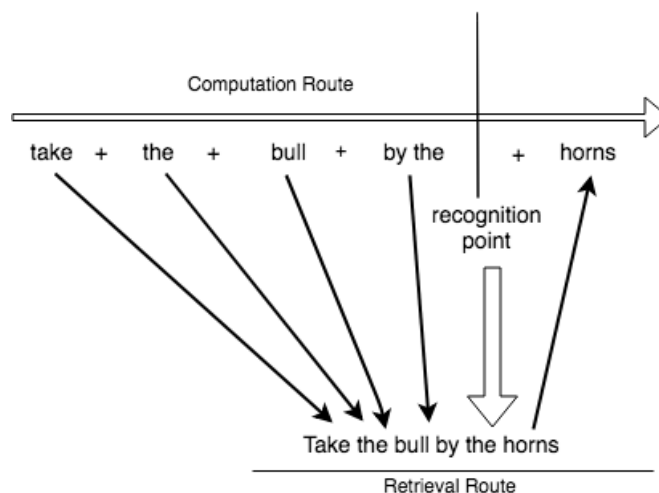
Figure 1: Dual route model for the idiom 'take the bull by the horns'. Black arrows represent associative links and white arrows represent process or activation of different route.

When 'Take the bull by the…' is encountered, the computation route will be activated first. This should be the default process because the idiom's holistic form would only become apparent after encountering enough composing elements. The computation route is the only available approach until the recognition point is reached, this is referred as the 'key' of the idiom (Cacciari & Tabossi, 1988). After which point, the phrase may be registered as known, direct retrieval takes over and becomes the optimal approach of processing. In our example, the combination of constituent words in 'take the bull by the…' triggers the idiomatic configuration. The last word of the idiom 'horns' is automatically activated through the direct route before actually encountering it. The computation route is also available, but due to the delay in processing time, its contribution is often ignored. However, if up until the 'key', the phrase was pointing to a certain familiar idiom, but the final part revealed a different word from expectation, (for example, if 'tires' instead of 'horns' showed up), the computation route will be adopted again for further analysis. This is at the cost of processing time compare to relying on the automatic activation aspect of the direct route.

1.2.2   Evidence from English Idiom Studies

Studies have shown that idioms are processed faster than matched novel expression by native speakers (Gibbs, 1980; Swinney & Cutler, 1979). ERP studies (Molinaro,

Vespignani, Canal, & Cacciari, n.d.; Siyanova, 2010; Tremblay & Baayen, 2010) and fMRI studies (van Lancker Sidtis, 2012) both had shown that these two types of phrases are processed differently.

Glora (1997) showed that direct retrieval of idioms is moderated by subjective familiarity. Moreover, Titone and Connine (1994) found a strong positive correlation between an idiom's predictability and familiarity. Therefore, a highly familiar idiom's ease of retrieval may be contingent on the ease of prediction. These correspond to the assumptions of dual route model that familiar expressions show facilitatory effect over unfamiliar or novel matched phrases due to direct route activation.

1.2.3   Evidence from Chinese Idiom Studies

Studies done in Chinese showed processing advantage for Chinese idioms compared to novel control phrases along the same lines as English idiom studies (Simon, Zhang, Zang, & Peng, 1989; S. Zhou, Zhou, & Chen, 2004). ERP studies also supported differential processing between Chinese idioms and novel matched control phrases (Liu et al., 2010; Zhang et al., 2013). Moreover, patients with aphasia whose native language was either Chinese or English, showed the same patterns of impairment when processing idiomatic versus novel phrases (Chung, Code, & Ball, 2004). Therefore, Chinese idioms are treated similarly by native Chinese speakers as how English idioms are treated by native English speakers.

1.3   Carrol and Conklin (2014)

1.3.1   Study Description

There is mounting evidence for dual route as an idiom processing model in L1 idiom studies, but it is unclear whether familiarity to form or concept is the driver behind the idiom processing advantage. Form is defined in this thesis as the original present-tense surface structure of an idiom without considering its phrasal flexibilities (e.g., 'kick the bucket' was used instead of 'kicked the bucket' or 'kick the political bucket'). Since formal idioms are an integral part of the Chinese language, it would be helpful to

investigate whether cross-language facilitation can be seen for idioms in the Chinese-English bilingual context, in order to understand the underlying mechanism behind the dual route model.

Carrol and Conklin (2014) investigated the dual-route model in the Chinese-English bilingual context. Specifically, the researchers wanted to know whether an idiom's processing advantage can be seen for L1 idioms when they are presented in an L2 to bilinguals. With the knowledge that when L1 idioms are presented to participants in their original form, familiar idioms tend to be retrieved from the long-term memory and the entire form becomes activated faster compared to matched novel phrases. However, the authors were curious about whether the familiar form is the only driver of direct route activation, and what is the role played by the underlying concept of the idiom. Therefore, they tested the dual route model in the absence of the familiar idiom form.

They translated a set of Chinese idioms word-for-word into English and manipulated the ending word of these translated phrases. Two phrasal conditions were created: the idiom condition was the actual translation of the idiom; whereas the control condition had the last word of the idiom replaced by a control word that was matched with the real ending word. For example, the Chinese idiom '画蛇添足' is translated as 'draw a snake and add feet'. The idiom condition was 'draw a snake and add--FEET', and the control condition was 'draw a snake and add--HAIR'. Chinese-English bilingual participants (from now on, bilingual Chinese speakers/participants) read the translated idioms at their own pace up until the second last word, then press a button to proceed to a lexical decision task; for which, they make word/nonword judgement to the letter string appeared on screen. The reaction times (RTs) of the ending words from the two conditions were compared through a self-paced lexical decision paradigm. If cross-language facilitation was present for idioms, the translated Chinese idioms in the idiomatic condition should be familiar to bilingual Chinese participants. The authors hypothesized that if familiarity to form is the only driving force behind direct route activation, bilingual Chinese speakers should not show RT difference between idiom and control conditions; if familiarity to concept also plays a role, then the idiom condition should be responded faster than the control condition. They also included English idioms with the same manipulation as native

standards. Two counterbalanced lists were created with idiom condition of a certain idiom on one list and its control condition on the opposite list.

The authors found a marginal interaction effect ($p = .07$) between phrasal conditions and idiom origins among bilingual Chinese participants. Post hoc analyses for Chinese and English idioms found that Chinese idioms were responded to marginally faster than Chinese controls ($p < .05$). They interpreted these results as evidence for the important role played by conceptual familiarity in idiom processing.

1.3.1.1 Limitations to their Study

Carrol and Conklin's study was the first to examine translated idioms in the context of dual route model. Their investigation was not unflawed. Three limitations need to be addressed before interpretation of their results.

The biggest limitation is that the researchers used a self-paced reading as the 'prime'. Participants took as long as they wished in the priming stage, which introduced the possibility of active translation and prediction for the final word. The researchers' rationale was to accommodate non-native speakers of English for their slower reading speed. However, this design completely undermined the ability to detect one of the main assumptions of dual route model: the automatic activation of the direct route. With the introduction of time gap between prime and target, automatic activation is no longer discernible. Moreover, the authors did not report the time taken by participants on self-paced reading. If this information was available, one may be able to better speculate the strategies used by participants in approaching the task. To make matters worse, for stimuli selection, they did not match the unprimed RTs between idiomatic endings and control endings. In other words, the items in the idiomatic condition may have intrinsically different RTs than words in the matched control condition even in the absence of any priming. It may not be an overstatement to say that their paradigm was not well suited to answer their primary research question. They may have just tested whether active translation and prediction would lead to overall differential RTs for two sets of words that may already differ in that aspect.

The second limitation is the lack of effective norming for stimuli selection. The researchers had 4 bilingual Chinese speakers to rate the familiarity of the selected Chinese idioms in their original characters as preliminary measures. However, the authors did not incorporate any norms for the translations of Chinese idioms. Even though it is an investigation of cross-language facilitation effect, optimal translation will facilitate access to the underlying concepts. It would be helpful to norm the translated Chinese idioms with native Chinese speakers, and only keep the items that are recognized and predicted by these raters. If an item is not recognizable in its translated form, it will act like a novel phrase despite participants' indication of high familiarity to its original form.

The third limitation is the low power of the study and the marginal interaction effect. In total, 19 English speakers and 19 bilingual Chinese speakers participated in their study, which divides into about 10 participants per counterbalanced list. The low sample size may signify unreliable results. Despite the low sample, they were able to find a marginal interaction effect ($p = .07$) among bilingual Chinese participants in processing L1 idioms in L2. It has led to the speculation of the effect's reliability if a larger sample was used.

These three limitations undermined Carrol and Conklin's results and are critically in need of being addressed in further studies.

