Chapter 4: Behavioural correlates of voluntary orienting predicted by L1 and L2 proficiency: evidence based on the cueing paradigm

4.1 Introduction

When we communicate in daily life, the simple execution of our thoughts and ideas is governed by multilevel sub-processes. These sub-processes consist of comprehension and production of words and sentences, articulation of speech sounds and pragmatic use of language. During bilingual communication, such complexities become amplified. Language as a mode of communication doesn't work in isolation rather it works as a function of perception, memory, attention, and control processes. The process of language selection undergoes a multilevel analysis, not just within one language but also across the languages. But the question is why do we require a selection mechanism for any action performance? Intuitively, more information in any given situation should aid performance. But instead, information which we receive from different senses can be relevant or irrelevant to the current task demand. Therefore, in order to overcome this chaos, attentional processes act to prioritize information processing and same holds true with respect to the language selection mechanism.

Traditionally, language switching task, picture naming task and priming tasks have predominantly been used to investigate lexical access/selection during bilingual language processing. Interestingly, these tasks are a trade-off among selection, inhibition and switching, the component processes of cognitive control. Therefore, the current study examined the selection sub component of control processes as it operates for both languages as well as non-linguistic stimuli among bilingual individuals. In the current
study, selection in bilingual language processing was studied with respect to voluntary orienting, which influences the process of attention allocation. In general, selection as a component process is being studied since 1950s in an attempt to address the cocktail party effect which explains the selection of relevant information in the auditory domain. This mechanism was extensively studied by Cherry (1953), and it paved way for similar work in vision sciences. One of the first theories on conceptual selective attention was Broadbent's filter theory (1958), which explained the role of attention as a filter in order to modulate information processing. His model consisted of two stages, initial stage of parallel processing consisting of extraction of physical properties from the input signal followed by a serial extraction of complex psychological properties (i.e. meaning). Selective filter is applied to this second stage to protect it from information overload, thus only relevant information as a product of 1st stage analysis is fed to the 2nd stage. This early selection theory was followed by the late selection viewpoint by Deutsch & Deutsch (1963) and Duncan (1980) which considered capacity limitation to occur at a later stage, in which relevant information is selected after meaning extraction. Initially, late selection theories were considered more as an exception to the early selection theories.

The debate on early versus late selection was somewhat neutralized by the load theory. Lavie and Tsal (1994) favored the late selection theory in low load situation whereas high perceptual load favored early selection mechanism. Most of these theories attempted to determine the time at which selection takes place, thus solving its purpose of protecting the limited capacity system from overload. For doing so, processes were often discussed in terms of the attentive versus pre-attentive processes. Broadly, any process
which doesn’t require active control mechanism can be considered automatic in nature. Traditionally, automatic processing is considered to be independent of processing resources, may not involve conscious processing and may be unaffected by intentions and strategies (Posner and Snyder, 1975; Jonides, 1981). Maria Ruz and Juan Lupianez (2002) described automaticity with respect to spatial attention as a pre-attentive hardwired system which works in a ballistic manner not considering current demands or goals. Yantis & Jonides (1990) & Theeuwes (1991) consider that attention capture is automatic as a default mechanism which can be overruled by voluntary control depending on task demands. Although, Dagenbach & Carr (1994) and DiLollo et al (2000) consider the understanding of automaticity to be effective only in a controlled setting. Participant’s behavioural manifestation shows automaticity in relation to the controlled context in which it is present. Language processing is influenced by both automatic and controlled processes. Models and theories of bilingual language processing also address the issue of language processing in a similar manner and debate on parallel and serial processing also exists in the field of bilingualism.

