CHAPTER 5

DISCUSSION
The third quarter of the 20th century witnessed the rise of an exciting stream of research – the research on the link between the right hemisphere and linguistic functions. With the seminal observations of Sperry and colleagues from their split-brain subjects (as cited in Gazzaniga, 1998), the quantum of research on the right hemisphere’s linguistic functions rose in the final quarter of the last century. During this period, several studies brought forth evidence in favor of the right hemisphere’s contributions to linguistic processing through diverse techniques and paradigms employed in various populations including normal subjects and those with aphasia, callosotomy, hemispherectomy, right hemisphere damage, as well as epilepsy. Although such evidence was not without criticisms, it is now generally accepted that the right hemisphere contributes to certain linguistic functions.

Among these linguistic functions, the right hemisphere’s role in lexico-semantic processing drew considerable research attention in the past. Both inferential and empirical evidence derived from normal and clinical populations have provided convincing evidence for the lexico-semantic processing skills of the right hemisphere. However, the evidence is questioned on methodological and empirical grounds. For instance, a good deal of evidence on RH’s contribution or the lack of it was derived from studies that included subjects with RHD as control groups, where the primary research focus was often on the lexico-semantic functions in subjects with left hemisphere damage and aphasia. Joanette et al. (1990) argued that the most feasible means of obtaining information about RH’s role in lexico-semantic processing would be from the investigations on those right-handed subjects with RHD who possess an intact left hemisphere. The studies performed on such subjects in the past have, however used diverse tools and protocols that often limited the comparison of results across them. In this context, the current study was undertaken specifically to investigate the lexical retrieval skills in subjects with RHD using a comprehensive set of tasks that employed both convergent (e.g., confrontation naming) and divergent (i.e., verbal fluency) tasks. Before proceeding to the discussion of the results, in the following section, a brief discussion on the battery used in the current study is presented.
The battery

As part of the current study, a comprehensive battery including several lexical retrieval tasks was developed. The tasks in the battery were selected based on an extensive literature search on lexical retrieval functions in brain-damaged populations including subjects with left hemisphere damage (i.e., aphasics) as well as those with dementia and epilepsy. Owing to this reason, results from some of the tasks did not have comparative findings from previous studies in the RHD population (e.g., responsive naming). In this context, such results may be considered as novel in nature with respect to the population under study.

The battery employed both convergent and divergent tasks. The former set of tasks was intended to elicit a specific response to a stimulus such as in the case of confrontation naming tasks. The divergent tasks, on the other hand, were used to elicit a number of responses to a particular stimulus (e.g., verbal fluency task) (Worrall & Hickson, 2003). The inclusion of both of these tasks, thus, had the potential to capture the specific lexico-semantic deficit in subjects with RHD, be it converging or diverging in nature.

Both convergent and divergent tasks included a comprehensive set of sub-tasks that were designed to capture the lexico-semantic processing difficulties of subjects with RHD. For instance, under the convergent task, antonym- and synonym-generation tasks were purported to be more effortful as they necessitated the search of semantically closely-related (in the case of synonyms) and closely-associated (in the case of antonyms) words. With respect to the category- and definition-naming tasks, again, one could consider that the difficulty level is different between these two tasks. For example, under definition-naming task, multiple semantic features (e.g., *sondilu iruva ati dhodda pra:ni – a:ne* [a big animal with a trunk – elephant]) progressively narrow the lexical search to the target item (e.g., *sondilu iruva → ati dodda → pra:ni*: none other than elephant), whereas the category-naming task invites a multitude of semantically-related items, which in turn, leads to the selection of a super-ordinate or category name, perhaps a task essentially tapping the holistic processing capabilities of the right hemisphere.
The divergent (i.e., verbal fluency) tasks were included in the battery based on previous evidence that such tasks are sensitive to lexico-semantic impairments (Joanette & Goulet, 1986). These tasks assess the ability to generate a multitude of exemplars in a given period of time (usually 60 seconds), which essentially requires infallible lexico-semantic processing skills. It may also be noted that deficits other than those in the lexico-semantic domain, such as executive dysfunctions could interfere with these tasks (Shimamura, 2002). Within the verbal fluency tasks, the semantic and phoneme fluency tasks have shown sensitivity to different cognitive dysfunctions. The semantic fluency taps the deficits in processing a specific lexical category, (for instance, animals) thus revealing the predominant linguistic deficits. The phoneme fluency task, on the other hand, has a broader impact as the lexical search is guided by the phoneme rather than specific categories of knowledge (Henry, Crawford, & Phillips, 2004).