1.4   Purpose of this Thesis

The present thesis intends to test the same hypotheses and answer the questions left from Carrol and Conklin (2014) using a different methodology. Specifically, I am testing the dual route model and the underlying mechanism of direct route activation. My design eliminates the time gap between prime and target and my study still asks the question of whether direct route can be activated for L1 idioms presented in L2. I will use an appropriate sample size both in terms of participants and the number of idioms, with the idioms being selected with scrutiny. With these thorough considerations in my methodology, results can be interpreted with much more confidence.

Chapter 2

2 Study 1: Idiom Norms

The existing norms for English idioms are usually not up to date (Libben & Titone, 2008; Titone & Connine, 1994). With the rapid transition of language usage patterns and the creation and modification of expressions, significant changes have occurred in people's perception of common idioms (Brysbaert, Warriner, & Kuperman, 2014; Bulkes & Tanner, 2017). Norming data were recently updated for many other figurative language tropes. For example, metaphor norms were updated by (Campbell & Raney, 2016). At the time of the preparation of this study, no updated norms for idioms were done in North America. Therefore, I decided to collect norming data for the experimental stimuli which will be Study 1 of my thesis.

This chapter is in line previous idiom norming literature by taking the heterogeneous nature of idioms into consideration. Previous studies have consistently shown that a variety of dimensions influence the speed and accuracy with which an idiom can be retrieved (R. W. Gibbs Jr, 1980; Libben & Titone, 2008; D. Titone & Libben, 2014). For example, Cacciari and Tabossi (1988) and Titone and Connine (1999) suggested that figurative meanings of highly familiar and predictable idioms are retrieved at a faster rate compare to less familiar and predictable ones. The faster retrieval is due to that the more predictable the idiom's final word, the more unitary is its representation in the lexicon.

2.1 Purposes and Hypotheses

The purpose of Study 1 was to select qualified idioms for the main study. Filter criteria were based on descriptive norms of selected dimensions. I examined two dimensions of idiom comprehension that were relative to the purpose of the current study, namely, familiarity and predictability. The rationale for choosing these two scales was that these scales together provide both subjective and objective measures of people's familiarity and knowledge of idioms' forms. The activation of the direct route of dual route model relies mainly on familiarity. These dimensions ware also shown to ultimately affect the

online processing of idioms (Cacciari & Glucksberg, 1991; Swinney & Cutler, 1979). Study 1's main goal is to select the idioms that are only familiar to native speakers of the language where the idioms came from. In other words, English idioms should only be familiar to native English speakers, but not to bilingual Chinese speakers, and vice versa for translated Chinese idioms.

I asked both native English speakers and bilingual Chinese speakers to complete the ratings for all items. I was most interested in the translated Chinese idioms that can be closely predicted (i.e., completed) by bilingual Chinese speakers but cannot be predicted by the majority of native English speakers. These criteria would provide basis for that, when given enough time, bilingual Chinese participants can recognize the translated idiom based on lexical and conceptual association of the idiom's original form. On the other hand, because of the lack of lexical and conceptual background knowledge, English speakers would not be able to make correct predictions regardless of the amount of time given. I was also interested in the English idioms that can be accurately predicted by native English speakers and cannot be accurately predicted by the majority of bilingual Chinese speakers. I also included familiarity rating as a second layer of proof. Only the idioms that were rated as highly familiar by native speakers of the language where the idioms came from were to be selected.

Therefore, this study intended to filter out the idioms that are highly familiar or predictable by non-native speakers of the language where the idioms came from, as well as the idioms that are too peculiar to native speakers.

2.2   Method

2.2.1   Materials

2.2.1.1   English Idioms

The majority of English idioms were selected from Titone and Connine's (1994) descriptive norms study. In their study, the researchers investigated familiarity and predictability, along with other measures (i.e., compositionality, literality), of 171

common English idioms. Despite that compositionality was one of the dimensions used, Carrol and Conklin's (2014) post hoc analysis of compositionality showed that it was not a significant predictor of idiom processing advantage in bilingual Chinese speakers. Due to the similar nature of the two studies, therefore, this scale was not included in my norming. Only the idioms with mean familiarity rating above 4 (on a 7-point Likert scale; 1 means "never heard of before", 7 means 'very frequently encountered') across all of their 30 participants were included in the present study. I also compared this list to English idioms used by Carrol and Conklin (2014), unlisted items were added.

In addition, common idioms were also chosen from http://www.idiomsite.com and http://www.ef.com/english-resources/english-idioms/. I created a large list for norming, since the stringent selection criteria may lead to heavy elimination.

2.2.1.2   Chinese Idioms

Chinese idioms in their original forms were chosen by the author, then translated to English using MDBG (https://www.mdbg.net/chinese/dictionary) online translator. Subjective discretion was used during the translation phase to make sure the translation was both literal and sensible. Only the idioms whose translation preserved the original idiom's word order were included (e.g., 望穿秋水---'gaze- through-the autumn-water', meaning 'to eagerly look forward to seeing someone').

2.2.1.3   Familiarity Scales

I used Titone and Connine's (1994) familiarity scale to get descriptive measures for idioms. Familiarity is defined here as how often the person either hears or uses a given idiomatic expression. Familiarity scale was a 7-point Likert scale based on subjective frequency of encounter, ranging from 'never heard of before' (1) to 'very frequently encountered' (7). Although Titone and Connine used two operational definitions (i.e., frequency of encounter; knowledge of the idiomatic meaning) to collectively measure familiarity, the present study concerned more about form activation rather than meaning, thus, only the frequency subscale of familiarity scale was used (see Appendix A for full task instruction). This scale included all the English and translated Chinese idioms

developed by the author, and to be completed by both native English and bilingual Chinese speakers.

Moreover, because translation equivalent was hard to achieve for Chinese idioms, due to the compact syntax of four-characters. The original form of the idiom in Chinese was likely not immediately apparent to participants. Chinese participants were encouraged to guess the original form of the idiom if they believe it was translated from Chinese, then to make frequency ratings based on that. If no close match came to mind upon seeing the translated idiom, participants were to give a 'never heard of before' rating; if the original form was readily available, participants were to give a 'very frequently encountered' rating. However, they had to utilize their judgement to decide whether the idiom in question is an English or a Chinese one. Note that the frequency of translated Chinese idioms were actually rated on the idioms' original character forms.

2.2.1.4   Predictability Scale

The predictability scale in the present study was similar to the original predictability scale in Titone and Connie (1994). The cloze (i.e., fill the blank) task (e.g., Take the bull by the ___) I used was without context (see Appendix B for full task instruction), whereas Titone and Connie put the idioms into carrier sentences. Predictability was defined as the likelihood of completing the phrase in an idiomatic manner. Recent large-scale idiom-norming study (Bulkes & Tanner, 2017) that was published during data collection phase of the present study also used cloze task for their predictability scale.

Predictability scale was presented to participants as a list of idioms with the last word omitted. Participants were told to fill-in the last word of each idiom with the first word that came to mind after reading the prompting partial phrase. This scale was completed both by native English speakers and bilingual Chinese speakers.

2.2.1.5   Qualtrics Surveys

The familiarity and predictability scales were posted online on Qualtrics. Participants needed to first complete the demographic questions (see Appendix C), only participants

that provided qualified answers were allowed to proceed to the norming. Two rounds of norming were done. English native speakers participated in the first round, they each completed either the familiarity or the predictability scale. A hundred and ninety-nine (199) items in total were included, 102 were English idioms and 89 were translated Chinese idioms. After filtering out disqualified items, the remaining idioms were used to create the second round of familiarity and predictability norming. Sixty-five (65) English idioms and 58 translated Chinese idioms were included in the familiarity and predictability scale. These scales were completed by bilingual Chinese speakers. Specific item filtering process will be explained in the data cleaning section below.

2.2.2   Participants

2.2.2.1   English Participants

Native English speakers were recruited through Amazon.com's mechanical Turk (i.e., M-Turk) crowdsourcing tool. Qualified participants were North American residents who were registered members of the M-Turk labor force and have a success rate of 95% in completing other surveys. Twenty-nine had completed the predictability scale out of the 271 participants that had started; and 28 had completed the familiarity scale out of the 57 participants that had started. Participants received one dollar for completing either scale. Participants ranged from 21 to 68 ($M = 36.02$, $SD = 11.03$) years of age. All of the included participants were born and raised in English-speaking North American countries.

2.2.2.2   Chinese Participants

Bilingual Chinese speakers were recruited through emailing potential qualified participants with survey link attached. Potential participants were located either in Alberta or Ontario, Canada. Eight had completed the predictability survey out of the 15 participants that had started; and all of the 8 participants completed the familiarity survey. Out of the people that completed the surveys, their age ranged from 24 to 29 ($M = 26$, SD = 1.51), and years being in Canada ranged from 3 to 15 ($M = 7.75$, $SD = 4.09$) years. All

of the included participants were native Mandarin Chinese speakers, and highly fluent in both Mandarin Chinese and English.