Selective attention is considered as a unique cognitive mechanism which consistently shows advantage for bilinguals in comparison to monolinguals (Bialystok, 1992). Stemming from the literature on language switching in bilinguals, different control mechanisms are often proposed such as selective consideration of the intended language (Costa & Caramazza, 1999, Costa et al, 2006, La Heij 2005) or inhibition of the unintended language (Green, 1998, Meuter and Allport, 1999). These sub components are rarely addressed in isolation which would be important to understand the tradeoff between the sub components of control as a function of bilingualism.
Existing evidences comparing bilinguals against monolinguals have shown mixed results with respect to the interaction between bilingualism and selective attention. For instance, Costa, Hernandez and Sebastian-Galles (2008) reported no difference between monolingual and bilingual participants with respect to the orienting effect on the attention network task (ANT). However, Poarch and van Hell (2012) showed a significant interaction between language groups (second language learners, bilinguals and trilinguals) and the orienting effect. They showed greater orienting effect on the ANT task for bilinguals and trilinguals in comparison to second language learners. There was no difference between bilinguals and trilinguals. Another interesting study examined 4 month old infants’ orienting behaviour with respect to a particular language being spoken by using the orientation latency procedure. Although the study addressed language perception of native and non-native languages, it was interesting to find that Spanish/Catalan monolinguals quickly orient to their native language unlike the Spanish-Catalan bilingual infants (Werker and Byers-Heinlein, 2008). Amso and Johnson (2005) while studying infants suggested that developmental changes in visual selection are rooted in the emerging inhibitory control mechanisms, thus, highlighting a trade-off in the operation of orienting and inhibitory control, which results in an effective selection of a particular language in day to day life. Kroll, Bobb, Misra & Guo (2008) highlighted the requirement of inhibition of the nontarget language in language selection. They concluded from their review that bilinguals’ both languages are activated in parallel but they compete for selection. Hence, the current study examined the differences in voluntary orienting in L1 and L2 with respect to lexical-semantic processing among bilinguals compared to the orienting effects for non-linguistic stimuli by using the cueing
paradigm. We also examined the nature of influence of language proficiency on the selection mechanisms for L1, L2 and non-linguistic stimuli.

Previous studies using linguistic stimuli and the cueing paradigm have addressed various questions in past. For instance researchers have looked the influence of familiarity of a letter string on the orienting mechanism. Givon et al (1990) suggest the absence of orienting mechanism in case of familiar letter strings i.e. words as compared to non words. Words are processed in parallel thus resulting in the absence of cueing effect (invalid trials being slower than the valid trials). Such results were challenged by McCann et al (1992) and Ortells et al (1998) suggesting no difference in orienting mechanism between words and non words. This factor of familiarity of the stimuli resulting in preattentive nature of processing can also be attributed by the visual pathway itself. There are studies which suggest a unique commonality in the dorsal pathway mediating spatial selection as well as orthographic processing of visual word recognition (Vidyasagar, 1999, 2001).

The current study employed the classic cuing paradigm (Posner, 1980) in order to study the selection mechanism with respect to endogenous orienting in both the languages of a bilingual. Cueing paradigm is one of the main tools in studying endogenous and exogenous orienting. Distribution of attentional gradient is modified by using a cue. Endogenous or voluntary orienting is used to look at the top down mechanisms mediating the engaging and disengaging function of attention in the form of valid and invalid cues respectively. Valid cues always predict the occurrence of the target whereas invalid cues do not predict the appearance of the target.
Voluntary orienting with respect to semantic processing with linguistic and nonlinguistic stimuli was examined among Hindi-English bilingual adults in the current study. Words in L1 and L2 and pictures of animate and inanimate objects were employed and were run in three separate blocks in the same experiment in order to compare the orienting effects between linguistic and non-linguistic stimuli. It was hypothesized that cueing effect would be more for linguistic stimuli as compared to nonlinguistic stimuli (L2>L1>pictures) in view of the effect of the increasing order of automaticity (Calabria et al., 2011). The study also aimed to look at the effect of attention manipulation on the processing of linguistic and non-linguistic stimuli as a function of language proficiency. It was hypothesized that orienting effects for linguistic and non-linguistic stimuli would be predicted by both L1 and L2 proficiency.

4.2 Method

Participants

Twenty nine Hindi-English right handed bilingual adults (Mean age: 23.4 years, with 11 males and 18 females) with Hindi as their L1 and English as their L2 participated in the study. They reported the use of the two languages on a day to day basis, with at least 7 years of basic education in both the languages with no significant history of sensory, motor or neurological disorders. Participants were selected randomly from University of Allahabad. Participants in both the experiments were matched on proficiency levels. Language history questionnaire and the test of language proficiency were administered to collect subjective and objective information about language use and language proficiency.
Material

Language history questionnaire: It consisted of questions related to the acquisition history, context of acquisition, environment of acquisition, present language use (in percentage), language preference, use of language with family, friends, extended family, neighbors and respective hours of usage (per day), medium of instruction and self reported proficiency level on different domains (1-5 point rating). All this information was organized under three major headings related to subjective measures of language proficiency: age, use and proficiency related self reported information. Administration of the questionnaire took approximately 20-30 minutes.