5.1.1. Administration and scoring

The tasks (i.e., convergent & divergent) were administered in a random manner. Further, within each major task, the subtasks were randomized in order to nullify the effect of fatigue. It may also be noted that the participants in both groups were periodically queried about the need for a break in the administration and whenever demanded by them, the task administration was stopped and continued after a short break or a day.

All the responses were audio-recorded for later transcription and analysis. A group of three SLPs (native Kannada speakers) were required to transcribe the audio-recorded responses. The transcribed data was subjected to a reliability analysis. The transcriptions of the three SLPs showed good agreement between the three transcriptions as well as the individual’s own transcription of a portion of the responses, at a later date. The investigator (with the help of an SLP who was a native Kannada speaker) analyzed the responses.

The scoring criterion employed in the present study was distinct from the traditional naming test batteries (e.g., Boston Naming Test: Kaplan, Goodglass, & Weintraub, 1983). Under the convergent conditions, the present battery included a novel category of response (i.e., delayed correct response - DCR) which included those responses that were accurately retrieved after an initial response time of 10 seconds and those retrieved after the provision of
phonemic/syllabic/semantic cues (after the initial 10 second response time). The reason for the inclusion of this response category was to make the battery sensitive to even subtle lexico-semantic deficits in subjects with RHD. Additionally, it has also been reiterated in the literature that the tests/batteries (and therefore, the scoring criteria) designed to assess the linguistic deficits associated with LHD and aphasia are often insensitive to the lexico-semantic deficits in RHD (e.g., Abusamra et al., 2009; Bryan, 1988). The remaining response types were coded based on well-established guidelines borrowed from the literature (convergent tasks: Corina et al., 2010; divergent tasks: Joanette & Goulet, 1988; Troyer et al., 1997).

In sum, the present study employed a comprehensive battery of lexical retrieval tasks that were expected to capture even subtle lexico-semantic processing deficits associated with RHD. A good number of tasks were novel to the population under study. Further, a few categories of error responses (e.g., delayed correct response) were included to make the battery more sensitive to the arguably subtle lexico-semantic processing deficits in subjects with RHD. In the following section, the results of both convergent and divergent tasks are discussed in the light of previous research evidence.

5.2. Lexical retrieval skills in subjects with right hemisphere damage

5.2.1. The convergent tasks

The comparison of performance on the noun-retrieval task showed a significant difference between the clinical and control groups with the former group showing an apparently lower score compared to the control group. The noun-retrieval task, being a universally-employed task to assess the lexical retrieval skills, showed that subjects with RHD exhibit difficulties in retrieving accurate names of entities. Similar findings were also reported by Thomson et al. (1998) who employed Western Aphasia Battery (Kertesz, 1982) and Boston Naming Test (Kaplan et al., 1983) in a group of 33 subjects with RHD. In Thomson et al.’s (1998) study, the BNT identified only 21% subjects with RHD as having lexical retrieval deficits. Distinct from this result, the present study showed that a considerable number of participants in the clinical group exhibited difficulties in retrieving the names of objects. This could be attributed to two factors. First, Thomson et al. (1998) used BNT which was originally designed to assess the lexico-semantic functions in subjects with aphasia following
left hemisphere damage and such tests may not be adequately sensitive to subtle lexico-semantic disturbances (e.g., Abusamra et al., 2009; Bryan, 1988). The second reason for the significant difference in these (as well as most of the convergent) tasks between the two groups could be due to the stringent scoring criteria employed in the present study. For instance, the delayed correct responses (discussed earlier) were eliminated from the calculation of the mean accurate score, unlike in most of the traditionally available naming batteries (e.g., BNT: Kaplan et al., 1983). Thus, it is apparent from the present result of noun-retrieval task that a specifically designed task combined with stringent scoring criteria could be sensitive to the subtle lexical retrieval difficulties in subjects with RHD.