2.3   Procedure

English participants completed the scale through M-Turk and each received 1 dollar as compensation. Chinese participants received a reusable link from the researcher and completed it for free out of kindness.

2.4   Results and Discussion

2.4.1   English Participants' Data Cleaning

Due to the difficulty associated with recruiting bilingual Chinese speakers, English participants acted as the first layer of filter. Their responses to the familiarity and predictability scale was first analyzed, the retained items were then used to create the scales for bilingual Chinese participants. Only the English idioms that were completed accurately by more than 90% of the participants and translated Chinese idioms that were correctly or closely predicted by less than 20% of the participants were retained.

It was shown that with English idioms, the predictability scale was highly correlated with familiarity scale. In other words, high familiarity rating of an idiom is correlated with its high percentage of accurate prediction. Thus, I did not remove additional English idioms based on familiarity ratings. Nonetheless, an additional layer of filter was used for translated Chinese idioms. Any translated Chinese idioms with a mean rating above 3 were removed to ensure that the retained Chinese idioms were unfamiliar to English participants. Retained English idioms had high overall familiarity ratings (*M*= 5.4, *SD* = .722), and Chinese idioms had low overall familiarity ratings (*M* = 1.40, *SD* = .309) from native English participants.

2.4.2 Chinese Participants' Data Cleaning

The filtered familiarity and predictability scale was created for bilingual Chinese participants after removing disqualified items based on English participants' responses. Due to the lack of exact translation-equivalents for Chinese idioms and relatively small sample of Chinese raters, more lenient criteria were used at this stage of filtering. All translated Chinese idioms that were closely predicted (i.e., synonyms of the original translated ending; e.g., cave vs. hole); by more than 50% of the native Chinese participants were retained, and all English idioms that were correctly completed by less than 20% of the participants were retained.

I also looked at Chinese participants' familiarity rating and removed any English idioms with mean rating greater than 3. Retained English idioms had low overall familiarity ratings ($M = 2.07$, $SD = .482$), and Chinese idioms had high overall ratings ($M = 4.14$, $SD = .075$) from native Chinese participants.

2.4.3 Overall

After the thorough two-step filtering process, 48 English and 48 translated Chinese idioms were retained to be used in the main study. Study 1 provided the basis for stimulus selection for Study 2. See Appendix D for the full list of idioms used in Study 2.

Chapter 3

3   Study 2: Cross Modal Idiom Processing

This chapter builds on Study 1 by using the retained idioms to test the predictions of the dual route model. This study will also extend previous studies on bilingualism (Cieślicka, 2006; Kecskes, 2000; Wolter & Gyllstad, 2011), hybrid model of idiom processing (Caillies & Butcher, 2007; Sprenger, Levelt, & Kempen, 2006; Titone & Connine, 1999), cross-modal paradigm (Beck & Weber, 2016; Titone & Libben, 2014) by looking at cross-language idiom processing. An understanding for cross-language facilitation in bilinguals has always been a fascinating topic in the field of psycholinguistics.

3.1   Cross Modal Paradigm

Auditory-Visual cross-modal priming has advantage over visual-visual priming because visual stimuli can be precisely timed to display right at the offset of the auditory prime without the need of introducing masks. This would allow for the accurate measure of automatic activation of the direct route through timed responses of the lexical decision task (Cacciari & Tabossi, 1988; Titone & Connine, 1994). The common procedure of auditory-visual cross-modal paradigm is to have the participant gaze on a fixation point while listening to the prime, then make lexical decision to the letter-string appears on the screen at the offset of each auditory prime.

Cross-modal paradigm has been widely used in idiom studies. Titone and Libben (2014) investigated on how various linguistic differences among idioms modulate figurative meaning activation using cross-modal semantic priming. The authors suggested that cross-modal design is ideal for tracking meaning activation over time. Moreover, Cieślica (2006) used cross-modal design to compare the literal and figurative saliency of English idioms in Polish-English bilinguals. She found a greater priming effect for literal meanings in these advanced English L2 speakers. In addition, Beck and Weber (2016) aimed to look at the effects of L1 on L2 idiom comprehension in German-English bilingual speakers using cross-modal lexical decision task. Half of the English idioms

they chose had matching German translations, the other half that had no matching German translations. They found priming effect for both literal and figurative meanings of the idioms, but no effect of translatability was discovered. These studies have all suggested that cross-modal priming is an effective methodology for investigating underlying mechanisms of idiom processing. Therefore, the present study will be using cross-modal priming as the main paradigm.

3.2 Purpose and Hypotheses

The present study investigated whether the dual route model can be applied to translated idiom processing in order to understand the underlying mechanism behind direct route activation. Previous studies have shown that formulaic language is processed faster than matched novel phrases by speakers who are familiar with them (Durrant, 2008; Jiang & Nekrasova, 2007), and this has been specifically demonstrated for idioms (Gibbs, 1980; Swinney & Cutler, 1979). The dual route model postulates that this facilitation is due to direct route activation, which saves time from having to calculate meaning for each constituent word. To my knowledge, Carrol and Conklin (2014) was the first study that investigated on the role of dual route in translated idioms. I asked the same research question as these researchers, namely, whether dual route can be the explanatory model for L1 idiom processing in L2, in the same way as processing L1 idioms in L1. In other words, whether the same facilitatory effect can be seen for translated idioms compared to matched control phrases. Translated idioms preserved the idiomatic concept and the lexical association at the conceptual level but eliminated the familiar form. This can help to disentangle the roles played by familiarity to form and to concept, in direct route activation; if idiom processing advantage was seen when L1 idioms are processed in L2, then familiarity to concept should also be a contributing factor. With the aforementioned limitations to Carrol and Conklin, critical modifications need to be made. To address these limitations, I used cross-modal paradigm for more sensitive measures of RTs, and larger sample size in terms of both participants and number of idioms.

It was hypothesized that there was a three-way interaction among phrase type, idiom language and participants' native language. Distinctive RT patterns for phrases from each

language should be seen across the two native language groups. That is, native English speakers would respond faster to English idioms than matched English controls, but show no RT difference for Chinese idioms and matched Chinese controls. Whereas Chinese participants would show facilitatory effect for translated Chinese idioms compared to matched Chinese controls, and no RT difference for English idioms and matched English controls. If this RT pattern was seen in Chinese participants, it can be seen as evidence that familiarity to concept contributed to direct route activation.

Building on the norms from Study 1, I made sure that one language's idioms are only familiar to native speakers of this language. Therefore, native speakers of each language should not respond differentially to phrasal conditions from outside of their native language. This experiment will provide stronger evidence for understanding the underlying mechanism of direct route activation.

3.3   Methods

3.3.1   Materials

3.3.1.1   Idiom and Filler Stimuli

The stimuli of interest consisted of English idioms, English matched control phrases, translated Chinese idioms and translated Chinese matched control phrases. Matched control phrases were formed by replacing the last word of the corresponding idiom with an idiomatically irrelevant word. In addition, filler items were composed of word-fillers and non-word fillers.

The 48 English idioms and 48 translated Chinese idioms retained in Study 1 were used in this study as stimulus of interest. Control phrases were created from these items by selecting an alternative final word that was matched with the original for part of speech, length, frequency and unprimed reaction time. These factors were controlled because they could potentially contribute to differential RTs.

Frequency and unprimed RT data were provided by the English Lexicon Project (ELP) corpus database (Balota et al., 2007). The ELP is a large database of descriptive and behavioral data, along with a search engine that allows user to quickly access information of interest. I specified the range of word frequency, length, and unprimed lexical decision time based on idioms' original ending words' data, ELP then returned a list of words that satisfied these search criteria. I picked matched control words for each idiom from this list and matched the part of speech with the original ending word.

I used Freq_HAL measure of ELP as our basis for word frequency. "Freq_HAL refers to the Hyperspace Analogue to Language (HAL) frequency norms, based on the HAL corpus, which consists of approximately 131 million words gathered across 3000 Usenet newsgroups during February 1995" (Balota et al., 2007). The comparison between English idioms' original endings and alternative endings showed no significant difference in frequency, $t(47) = .440$, $p = .662$, or unprimed RTs, $t(47) = .153$, $p = .879$. The comparison between translated Chinese idioms' original endings and alternative endings also showed no significant difference in frequency, $t(47) = .346$, $p = .731$, or unprimed RTs, $t(47) = .583$, $p = .562$.

Filler items consisted of word fillers and non-word fillers. Word fillers were 48 literal English phrases, all were literally plausible, grammatical English phrases (e.g., warn him about drugs). Equal number of phrases that end with non-words were created. Non-word fillers were composed of 86 unused English or translated Chinese idioms, and 58 literal phrases. These phrases had the last word replaced by a non-word. All non-words were taken from the ARC non-word database (Rastle, Harrington, & Coltheart, 2002), and conformed to the phonotactic rules of English.