Test of language proficiency in Hindi and English: An indigenously developed test of language proficiency consisting of different tasks under the domains of speaking/understanding and reading/writing was employed. Speaking/understanding domain consisted of both production and comprehension tasks which measured the level of performance at lexical, syntactic as well as discourse level including confrontation naming task, discourse analysis, convergent production/synonym tasks and auditory comprehension. Similarly, reading/writing domain consisted of tasks of reading comprehension, fluency, phonological awareness and written discourse. Performance on each test was measured in terms of accuracy percentage and was added to the composite score for each domain namely speaking/understanding and reading/writing. The questionnaire and the proficiency test were individually administered in a quiet well lit room.
Stimuli

This experiment is based on the cuing paradigm wherein stimuli consisted of animate and inanimate words in L1 (Hindi) or L2 (English) as well as line drawings of animate and inanimate objects which were presented on the computer screen. The words were selected from a set of 303 words in both languages out of which a total of 130 words were selected (65 in each language) on the basis of the ratings with respect to frequency, imageability and familiarity levels of each word on a 5 point rating scale. Words in both languages were matched in length and consisted of both animate and inanimate words.

The pictures were selected from IPNP database (Abbate & LaChappelle 1984). A total of 130 pictures were taken and were rated by 10 high proficient Hindi-English bilinguals at University of Allahabad. Pictures were rated on familiarity and frequency on a 0-5 rating scale and only those pictures were selected which scored in the range of 4-5 points with the mean of 4.17. An arrow pointing towards left or right was used as the endogenous spatial cue indicating the location of the stimuli followed by the target stimulus. 70% trials were valid trials in which the cue predicted the location of the stimuli and 30% trials were invalid trials in which the cue did not predict the location of the target. The task was to make animacy judgment in terms of deciding if the stimulus word/picture was animate or inanimate. L1, L2 and picture stimuli were run in three separate blocks. Such blocks were used after conducting a pilot study with mixed blocks of L1 and L2 which showed complex interactions between the languages due to language switching in addition to selection. Hence, in order to understand the selection mechanisms per se with respect to the linguistic and non-linguistic stimuli, three separate blocks were used in one
experiment. The order of presentation of each of the three blocks was counterbalanced across participants.

Procedure

Participants were required to sit in front of the computer monitor at a distance of 60 cm. Stimulus presentation and response were controlled by E-Prime software. The stimuli were displayed against a white background on the computer screen. Each trial began with the appearance of a fixation cross at the centre for 200 ms, followed by the appearance of an endogenous cue (arrow) subtending at the centre of the screen for 250 ms at the centre of the screen replacing the fixation cross which was followed by a blank screen for 50 ms. The stimuli thus appeared in the left or right hemifield with a cue to target interval of 200 ms after the onset of the cue, and stayed until the response was made. The words/pictures subtended at a visual angle of 2 degree from the fixation point. The stimuli were presented as black color font/line drawing on white background. Participants were instructed to respond to the target as quickly and accurately as possible by pressing right arrow key for animate and left arrow key for inanimate word/picture (see figure 4.1).
Figure 4.1: Trial structure for the endogenous cueing experiment.
4.3 Results

Behavioural performance was assessed based on the reaction times (RTs) to each target presentation in an animacy judgment task. Mean reaction times were computed for valid and invalid trials for L1 (Hindi), L2 (English) and picture stimuli separately. Error trials and outlier trials with reaction times being three standard deviations above and below the condition specific means were excluded which left us with about 89.4% of the trials for statistical analysis. Comparisons between valid and invalid trials were made with respect to cue type (i.e. valid or invalid) as well as proactive and reactive control for all the three blocks of the experiment.

Orienting effects in L1, L2 and picture stimuli were analysed. The mean RTs were subjected to a three way, 3 (stimulus type: Hindi/English/picture) * 2 (cue type: valid/invalid) * 2 (semantic category: animate/inanimate) repeated measures ANOVA. There was a significant main effect of stimulus type, $F(1,27) = 69.52, p = 0.000$, cue type, $F(1,28) = 13.285, p = 0.001$, as well as for semantic category, $F(1,28) = 133.35, p = 0.000$). The two way interaction between cue type and stimulus type was significant, $F(1,27) = 3.487, p = 0.045$. The Tukey’s post hoc analysis showed significant cue effect only for English (L2) in the absence of any effect for Hindi (L1) and non-linguistic stimuli. Further, there was a significant two way interaction between stimulus type and semantic category, ($F(1,27) = 9.506, p = 0.001$). Post hoc analysis showed significant difference between animate and inanimate stimuli for all three stimulus types (L1: $p = 0.000$, L2: $p = 0.000$, picture stimuli: $p = 0.001$) suggesting that reaction times were faster for animate as compared to inanimate words/pictures. It was also interesting to find
a significant cue effect for inanimate stimuli \( (p = 0.018) \) on the post hoc analysis of the 2 way interaction between cue type and semantic category, \( F(1,28) = 8.102, p = 0.008. \)