Similar to the nouns, the retrieval of verbs on the basis of the pictures depicting various actions also showed a significant difference between the two groups. However, the overall performance of the two groups of participants on verb-retrieval task was apparently poorer compared to the noun-retrieval performance. The comparatively poor performance of the control participants in verb-retrieval task finds support from previous priming studies in neurologically normal subjects (e.g., Krishnan, Tiwari, & Rajashekar, 2009). These authors compared the processing of nouns and verbs through priming technique and reported that the latter class of words was more difficult to process as evidenced by the increased reaction times and error rates, supporting the previous arguments of Bird et al. (2003) that verbs are inherently complex, more abstract and less imageable. The poor performance of the clinical group on verb-retrieval task supports the findings of Neininger and Pulvermüller (2003) who found specific deficits in naming action words in a subgroup of subjects with right frontal lobe lesion. Corroborative evidence in support of the findings from the current study has also been reported by Rutten et al. (2002). These authors reported increased activation of the right hemisphere in a series of tasks that included verb generation.

Additionally, in the light of previous observations on grammatical class-specific lexical retrieval deficits in people with brain damage (e.g.s., Bastiaanse & Jonkers, 1998; Caramazza & Hillis, 1991; Damasio & Tranel, 1993; Krishnan & Tiwari, 2010), it was decided to examine if the clinical population’s poor performance on verb-retrieval task was due to the inherent processing difficulty associated with verbs alone or to the combined effect of verb processing difficulty and brain damage. The repeated measures ANOVA performed to
examine this question revealed a significant main effect for the interaction between the tasks and the participant groups (see Figure 4.1, Results). It may, therefore, be inferred from this result that the clinical group’s significantly poor performance on verb-retrieval task was a combined effect of brain damage and the inherent difficulty in verb processing. This finding signifies that damage to the right hemisphere could result in disproportionate impairment in retrieving verbs compared to nouns.

The scores of the clinical group on both antonym- and synonym-generation tasks were significantly lesser than that of the control group. To the best of our knowledge, only one study in the past investigated the antonym-generation skills in subjects with RHD (Joanette et al., 1983) and reported subtle difficulties in this population. In this context, the present study provided further evidence for the difficulty in the antonym-generation task in RHD.

Considering the performance of the two groups of participants on antonym- and synonym-generation tasks, it was observed that, irrespective of the group, the former was generated more accurately than synonyms. Again a repeated measures ANOVA was carried out on the scores of the two groups on these two tasks to examine if the brain damage (in the clinical group) resulted in any specific disadvantage while processing the synonyms. The results however, did not show any interaction between the group and the tasks, thereby confirming that the brain damage did not result in any specific disadvantage while processing these two classes of words. The literature survey revealed no previous studies comparing the generation of antonyms and synonyms in subjects with RHD. In this context, this finding is novel and explorative in nature.

Additionally, the better performance of the control participants on antonyms compared to their own performance on synonyms sheds light into the processing difference between these two classes of words. It is possible to infer from the current result that the antonymous words may be paired more strongly than the synonymous words. In this context, it may be hypothesized that the antonymous words may be associatively-linked with each other (e.g., happy-sad, good-bad, male-female) as opposed to the synonymous pairs that may be linked with each other through direct semantic relations (e.g., happy-glad). Yet another reason for the processing advantage in the case of antonyms may be the associative occurrence of these word pairs (e.g. sukha-dhukha; [happy-sad]), unlike the synonyms in day-to-day
communication. These are explanatory hypotheses and future studies may investigate the relative processing difference between antonyms and synonyms.