3.3.1.2　Counterbalanced Lists

The stimuli were divided into two counterbalanced lists with an idiom and its control appearing on opposite lists. Each participant heard 24 English idioms, 24 English controls, 24 translated Chinese idioms, 24 translated Chinese controls, 48 word fillers and 144 non-word fillers (see Table 2 for an example from each condition). See Table 3 for

Descriptive summary of the ending words. The complete list of idioms is found in the appendix D.

Table 1 : Example of stimulus materials for each condition.

Condition	Prime	Target	Number
English Idiom	A chip off the old	Block	24
English Control	A chip off the old	Fence	24
Chinese Idiom	Draw a snake and add	Feet	24
Chinese Control	Draw a snake and add	Hair	24
Filler phrase + Word	Explain the facts to	Mother	48
Filler phrase + Non-word	Cut a long story	Tealth	144

Table 2：Descriptive summary of the idioms used in Study 2.

	English Idiom	English Control	Chinese Idiom	Chinese Control
Freq_HAL	50472	46324	54506	50710
Unprimed RT (SD)	605.93 (46.02)	604.74 (36.24)	602.03 (46.14)	607.74 (50.33)

Notes: Freq_HAL refers to the Hyperspace Analogue to Language (HAL) frequency norms, based on the HAL corpus, which consists of approximately 131 million words fathered across 3000 Usenet newsgroups during February 1995. Unprimed response times in msec and standard deviations (in brackets) for idiom and control endings are also presented.

3.3.1.3   Auditory Primes

Due to the cross-modal nature of the present study, the primes (i.e., partial phrase prior to the ending word) were delivered in auditory mode. The auditory primes were recorded by a native English speaker (i.e., born and raised in Canada) using Audacity digital editor. Attention were paid during recording to ensure that all items were treated equally, the last word of the primes were finished with a flat tone. This way, both English and translated Chinese idioms' prime sounded equal in terms of expectation in the voice for the ending word.

3.3.2   Participants

3.3.2.1   English Participants

Sixty-six native English speakers (with no experience of learning Mandarin) took part in the study for course credit. Age of participants ranged from 17 to 20 years old (M = 18.16, SD = .74). All of the participants were either born in Canada/the U.S. or raised in Canada (i.e., moved to Canada before 3 years of age). This was to ensure these participants had sufficient exposure to common English idioms.

Five participants were excluded from the analysis. One was due to software error; two were due to low performance (i.e., < 80%); one was due to not following the instruction of wearing the headphone throughout the experiment; the last one was eliminated due to knowledge of Mandarin. Sixty-one English speakers were included in the final analysis, 31 completed counterbalanced List 1, and 30 completed counterbalanced List 2.

3.3.2.2   Chinese Participants

Seventy-two native Mandarin speakers were recruited through psychology undergraduate research participation pool or recruitment poster. Only people that were born and raised in China until at least age 11 and have lived in Canada for more than 3 years were qualified to take part in the study. This was to ensure that participants received sufficiently formal education in China to acquire the common Chinese idioms, and also proficient in English to understand the English words used in the task. Participants were all registered undergraduate students at Western University. They have all passed the stringent university entrance English language exams, therefore, no additional language test was administered. Age of participants ranged from 17 to 30 years old (M = 20.10, SD = 2.70). In addition, these participants were asked to complete a demographic questionnaire to indicate the number of years lived in China and Canada (see Appendix E). Participants' years lived in China ranged from 11 to 21 years (M = 15.30, SD = 2.55), and their years lived in Canada ranged from 3 to 8 years (M = 4.89, SD = 1.39). See Table 4 for descriptive summary.

Fourteen participants were excluded from the analysis. Six were excluded for not satisfying the inclusion criteria; another 6 were excluded because of low performance (i.e., < 80%), one was due to native language being Cantonese and unfamiliar with Mandarin; the last one was eliminated due to software error. Fifty-eight bilinguals were included in the final analysis, 29 completed each counterbalanced list.

3.4   Procedure

Each participant first filled out a demographic questionnaire to indicate their knowledge of language(s) and years of residency in different countries. The experiment was constructed using PsychoPy open-source software (Peirce, 2007; see Figure 1 for the Study 2 paradigm). Participants were instructed prior to starting the computer task that they will hear auditory information through the headphones, some of which will be partial English idioms and partial translated Chinese idioms, and after each auditory prime, they will make a lexical decision about the letter string that shows up on the screen. Additional on-screen instruction was provided as well.

During the auditory prime, a mask composed of 10 number signs (i.e., ##########) were presented on the screen. Once the auditory priming was over, the mask disappeared, and the letter string showed up, and stayed on the screen for a maximum of 5 seconds. Participants then used keyboard press to indicate word/non-word responses (i.e., 1 for word, 0 for non-word). They could make responses as soon as the letter string appeared. Once the response was recorded, the next trial will begin. If participants did not make a response within 5 seconds, the screen will go blank, and participants still had to press either 1 or 0 to continue to the next trial. This design was to ensure that participants were engaged in the task rather than passively letting the trials pass. If they made an incorrect response, they will receive an auditory feedback in the form of a short buzz. Accuracy and RTs were recorded. Ten practice trials were given. The trials in the actual experiment were presented in random order until each participant had responded to all 288 items. Bilingual Chinese speakers and English speakers received the same two counterbalanced lists.
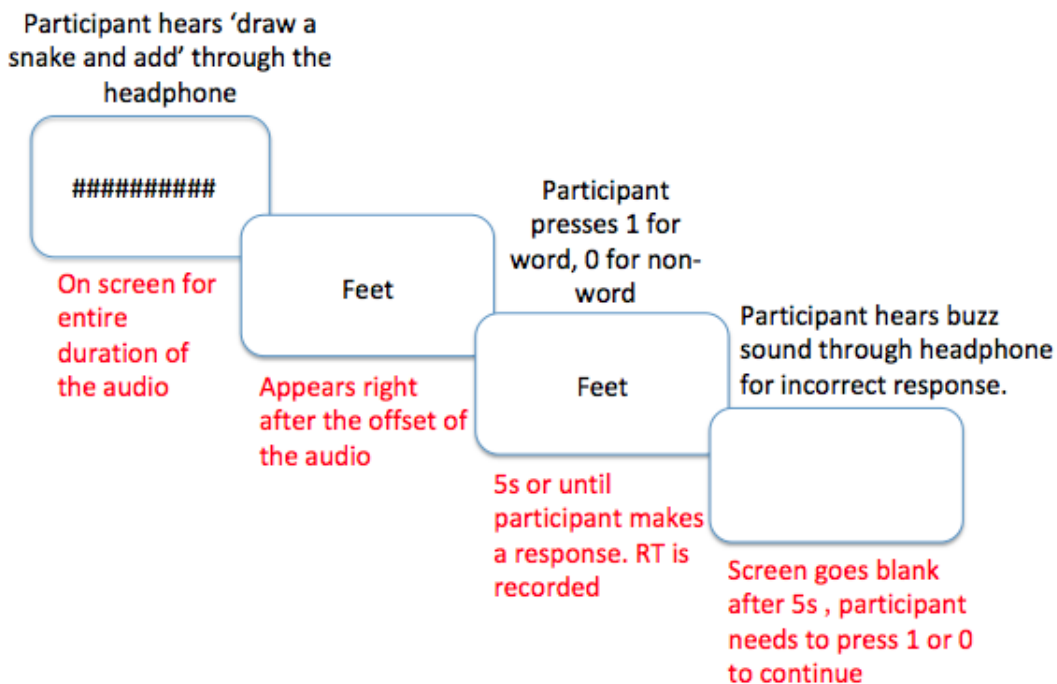
Figure 2： Illustration of Study 2 paradigm using 'draw a snake and add feet' as an example.

3.5　Data Cleaning

3.5.1　By Subject

Filler items and incorrect trials were not analyzed. Each participant's data was examined individually. Any trial with RT longer than 3 standard deviations away from the mean RT of that specific individual were removed (Kinoshita, Norris, & Siegelman, 2012; Lee & Taft, 2009). For bilingual Chinese speakers, 2.6% of total trials were removed. For English speakers, 1.9% of total trials were removed.

3.5.2　By Item

Simple item analysis was done on idiom ending words to get the count of people getting each word correct. Words that were correctly responded by less than half of the participants were labelled for later removal. This was an indicator that most people did not think they were words. For instance, translated Chinese idiom 'add dog's tail to ferret', the word 'ferret' was judged as non-word by 23 out of 29 participants, thus would

not be a good item to include in the analysis. Worth noting here is that I not only removed these words from analysis, as well as their matched control words on the other list. In other words, the whole idiom was removed from analysis if one of its ending words was seen as non-word by most participants. This item analysis was done for both bilingual Chinese participants and English participants. Three Chinese idioms and 5 English idioms were removed, this left us with 45 translated Chinese idioms, and 43 English idioms. Distribution of RTs for both language groups is shown in Table 3.