The three way interaction between stimulus type, cue type and semantic category was also significant, \( (F(1, 27) = 3.565, p = 0.042) \). Tukey's post hoc test for the three way interaction showed a significant cueing effect only for the inanimate category for linguistic stimuli (for L1: \( p = 0.017 \), L2: \( p = 0.00 \)) in the absence of the effect for non-linguistic stimuli (both animate and inanimate). Effect of cueing was not evident for picture stimuli as they are processed automatically before linguistic stimuli.

Further, cueing effects for both linguistic and non-linguistic stimuli were analyzed based on the performance on slow and fast trials to look at the proactive and reactive mechanisms of control with respect to selection. This analysis could also explain the increasing order of the orienting effects (L2>L1>picture stimuli). Further, orienting effect for linguistic and non linguistic stimuli was also assessed as a function of language proficiency (see figure 4.2).
Figure 4.2: Mean reaction times for valid and invalid trials for words in Hindi (L1), English (L2) and nonlinguistic stimuli
**RT analysis for the slow and fast trials**

RT distributions were computed at 5\textsuperscript{th} and 95\textsuperscript{th} percentiles for each language and picture stimuli for both the cue types. Cumulative distribution function was performed to compare the variability in cognitive control processes as a function of conditions in different stimuli types.

Three way ANOVA with a 3 (stimulus type: words in Hindi, English, and Pictures) * 2 (cue type: valid and invalid) * 2 (trial type: slow and fast) design, was performed. The main effects of stimulus type, cue type and trial type were significant, $F(1, 27) = 36.288, p = 0.000$, $F(1, 28) = 180.75, p = 0.000$, $F(1, 28) = 20.476, p = 0.000$, respectively. In the absence of a three way interaction $F(1, 27) = 1.868, p = 0.174$, various two way interaction effects were evident between stimulus type and cue type as well as between trial type and cue type, $F(1, 27) = 15.046, p = 0.000$ and $F(1, 28) = 11.595, p = 0.002$ respectively. Tukey’s post hoc test for the two way interaction between trial type and cue type showed a significant difference between the valid and invalid trials only on slow trials. Two way interaction between stimulus type and trial type was not significant ($F(1, 27) = 1.583, p= 0.224$). Pair-wise comparisons were performed to look at the differences with respect to slow and fast trials. Results of the paired samples t test showed a significant effect for L1 and picture stimuli only on fast trials $t(28) = 3.473, p = 0.002$ and $t(28) = 2.916, p = 0.0073$ respectively and for both fast and slow trials for L2, $t(28) = 2.852, p = 0.00$ and $t(28) = 3.707, p = 0.001$. Hence, orienting effects for L1 and picture stimuli were observed only on fast trials whereas, it was evident on both fast and slow trials for L2 (see figure 4.3).
Figure 4.3: Behavioural performance on slow and fast trials on valid and invalid trials for stimuli in Hindi (L1), English (L2) and nonlinguistic stimuli
Language proficiency and endogenous orienting in L1, L2 and picture stimuli

Relationship between language proficiency and endogenous orienting in L1, L2 and picture stimuli was examined. Difference scores obtained by subtracting the reaction times for valid trials from those of invalid trials were correlated with the performance on language proficiency tasks. Multiple regression analysis was performed by using the simultaneous method.