Quite distinct from the remaining tasks, participants in the clinical group performed fairly equally to those in the control group on definition-naming task. This finding, though surprising, could be explained on the grounds of the nature of the task. That is, in the definition naming task, the stimuli were designed to provide the semantic information in a temporally progressive manner. For instance, *sondilu iruva ati dodda pra:ni* – a big animal with a trunk – is none other than elephant. In this context, it may be argued that provision of the semantic information (or features) in a temporally progressive manner would help the participant to converge onto the specific lexical entity that matches these semantic features. Further, the absence of significant difference between the scores of the two groups on definition-naming task may provide indirect support for the ‘suppression deficit hypothesis’ (Tompkins & Lehman, 1998). According to this hypothesis, damage to the right hemisphere leads to the pathological maintenance of lexical alternatives that fail to suppress eventually, leading to the erroneous selection of such alternatives into the verbal output. In the definition-naming task, as mentioned above, provision of stimuli in a temporally progressive manner that facilitates the semantic convergence onto the target lexical items may have eliminated such pathologically maintained lexical alternatives, leading to the selection of accurate lexical items. In essence, by providing indirect evidence to the ‘suppression deficit hypothesis’ the definition-naming task confirms the role of right hemisphere in lexico-semantic processing.

In contrast to definition-naming, the participants in the clinical group performed significantly poorly on responsive-naming task. This task required the participants to retrieve the lexical item in response to a question, a task similar to the one that is used in Western Aphasia Battery (Kertesz, 1982). Unlike the definition-naming task, this task did not provide any semantic features that eventually led to the accurate selection of the lexical item.

A responsive naming task has been included under the naming subtest of Western Aphasia Battery and this battery had been administered to people with both left and right hemisphere damage during its standardization. However, the RHD participants’ scores on this task are unavailable for comparison as the naming subtest of WAB uses a composite scoring procedure, combining scores from other tasks such as visual confrontation naming, sentence
completion, and verbal fluency. Further, to the best of our knowledge, no investigations have reported the RHD subjects’ scores explicitly on this task. Therefore, based on the current evidence, it may be inferred that subjects with RHD perform significantly poorly on responsive-naming task.

Considering the sharp difference in performance between the definition- and responsive-naming tasks, a brief discussion on the lack of consensus on certain terminological issues observed in the literature is deemed necessary. In the present study, responsive-naming was essentially similar to the task under the same label in the original version of Western Aphasia Battery (Kertesz, 1982) and its various adaptations to other languages (e.g., into Kannada, Karanth et al., 1991). However, the survey of literature has shown certain discrepant usage of the term ‘responsive naming’. For instance, Farias et al. (2005) used a typical definition-naming task, in which the participants were required to name auditorily-defined items. In the light of the current results that showed a significant difference between the scores of the two participant groups on definition-naming task, it is advocated that the terms ‘definition-naming’ and ‘responsive-naming’ are not synonymous and these should not be interchangeably used. Additionally, it is evident from the current study that the responsive-naming task (such as the one in the present study and Western Aphasia Battery, Kertesz, 1982) is sensitive to lexical retrieval skills in subjects with RHD, and it may, therefore, be employed to assess the lexical retrieval skills in people with RHD.