Table 3：Descriptive summary of RTs in the four conditions.

	English Idioms	English Controls	Chinese Idioms	Chinese Controls
English Participants RT	605 (114)	687 (107)	643 (111)	677 (115)
Chinese Participants RT	742 (154)	787 (141)	757 (145)	800 (146)

Note: Mean response times in msec and standard deviations (in brackets) for English and bilingual Chinese speakers in each of the four experimental conditions.

3.6   Results

3.6.1   All Participants

The primary analysis was designed to examine my main hypotheses, namely, the 3-way interaction amount phrase type, idiom language and participants' native language. Participants would experience direct route activation only for idioms they are familiar with, in other words, ones from their native language.

To test this, a Four-way (2 x 2 x 2 x 2) mixed analysis of variance (ANOVA) was performed in R (R core Team, 2017) through package 'afex' (Singmann et al., 2018) with participants native language and counterbalanced-list as between-subjects factors and idiom's language origin and phrase type as within-subjects factors. Counterbalanced list was included as a factor to account for between lists error variance, however, it was not a variable of interest, no further analyses will be reported (Pollatsek & Well, 1995).

A significant three-way interaction among native language, idiom's language origin and phrase type was found; $F(1, 115) = 8.82$, $p = .004$, $\eta^2 = .002$. This showed that, as

predicted, the interaction between idiom's language origin and phrase type was significantly different across the two native language groups.

Several main effects and 2-way interaction effects were also revealed. A significant main effect of native language was observed; $F(1, 115) = 28.80$, $p < .0001$, $\eta^2 = .18$. A significant main effect of idiom's language origin was found; $F(1, 115) = 9.30$, $p = .003$, $\eta^2 = .003$. A significant main effect of phrase type was shown; $F(1, 115) = 109.85$, $p < .0001$, $\eta^2 = .04$. A significant interaction effect of phrase type and idiom's language origin was revealed; $F(1, 115) = 10.21$, $p = .002$, $\eta^2 = .002$. No significant interaction effect of native language and idiom's language origin was detected; $F(1, 115) = .17$, $p = .68$. No significant interaction effect of native language and phrase type was revealed; $F(1, 115) = 1.67$, $p = .20$.

Two separate two-way mixed ANOVAs were then conducted for each native language group to discern their distinct patterns.

3.6.2   English Participants

This secondary analysis was designed to test the effect of idioms' language origin on lexical decision RTs across phrase types among English participants. I expected a main effect of phrase type where participants would experience direct route activation for English idioms but not translated Chinese idioms. I also expected to see an interaction effect between phrase type and idiom language origin. English participants should show larger RT difference between phrase types for English idioms than for translated Chinese idioms.

3.6.2.1   Interaction Effect

A significant interaction effect was revealed both through analysis by subjects, $F(1, 60) = 14.78$, $p = .0003$, $\eta^2 = .01$; and analysis by items, $F(1, 60) = 9.05$, $p = .003$, $\eta^2 = .05$. Tukey adjusted post-hoc tests were conducted using R package 'emmeans' (Lenth, 2018). This planned comparison revealed that English participants were significantly faster at responding to idiomatic phrases than to control phrases, this was true for both English

idioms, $t(119.48) = 9.65$, $p < .0001$; and translated Chinese idioms, $t(119.48) = 4.03$, $p = .0001$. The significant interaction showed that English speakers responded differently to English phrases compare to translated Chinese phrases across the levels of phrase type conditions. As shown in figure 3, control phrases had on average longer RT than idiom phrases, this was true to both English and Chinese idioms, but the difference was much more obvious for English than for Chinese idioms. This larger RT difference between English phrase conditions signified that there was direct route activation. However, the smaller but yet significant difference between the Chinese phrase conditions may represent a different cognitive mechanism involved in the process.

3.6.2.2   Main Effect

A two-way (2 x 2) ANOVA with repeated measures was conducted using R package 'afex' with idiom's language origin and phrase type as within-subjects factors. A significant main effect of phrase type was observed in both subject analysis, $F(1, 60) = 100.10$, $p < .0001$, $\eta^2 = .06$; and item analysis, $F(1, 169) = 46.81$, $p < .0001$, $\eta^2 = .22$. A significant main effect of idiom's language origin was shown through analysis by subjects, $F(1, 60) = 8.46$, $p = .005$, $\eta^2 = .004$; but not analysis by items, $F(1, 169) = 2.11$, $p = .15$.

3.6.3   Bilingual Chinese Participants

This secondary analysis was designed to test the effect of idioms' language origin on lexical decision time across phrase types among bilingual Chinese participants. A main effect of phrase type was expected, where participants would experience direct route activation for translated Chinese idioms but not for English idioms. An interaction effect between phrase type and idiom's language origin was also expected. Chinese participants should show larger RT difference between phrase type conditions for translated Chinese idioms than for English idioms.

3.6.3.1   Main Effect and Interaction Effect

A two-way (2 x 2) ANOVA with repeated measures was conducted using R package 'afex' with idiom's language origin and phrase type as within-subjects factors. No significant main effect of idiom's language origin was shown through either subject analysis, $F(1, 57) = 2.34$, $p = .13$; or item analysis, $F(1, 169) = .77$, $p = .38$. No significant interaction effect was revealed by either subject analysis, $F(1, 57) = .01$, $p = .92$; or by item analysis, $F(1, 169) = .01$, $p = .92$. The lack of interaction signified that Chinese participants processed English and Chinese idioms in a similar fashion. A significant main effect of phrase type was observed in both subjects analysis, $F(1, 57) = 29.41$, $p < .0001$, $\eta^2 = .02$; and item analysis, $F(1, 169) = 11.28$, $p = .001$, $\eta^2 = .06$. Tukey adjusted post-hoc tests were conducted using R package 'emmeans' (Lenth, 2018). This planned comparison revealed that bilingual Chinese participants were significantly faster at responding to idiomatic phrases than to control phrases, this was true for both translated Chinese idioms, $t(113.99) = 3.78$, $p = .0003$; and English idioms, $t(113.99) = 3.93$, $p = .0001$.

See figure 3 for comparisons of the RTs in the 4 conditions between native English speakers and bilingual Chinese speakers. It shows that the 3-way interaction was driven by native English speakers' significant differential responses for Chinese and English phrase conditions, with clear evidence of direct route activation for English idioms. The lack of difference in RT patterns in bilingual Chinese participants was interesting and worth further exploration, I will speculate it further in the next section.
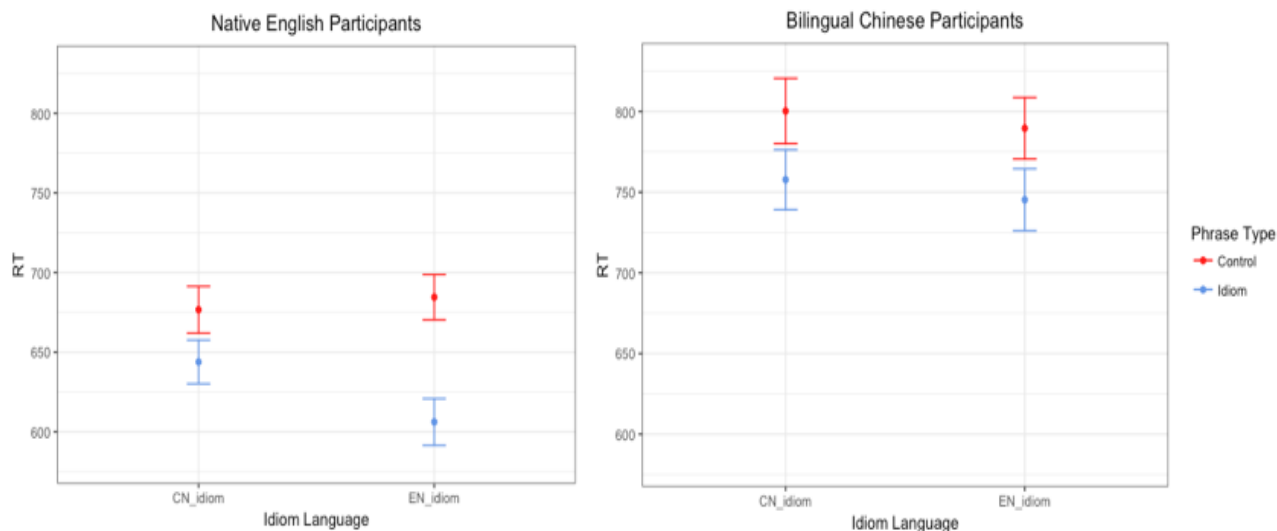
Figure 3 : Native English and Bilingual Chinese speakers' average RTs along with 95% confidence intervals across the four experimental conditions. Control conditions are represented in red, and idiom conditions are represented in blue.