In the domain of speaking/understanding, there was a significant correlation between the task specific scores on L1 proficiency tasks and difference scores for L1 (Hindi). Discourse analysis and words per minute in L1 in the speaking/understanding domain were able to account for 19.0% and 28.6% of variance respectively (R = 0.436, R square = 0.190, Adjusted R square = 0.160 and R = 0.536, R square = 0.286, Adjusted R square = 0.261 respectively) and the models were significant, $F (1, 28) = 6.352, p = 0.018, F (1, 28) = 10.867, p = 0.003$). Difference scores representing the cue effects in L2 (English) correlated with the total score of L2 proficiency. L2 proficiency in the speaking/understanding domain and reading/writing domain was able to predict 48.5% and 21.3% of variance respectively and the model was significant, $F(1, 28) = 25.403, p = 0.000$ and $F(1, 28) = 7.287, p = 0.012$. Picture stimuli also showed a task specific correlation with L1 and L2 speaking/understanding subtasks as observed in case of stimuli in L1. Synonym production in L1 and discourse understanding in L2 were able to account for 17% and 18.2% of variance respectively and the model was significant in both the cases, $F (1, 28) = 5.541, p = 0.026$ and $F (1, 28) = 6.005, p = 0.021$ respectively. Similarly, cue effects for L1 and picture stimuli showed no significant correlation with L1 and L2 proficiency in the domain of reading/writing.
**Relationship between language proficiency and orienting effects on slow and fast trials**

It was interesting to find task specific correlation between proficiency and orienting effects for L1 and picture stimuli for both slow and fast trials, whereas total score in speaking/understanding and reading/writing correlated with orienting effects in L2.

Discourse understanding in L1 and words per minute in L1 showed a significant relationship with performance on the cuing task in L1, and were able to predict 20% and 14.1% of variance for fast trials only. Models were also significant, $F(1, 28) = 6.757, p = 0.015$ and $F(1, 28) = 4.449, p = 0.044$ respectively. Discourse analysis in L1 and words per minute L1 were able to predict 29.8% and 28.8% of variance respectively for slow trials in L1. Model was significant, $F(1, 28) = 11.451, p = 0.002$, $(1, 28) = 10.926, p = 0.003$.

Total scores on L2 speaking/understanding tasks and L2 reading/writing tasks were able to predict 29.2% and 16.9% of variance with respect to fast trials in L2. Model was also significant, $F(1, 28) = 11.136, p = 0.002$, $F(1, 28) = 5.484, p = 0.027$. Total score on speaking/understanding tasks in L2 was able to predict performance on slow trials in L2 and was able to account for 24.4% of variance and the model was significant, $F(1, 28) = 8.716, p = 0.006$. For picture stimuli, synonym task in L1 and discourse understanding in L2 showed significant correlation with slow trials and were able to predict 16.2% and 18.8% of the variance with significant model fit, $F(1, 28) = 5.205, p = 0.031$ and $F(1, 28) = 6.266, p = 0.019$ respectively. Overall, speaking and
understanding domain predicted the performance on slow trials whereas both the domains predicted performance on fast trials irrespective of stimulus type.

### 4.4 Discussion

We examined voluntary orienting effects for linguistic and non-linguistic stimuli as a function of proficiency in L1 and L2. We employed the cuing paradigm with an animacy judgement task. We found a differential effect of cueing based on stimulus type and semantic category; a differential involvement of the proactive and reactive modes of control based on the stimuli type; and relationship between language proficiency and orienting effects for L1 and L2.

Overall, distinctions and similarities between bLC and GPCC were observed in bilingual population through their performance on a cueing task and the findings suggest that bLC may not work as a subsidiary to GPCC (Calabria et al 2011). Calabria et al (2011) demonstrated dissociation between bLC and GPCC on the basis of the differences in switch cost between linguistic and non-linguistic stimuli. The current study shows differences in performance between linguistic (word) and non-linguistic (picture stimuli) stimuli among Hindi-English bilinguals. Cueing effect was found to be stronger for linguistic as compared to non linguistic stimuli. Although, the exact nature of variation in control mechanism based on different stimuli are yet to be studied in detail but such preliminary findings are important for further exploration.
4.4.1 Orienting effects for linguistic and non linguistic stimuli

Cue effects were found to be significant for both L1 and L2 which is suggestive of generalized reduction in time efficiency as a function of cue indicating the location of the target on an invalid trial. Attention benefits induced by valid spatial cues were much larger in case of L1 (Hindi) as compared to L2 (English) and absent for non-linguistic stimuli. Animacy in itself had an effect, with the presence of cueing effects only for inanimate stimuli. This is contraindicative to the study by Ohman et al (2001) where they reported that animate stimuli attract more attention as compared to inanimate. Although, Kovic et al (2010) in one of the eye tracking studies suggested no difference in processing of these two categories apart from lesser initial gaze for animate as compared to inanimate stimuli. Separating the stimuli in different blocks helped in understanding the cueing effect due to stimulus related factors.