3.7   Discussion

The purpose of this thesis was to explore the underlying mechanism in idiom processing advantage. Specifically, it was hypothesized that if direct route activation is driven only by familiarity to form, bilingual Chinese speakers would show no difference between translated Chinese idioms and control. On the other hand, if familiarity to concept played a role in direct route activation, these bilinguals would show processing advantages for translated Chinese idioms compared to control. As comparisons, native English speakers should show facilitatory effect for English phrasal conditions, but no difference for Chinese phrasal conditions.

Results supported the dual route model in L1 idiom processing in L1. Native English speakers responded significantly faster to English idiomatic phrases than to matched control phrases. Results also provided preliminary evidence for direct route being driven by familiarity to concept, as bilingual Chinese speakers showed significantly faster responses to Chinese idioms than to controls.

To my surprise, both native English and bilingual Chinese participants showed significantly different responses between phrasal conditions from outside of their native

language, despite the stringent control measures taken in Study 1 to ensure unfamiliarity. Native English participants revealed faster responses to translated Chinese idioms than controls. I speculate this may be due to residual and uncontrolled semantic associations between prime and idiom's real ending. For instance, the Chinese idiom 'chicken feathers and garlic skins', the idiom ending 'skin' may be activated by the mentioning of 'feather', whereas the control ending 'plant' may not be. As one may expect, idioms' real ending should be intrinsically associated to the prime since they are meaningful established phrases, whereas control endings may not be. Therefore, spreading activation may contribute to shorter RTs in the idiom condition than control condition. Moreover, bilingual Chinese participants revealed faster responses to English idioms than controls. Several speculations can be applied. Firstly, it may be that despite the effort to select unfamiliar English idioms to Chinese speakers, the small number of raters (i.e., N = 9) did not reflect this population's true idiom knowledge. The participants in my study may have a stronger knowledge of English idioms than the raters did. Secondly, it could be that the English idioms were presented in written form during norming, but in auditory form during the actual experiment. English idioms are a colloquial form of expression, which appear less often in writing. Participants may be more acquitted with these English idioms than they consciously aware. Finally, the differential RTs for English idioms and controls may be due to different degree of spreading activation in idiom and control conditions, as we saw in how English speakers' process translated Chinese idioms.

Although bilingual Chinese speakers showed idiom processing advantage when processing L1 idioms in L2, it may be difficult to draw a firm conclusion in light of that English participants show essentially the same pattern. It was inconclusive to make strong argument for either direct route activation or spreading activation given these mixed results. Therefore, dual route model was supported again in processing L1 idioms in L1; preliminary support for the contributing role of familiarity to concept in direct route activation was provided; however, further studies are needed to disentangle these effects.

Chapter 4

4   General Discussion

This thesis sought to expand and extend the work of Carrol and Conklin (2014) by using a more rigorous methodology to investigate the underlying mechanism of direct route activation within the dual route model. I investigated whether this activation was solely due to familiarity to idiomatic form or that familiarity to the concept also played a role. Study 1 provided norms for English and translated Chinese idiom selection. Study 2 examined whether facilitatory effect can be seen when L1 idioms were processed in L2, where familiarity to form and to concept were disentangled.

4.1   Comparisons to Carrol and Conklin (2014)

4.1.1   Native English Speakers

My results generally supported the conclusions of Carrol and Conklin (2014) as well as the predictions of the dual route model more generally. In my study, a clear 3-way interaction signified that native English speakers and bilingual Chinese speakers showed different processing patterns for idioms of different origins. Carrol and Conklin did not report this information. For native English speakers, both studies pointed to the same direction: the significant interaction signified that idioms of different origins were responded differently across the two phrasal conditions. The same pattern was seen in both studies that native English speakers showed idiom processing advantage over matched novel phrases. Nonetheless, my results deviated from the hypotheses in that the idioms' facilitatory effect was not only seen for English phrases but also seen for unfamiliar translated Chinese phrases.

4.1.2   Bilingual Chinese Speakers

The absence of a significant interaction in both studies signified that bilingual Chinese speakers responded to idioms of different origins in a similar fashion. My study found a significant main effect of phrase type, whereas Carrol and Conklin did not find any

significant main effects or interaction effect. However, they claimed the interaction effect of $p = .07$ was approaching significance. In my study, bilingual Chinese speakers showed idiom processing advantage over matched control phrases for both translated Chinese phrases and for English phrases. Carrol and Conklin (2014)'s post hoc analysis separating the idioms by origin, found facilitatory effect for Chinese idioms over control but not for English phrases.

4.2   Evidence of Dual-Route Model

A dual-route model postulates that two approaches are available to speakers: the 'retrieval' route and the 'computation' route. These two routes are also referred to as 'direct' and 'indirect' route, respectively. Familiar phrases or formulaic expressions are stored in long-term memory and can be retrieved holistically, and novel phrases have to be calculated word by word for meaning. Direct route is activated when a familiar idiom is encountered; this recognition also activates the idiom's figurative meaning and condition of use (Carrol et al., 2014). Computation route is used when the encountered phrase is unfamiliar, thus, meaning must be computed rather than directly retrieved. Subjective familiarity is crucial in determining which route is more efficient for processing (Tabossi et al., 2009).

4.2.1   Interpretation of English Speakers' Results

Native English speakers' results from Study 2 generally supported differential route activation based on subjective familiarity: English phrasal conditions were responded significantly differently from translated Chinese phrasal conditions. Further analysis showed idiom processing advantage for both English idioms and Chinese idioms compared to their respective matched control phrases. The large gap between the English phrasal conditions was seen as evidence of direct route activation when L1 idioms were processed in L1. When native English speakers heard a familiar partial idiom up until the key recognition point through the headphones, the entire idiom was retrieved from the long-term memory.

The different RTs between unfamiliar Chinese phrase conditions was likely to be due to a bottom-up process that involves spreading activation of the idiomatic ending word by the prime's content words (e.g., chicken feature and garlic ___; idiomatic ending 'skins' is more closely related to the prime than control ending 'plant'). Although spreading activation may also contribute to facilitatory effects seen for English idioms, this was not likely to be the sole reason for seeing such a big RT difference for English phrases.

4.2.2   Interpretation of Bilingual Chinese Speakers' Results

One explanation of bilingual Chinese participants showing processing advantage for translated Chinese idioms over matched control phrases was due to the lexical association between L2 and L1 idiom's content words and the familiarity to the idiom's underlying concept.

The Revised Hierarchical Model (RHM) is one bilingual model that takes into account both lexical and conceptual association between the two languages (Kroll & Stewart, 1994). The RHM suggests that beginner L2 learners rely more on lexical links between L2 words and their L1 translations, the L2 forms are usually mapped onto existing L1 concepts. These lexical links remain even with the development of L2 proficiency. For advanced L2 speakers, conceptual links are also established between L2 words and concepts. This model further proposed that the links may differ in strength. Specifically, the lexical links are stronger from L2 words to L1 translation-equivalents than the reverse, and the conceptual links are stronger between L1 words and concepts than between L2 words and concepts (Wang, 2007). Along this line, previous studies found that lexical links between translation-equivalents are critical in bilingual language processing, even in the presence of conceptual links (Gollan, Forster, & Frost, 1997; Keatley, Spinks, & De Gelder, 1994). Both early and advanced bilinguals tend to translate faster from L2 to L1 than vice versa (Sholl, Sankaranarayanan, & Kroll, 1995). Moreover, accumulating evidence have suggested that lexical links are utilized more often in L2-L1 translation, whereas conceptual links are recruited in L1-L2 translation (Kroll & Stewart, 1994; Sholl et al., 1995). Jiang (1999) investigated cross-language

priming effect in Chinese-English bilinguals and found significant effects in both directions.

If lexical and conceptual links exist at single word level, it may also be applied to multi-word phrases such as idioms. An idiom can be seen as a unitary entry in the lexicon, as well as a single concept in the conceptual store that can be accessed directly by either of the language. Bilingual Chinese participants in Study 2 were advanced L2 speakers, they have established lexical links between L2 and L1, as well as conceptual links between L2 words and concepts. As shown in cross-language priming studies, when L2 was used in processing, L1 translation-equivalent was also activated to a certain degree. Therefore, in my study, when idiom constituent words were processed in L2, lexical links between L2 and L1 words, and L2 words and idiomatic concept were also established. There may or may not be L2-L1 translation occurring automatically in the process of accessing the idiomatic concept. Because there was no gap between the auditory prime and the lexical decision task in my study, lexical association between L2 and L1 was established automatically. These can be used to explain bilingual Chinese participants' results in my study. For example, when the translation-equivalent of Chinese idiom--'Draw a snake and add' was encountered, strong lexical association between L2 words and L1 words were established. Note that there was no way of knowing whether it was L2 or L1 form or both that led to conceptual activation of the idiom, future studies should find ways to disentangle the effect of L1 and L2 on activating idioms at the conceptual level. When the specific idiom was recognized in its L2 form and was facilitated by the lexical association with L1, the entire idiomatic concept was activated, along with the ending word--'feet'. Then the strong association between the concept and L2 word drove the idiom processing advantage over matched novel phrases.

Carrol and Conklin (2014) suggested that strategic processing was used by bilingual Chinese participants in their study. The authors argued that due to the self-timed protocol, participants potentially took the time to translate the primes from L2 to L1 and made predictions for the final character. Even in the absence of strategic translation, the authors believed that at least automatic activation should have occurred. Therefore, they postulated that lexical association of the form was the driving force behind idiom

processing advantage for translated L1 idioms. My Study 2 design eliminated the possibility for active strategic translation. There was no gap between prime and target, the onset of lexical decision task was right at the offset of auditory priming.

My speculation, contrast to Carrol and Conklin, was that L2-L1 translation did not occur during Chinese idiom processing. Translation was unlikely to have taken place because the Chinese conditions' RTs did not differ significantly from the respective English conditions' RTs. Note that the Chinese and English idioms' endings were matched on length, frequency, part of speech and unprimed lexical decision RT for comparison purposes. English idioms were not subjected to translation, and since Chinese idioms had comparable RTs, it was reasonable to assume that bilingual participants did not spent extra time on translating Chinese idioms. However, the possibility of translation cannot be completely eliminated for that some proportion of bilingual participants translated all idioms to L1 for processing, regardless of the idiom's origin. This may have prolonged this group's overall RTs for all 4 conditions and may partially explain that bilingual Chinese speakers had longer RTs than native English speakers. The main contributing factor of slower RTs, though, was still L2 proficiency (Kotz & Elston-Güttler, 2004; Tse & Altarriba, 2012). In addition, based on many bilingual Chinese participants' comments, they barely had enough time to process the auditory contents in L2, as the upcoming lexical decision task itself was already daunting enough. While the RHM offered explanation for bilingual lexicon, it was not an idiom processing model. Bilingual Chinese participants' results should be seen as supporting evidence of dual-route model, as familiar phrases were responded faster than matched novel phrases. My study also provided preliminary information on the role played by conceptual familiarity in cross-language direct route activation. Presenting L1 idiom in L2 eliminated the familiar form and only kept the familiar underlying concept. Unlike how native speakers adopt retrieval of the familiar form as the preferred strategy in processing familiar L1 idioms in original forms (Cieślicka, 2006), bilinguals use both lexical association between L2 and L1, also the link between L2 words and idiomatic concepts to process L1 idioms in L2 (Dong, Gui, & Macwhinney, 2005).

Another explanation for the idiom processing advantage seen in bilingual Chinese speakers was that an idiom's constituent words tend to be semantically connected (Liu & Cheung, 2014). Unlike the colloquial status of English idioms, the usage of Chinese idioms is often taken as a sign of someone's learnedness. Acquiring substantial knowledge of Chinese idioms is a critical component of formal education. Because of the frequent occurrence of the constituent words within an idiom, and the frequent encounters with the idiom, people are likely to form not only lexical but also conceptual links between these words. When the bilingual Chinese participants acknowledged that my study was about idioms, the idiom subset of their vocabulary may be particularly activated. When encountering the first few constituent words of an idiom, participants may have activated the concepts for many potential associative words that could form idioms. For instance, the mentioning of 'snake' could activate 'cave', 'feet', 'bow', these words can all form common Chinese idioms with the concept 'snake'. It may be the case that the idiom in question was never specifically activated, only the concepts that formed associative links with the key word in the prime were activated. Despite the multiple activation of the potential concepts, if one of them was the word that showed up next, participant would have shorter RT for it compared to an inactivated word.

Bilingual Chinese participants also showed significant RT difference for English phrase conditions, this was different from my prediction. These results may be due to a higher familiarity to English idioms in my testing sample than my norming sample, therefore this faster response could be a sign of direct route activation. On the other hand, the more likely explanation was a bottom-up spreading activation between the prime and idiom's real ending word, just as how I speculated for English participants' responses to clearly unfamiliar Chinese idioms. Further studies are needed to disentangle the different cognitive processes underlying similar behavioral pattern.

4.3   Limitations and Future Directions

Study 1 could be improved in two ways. Recall that in Study 2, bilingual Chinese participants had shorter RTs for English idioms than control, this can partially be attributed to the need for yet more effective idiom norming criteria than Study 1. Despite

the thorough test measurements used in Study 1 to ensure that English idioms are unfamiliar to bilingual Chinese speakers, the small number of raters (N = 9) was not representative of this population's English idiom knowledge at large. The reason that I did not recruit many bilingual Chinese speakers to norm the idioms was that they are a scant resource in the participant pool. I did not want to exhaust them in the norming process then run into the situation of not having sufficient number of qualified participants signing up for the main study. Another explanation for seeing facilitatory effect for English idioms over controls in bilingual Chinese speakers in Study 2 was that Study 1 was done in written form while Study 2 used an auditory-visual cross-modal design. English idioms may appear much more familiar in auditory than written form, thus, this sense of familiarity may drive down the time needed to respond to idioms. Future studies may wish to conduct norming with larger sample of raters, and potentially carry it out in an auditory form or the form that is consistent with their main study method.

Two limitations of Study 2 also warrant discussion. The first limitation lay in the lack of objective measures of people's attentiveness to auditory contents. A few bilingual Chinese participants had noted that they thought the auditory stimuli were merely distractors to impede their performance on the lexical decision task, and they actively ignored them. Some other Chinese participants had mentioned that they were so drawn in by the difficulty of lexical decision task and did not pay much conscious awareness to the auditory primes. Despite these remarks, cross-modal priming should lead to automatic activation of the whole idiom instead of a conscious process of predicting. Nonetheless, it would be more effectively argued that faster responses were due to the priming effects of the auditory stimuli if objective measures of attention to these stimuli can be obtained. Therefore, future studies should include attention checks between the trials, both to encourage participants to pay attention to the auditory stimuli, and to provide reasons to remove people in cases where attention was lacking.

The other limitation may not have an easy solution for improvement. In Study 2, native English participants showed faster responses to Chinese idioms than controls, despite the complete lack of knowledge of Chinese idioms. I speculated this may be due to semantic

association between constituent words in the primes and the idioms' endings. For instance, the Chinese idiom 'chicken feathers and garlic skins', the idiom ending 'skin' may be activated by the mentioning of 'feather', whereas the control ending 'plant' may not be. Future studies may want to take spreading activation into consideration in the development of experimental and control pairs. Moreover, event-related potentials (ERPs) can be used to determine the role of idiom structure and concept in idiom processing advantage. It has been shown that P600 component was sensitive to the structure in highly constraining context, whereas N400 component is sensitive to semantic integration (Friederici, 2002; Kutas & Federmeier, 2000; Liu., et al., 2010). The presence or absence of these effects would help us determine how translated idioms are processed differently compare to idioms in their original characters. Moreover, we could understand whether translated idioms are still perceived as highly structured and integral, and whether novel phrase endings lead to differential semantic activations among English and bilingual Chinese speakers. Furthermore, ERPs can distinguish the different cognitive mechanisms underlying the same behavioral pattern. For instance, we can then discover whether bilingual Chinese participants' response to English phrase conditions was due to direct route activation or spreading activation. Eye-tracking may also be used to investigate whether the local lexical context provided by an idiom was enough to facilitate retrieval of the final word. In addition, eye-tracking can uncover the differential reading patterns among participants of different native language, therefore to understand the component that drove the processing advantage in each group.

4.4   Conclusion

These studies showed that cross-language effects occur at a level above the single word, which lends support to a conceptual basis for the idiom processing advantage. L2 learners carry previous L1 knowledge into interpreting information presented in L2, this may at times lead to confusion or misunderstanding. Especially in interpreting figurative language in L2 where literal interpretation is less relevant, and meaning is often derived from guesses and speculations. Understanding how bilinguals' L1 knowledge contribute to L2 interpretation is one step further in developing more effective ways that would aid cross-language or cross-cultural communication.

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Appendices

Appendix A: Task Instructions for M-Turk Familiarity Norming

You will see some idioms, they are either English idioms or Chinese idioms translated to English. The two types of idioms will be intermixed. You may need to judge whether it is an original English idiom or a translated Chinese idiom, then make the ratings based on your knowledge.

For each of the following idiom you will need to make two judgements. First, decide how frequently you have seen, heard, or used the idiom without consideration of whether or not you know what it means. That is, rate the idiom's **frequency of occurrence independently from whether or not you know its meaning**. Make your ratings on a scale, with left to right meaning increase in magnitude. As the midpoint of the scale would indicate that you have come across that idiom moderately often.