Our results clearly indicate that orienting effects could be different for linguistic versus non-linguistic stimuli and also with respect to L1 versus L2. This language specific difference in orienting effects indicates the involvement of different mechanism for both the languages as well as for the non-linguistic task. Attention capture can be considered to be determined by automatic processing in case of stimuli in L1 and non-linguistic stimuli as compared to controlled processing for stimuli in L2 resulting in a larger cue effect. The cue effect in terms of attentional disengagement for stimuli in L2 was also found to be modulated by the semantic category of the stimuli. Thus it is not just language per se which interacts with voluntary orienting but also the semantic category to which the stimuli belong. Our findings are consistent with the Shtyrov et al’s (2013) proposition regarding the involvement of automatic lexical analysis in the absence of the
recruitment of attention mechanisms as observed with our results with L1. Coch et al (2005) also showed the involvement of sustained attention effects for linguistic stimuli as compared to non-linguistic stimuli.
4.4.2 Proactive and reactive control mechanisms mediate orienting effects in L1 and L2

Slow and fast trials were compared to explain the variability in cognitive control processes as a function of language proficiency and cueing effect. Slow and fast trials were analyzed to look at the variability in selection process as a function of language proficiency and cueing effect. It was interesting to find the involvement of proactive control mechanisms for L1 and picture stimuli since the cue effect for these was significant only on fast trials. On the other hand, cuing effects in L2 showed the involvement of both proactive and reactive control mechanisms since the cue effects for L2 were significant for both slow and fast trials. This is in compliance with our results from case studies of individuals with bilingual aphasia in which we found similar effects with respect to linguistic and non linguistic tasks (Dash & Kar, in press) discussed later in Chapter 6.

For the purpose of efficient performance, participants use one of the two modes of control. Proactive and reactive control should be considered as complementary, rather than mutually exclusive to each other. Similarly, controlled and automatic processes supplement each other. As the early perceptual features are influencing the selection mechanism for both linguistic and non linguistic stimuli, it can be postulated that early selection mechanisms are involved in the process irrespective of the variation in stimulus type.

In general, L1 has a stronger representation and thus results in faster reaction time showing better attentional facilitation as compared to L2. We find greater attentional disengagement effect for L2 as compared to L1 since L2 requires more controlled
processing, particularly in case of stimuli where two levels of processing are involved, including lexical access and semantic processing. We also find a null effect with respect to cuing for non-linguistic stimuli. Traditionally, picture superiority effect of picture as compared to words has been postulated (Stenberg, 2006). This can lead to automatic processing of picture stimuli resulting in the absence of cueing effect. It was evident from the results that the selection mechanism was influenced by the perceptual characteristics of the stimuli, thus resulting in pre-attentive processing and reducing the cue effect.

4.4.3 Language proficiency and orienting effects in L1 and L2

Overall language proficiency was able to predict performance on the cuing task for both linguistic and non-linguistic stimuli. Although, it was interesting to find that overall score for L2 proficiency was able to predict the performance on the cueing task with stimuli in L2 whereas, task specific proficiency in L1 predicted cuing effects in L1. It is known that Hindi (L1) being a consistent orthography depends more on sublexical processing and L2 depends more on lexical processing mechanisms. Language proficiency has come out as an important variable in many previous studies. Although, L2 proficiency was predominantly addressed in the previous study but analysis of both the languages and looking at the predictive nature of both has resulted in better understanding of the selection mechanism.

The current study demonstrated the distinction between bLC and GPCC by comparing performance on a cueing task with linguistic and non-linguistic stimuli. It was interesting to find this distinction in task performance, not only with respect to the cueing effect but also in terms of its relationship with language proficiency in the respective
languages. Orienting effects were found to be smaller in L1 as compared to L2 due to automatic versus controlled processing effects. Orienting effects in L1 and nonlinguistic stimuli were primarily mediated by proactive control mechanisms whereas those in L2 were mediated by both reactive and proactive control. Orienting effects in L1 were predicted by task specific proficiency in L1 and those in L2 were predicted by domain specific proficiency in L2.

4.5 Conclusion

This study was designed to understand data driven covert orienting with linguistic and non-linguistic stimuli. This was studied through a traditional cueing paradigm targeting selective attention specifically. It was evident in this study that spatial attention depends on the familiarity of the stimuli. In case of familiar stimuli, processing was parallel without the need to orient attention, thus automatic in nature. Language proficiency is an important predictor variable.