After you make your frequency judgement, you will rate the same idiom on a scale, depending on **how well you know the figurative meaning of the idiom**. The left most would mean that you have absolutely no idea what the idiom means, the midpoint that you are moderately certain of what it means, and the right most would indicate that you are 100% certain of the idiom figurative meaning and could easily put it into your own words.

Appendix B: Task Instructions for M-Turk Predictability Norming

You will see a number of idiom fragments. They are either original English idioms or Chinese idioms translated to English.

Your task is to complete these fragments with the first word that comes to mind, and write your answer on the line beneath each phrase fragments. For example, you might get an incomplete idiom phrase such as "take the bull by the____". In this case, the first word that might come to you is "horns". If that were so, you would complete the phrase as "take the bull by the horns"

It is important to realize that although there aren't any right or wrong ways to complete these phrase fragments, you should try to complete these phrases such that they are as meaningful as possible. For example, although it is possible that the first word that came to your mind when reading the phrase fragment "take the bull by the ____" might be "food" (if you are hungry), completing the fragment with "food" does not result in a meaningful phrase (e.g., take the bull by the food"). Therefore, in a case like this, your task would be to indicate the first word that came to you that can complete the phrase meaningfully.

Appendix C: Demographic Questions M-Turk Participants

For Native English Participants

Is English your native language and the language you are mostly fluent in?
- o YES
- o NO

Did you grow up in North America
- o YES
- o NO

What is your age?

For Bilingual Chinese Participants

中文是否是你的母语，并且你运用起来最熟练的语言？(Is Mandarin Chinese your native and most fluent language?)
- o 是 (yes)
- o 否 (no)

你在讲英语的国度（北美）生活过多少年？(How long have you been living in North America?)

你在中国生活过多少年？(How long have you lived in China for?)

你的年龄是多少？(What is your age?)

Appendix D: Idioms used in Study 2
Translated Chinese Idioms

Prime	Idiom	Control
a promise worth thousands in	gold	plan
assess the head and discuss the	feet	dogs
beat the grass and scare the	snake	beast
call a deer a	horse	games
chicken feathers and garlic	skins	plant
different mouths but one	sound	note
draw a snake and add	feet	hair
hair colored as crane feather with a face like a	child	clone
have neither learning nor	skill	brain
if the lips are gone, teeth will be	cold	done
love money as	life	gold
mark the boat to seek the	sword	steel
mountain of knives and sea of	fire	spam
play music to the	cow	rat
pull a snake from its	hole	deck
spend money as if it is	dirt	lamp
the smell of mother's milk has not	dried	hoped
thousand articles, same	rule	rock
throw an egg to hit the	stone	suite
throw brick to attract the	jade	gang
toss a stone to find out the	path	lake
wash one's heart and renew one's	face	turn
wind from an empty	cave	pine
wine and meat	friend	smells
a fox exploit the tiger's	power	women
add dog's tail to the	ferret	gravel
bite articles and chew	words	sales
brow raised in delight, eyes	smiling	learning
deep plans and distant	thoughts	squirrel
draw a pie to relieve one's	hunger	fossil
drink water and think of the	source	things
drop stones on someone who has fallen into a	well	page
every grass or bush a	soldier	illness
gaze through the autumn	water	level
light is red and alcohol is	green	worth
like tiger that had grown	wings	gifts

lips like guns in war of	sword	attack
love the house, also the	raven	voter
paint dragon and point	pupils	refuge
see a leopard through a	tube	plot
stand by tree stump waiting for	rabbit	litter
taste like chewing on	wax	pad
thinking of plums to reduce the	thirst	drafts
to dig up roots and inquire the	bottom	leader
to kill one to warn	hundreds	requests
to kill the chicken to warn the	monkey	novice
to raise one and infer	three	state
wipe one's eyes and	wait	tell

English Idioms

Prime	**Target**	**Control**
a blessing in	disguise	sunlight
a chip off the old	block	fence
a dime a	dozen	array
a penny saved is a penny	earned	owned
add insult to	injury	galaxy
an ace up your	sleeve	jeans
barking up the wrong	tree	wall
be strapped for	cash	coins
be the spitting	image	movie
beat around the	bush	wine
beat to the	punch	pitch
bite off more than one can	chew	soak
burn the midnight	oil	lie
climb on the band	wagon	moron
come hell or high	water	human
cut someone some	slack	moist
do something at the drop of a	hat	den
don't give up your day	job	box
drive a hard	bargain	journal
flash in the	pan	joy
food for	thought	freight
give a cold	shoulder	marriage
give someone the benefit of	doubt	faith

go against the	grain	sheep
go back to the drawing	board	point
has a bigger fish to	fry	dub
hit the nail on the	head	side
in the nick of	time	work
keep a level	head	game
lead up a blind	valley	factor
let the cat out of the	bag	zip
lie through one's	teeth	tears
make a clean	sweep	probe
on the edge of your	seat	plate
once in a blue	moon	link
out of the	blue	talk
rain on someone's	parade	flavor
rock the	boat	desk
rule with an iron	fist	grip
spill the	beans	chips
talk a mile a	minute	guitar
the ball is in your	court	clock
the best thing since sliced	bread	shame
the coast is	clear	warm
the elephant in the	room	star
the whole nine	yards	limbs
throw caution to the	wind	sake
to get bent out of	shape	shell

Appendix E: Demographic Questionnaire for Study 2

What is your age_____ and gender_____?

Is your native language English_____ or Mandarin Chinese_____? (check behind your answer)

Were you born and raised in Canada? _____or the United State? _____(check behind your answer)

Skip this question if you were born in Canada or the US. If you were born in China, how long have you been in Canada?_____Have you lived in other English-speaking countries other than Canada?_____If yes, for how long_____?

Skip if your native language is English. 你从几岁到几岁住在中国? _____

Appendix F: Ethics for Study 1 and 2

Western Research

Western University Non-Medical Research Ethics Board
NMREB Delegated Initial Approval Notice

Principal Investigator: Dr. John Paul Minda
Department & Institution: Social Science\Psychology, Western University

NMREB File Number: 109404
Study Title: An investigation into idiom processing by monolinguals and bilinguals

NMREB Initial Approval Date: July 18, 2017
NMREB Expiry Date: July 18, 2018

Documents Approved and/or Received for Information:

| Document Name	Comments	Version Date
Recruitment Items	Appendix B. Demographic Questionnaire for the first and second study.	2017/05/12
Instruments	Appendix A. Stimuli list. Received June 5, 2017.	
Instruments	Appendix C. Debriefing form for the priming study.	2017/05/12
Letter of Information & Consent	Study 1. MTurk Norming.	2017/06/30
Letter of Information & Consent	Study 2. Cross Modal Priming.	2017/06/30
Western University Protocol	Received July 4, 2017.	

The Western University Non-Medical Research Ethics Board (NMREB) has reviewed and approved the above named study, as of the NMREB Initial Approval Date noted above.

NMREB approval for this study remains valid until the NMREB Expiry Date noted above, conditional to timely submission and acceptance of NMREB Continuing Ethics Review.

The Western University NMREB operates in compliance with the Tri-Council Policy Statement Ethical Conduct for Research Involving Humans (TCPS2), the Ontario Personal Health Information Protection Act (PHIPA, 2004), and the applicable laws and regulations of Ontario.

Members of the NMREB who are named as Investigators in research studies do not participate in discussions related to, nor vote on such studies when they are presented to the REB.

The NMREB is registered with the U.S. Department of Health & Human Services under the IRB registration number IRB 00000941.
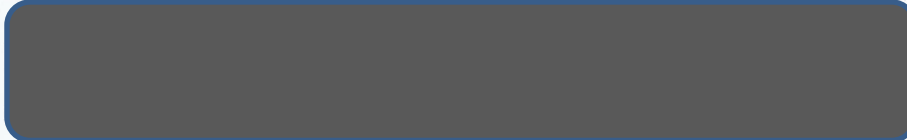
Curriculum Vitae

Name:	Toka (Tianshu) Zhu

Post-secondary Education and Degrees:

The University of Western Ontario
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2010-2015 B.A.

The University of Western Ontario
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2016-2018 M.Sc.

Honours and Awards:

Entrance Scholarship $1000
2010

Dean's Honors list
2013-2015

Related Work Experience:

Research Assistant
The University of Western Ontario
2013-2016

Lab Manager
The Brain and Mind Institute
2015-2016

Graduate Teaching Assistant
The University of Western Ontario
2016-2018

Selected Presentations:

Zhu, T., Minda, J. P. (July 2018). Evidence for Idiom Processing Advantage of L1 Idioms in an L2. Talk presented at the 28th Annual meeting of Canadian Society for Brain, Behavior and Cognitive Science, St. John's, NL

Zhu, T., Minda, J. P. (May 2016). The depletion of self-regulatory resources reduces performance on some subsequent tasks but not on all tasks. Poster presented at the Southern Ontario Behavioural Decision Research Conference, London, ON.