The performance on category-naming task revealed a significant difference between the two groups of participants in the current study. This task required the participants to retrieve the superordinate term (hyponym) for a set of three category members (e.g., katti [sickle], chuuri [knife], khadga [sword] – aayudhagalu [weapons]). The task may, therefore, be considered to activate a set of semantic features shared by the category members that could lead to the retrieval of the superordinate term for these members based on the shared/common semantic features. In this context, the significantly poor performance of the clinical group suggests that the right hemisphere aids in retrieving the superordinate term for a set of category exemplars. It may also be possible that the right hemisphere’s holistic processing potentials are tapped in this task, thereby leading to the impaired performance in subjects with RHD.
The comparison of the scores obtained from the two groups of participants on color-naming task showed significantly poor performance in the clinical group. This result is in agreement with the previous research findings that the right hemisphere is superior to the left in terms of color processing (Sasaki et al., 2007).

The naming of pictures depicting various emotional expressions also showed a significant difference between the two groups. Several studies in the past reported similar findings (e.g.s., Adolphs et al., 1996; Borod, 1993; Bowers et al., 1985; Darby, 1993; DeKosky et al., 1980; Rapcsak et al., 1989; 1993; Van Strien & Morpurgo, 1992). Further, during the data collection phase of the study, it was observed that several participants were attempting to name an emotion subsequent to the presentation of the picture depicting the ‘neutral’ face, despite the task-specific instructions to report the absence of any emotion as ‘neutral’.

In the task of naming famous faces, subjects with RHD obtained significantly poorer scores compared to the control subjects. According to the previous research findings, the information associated with famous faces could be processed in various ways such as visual recognition and semantic retrieval (Gainotti, 2007; Neilson et al., 2010). In the current study, although it was difficult to determine the nature of the mechanism behind the poor performance in the clinical group’s mean accurate responses, it was apparent during the data collection phase that several of the participants could indicate the significance of the people whose name they could not retrieve (e.g., A. P. J. Abdul Kalam – ‘former president’). This observation signifies that the mechanism behind poor performance on naming famous faces was not impaired visual recognition, rather, it was lexico-semantic in nature. Vladeanu and Bourne (2009), using the lateralized semantic priming paradigm in a group of 30 normal young adults, found an obvious semantic priming effect when semantically related prime faces were presented to the left visual field (RH) compared to the right visual field (LH). Based on this observation, Vladeanu and Bourne (2009) argued that the semantic information associated with famous faces is stored in the right hemisphere. Although this argument seems compatible with the current result, the observation that despite the frequent inability to name the famous people, the ability of the participants in the current study to provide information on the significance of the famous people indicated that they were able to process the
information semantically. In this context, it may be possible to infer that, the precise nature of deficit behind impaired performance on naming the famous face is neither visual recognition-nor semantic, but lexical in nature.

5.2.1.1. Error analysis: Convergent tasks

The analysis of error responses in the convergent tasks showed the predominance of delayed correct responses (DCR) followed by ‘no responses’. The preponderance of DCR could be attributed to several reasons. For instance, in the present study, a stringent response scoring criterion was employed to differentiate the correct responses from DCRs. Any accurate responses retrieved after the response time (10 seconds) as well as those retrieved accurately subsequent to the provision of cues were categorized as DCR. This is a deviation from the traditional naming tests that are designed for the assessment of lexical retrieval function in subjects with left hemisphere damage (e.g., aphasia). The reason for the exclusion of DCR from the statistical analysis of the accurate responses was that the current study aimed at the lexical retrieval skills of the RHD population without comparison to the LHD population. The analysis of the responses derived with such a response scoring criterion showed that subjects with RHD performed poorly compared to the normal control participants. Thus, it could be inferred from this section of the results that the lexical retrieval skills in subjects with RHD could be faithfully assessed with suitable tasks/instruments specifically designed for this purpose with appropriate scoring criteria. In this context, caution may be exercised while interpreting the results and drawing conclusions about the lexical retrieval skills in subjects with RHD especially when such results are obtained from tests/tools specifically designed for other clinical populations (e.g. aphasics).

It may also be observed that even subjects in the control group exhibited considerable DCRs. However, the difference in mean number of DCRs between the two groups was statistically significant (see Table 4.6, Results) with the clinical group outperforming the control group. The DCR in the control group could be attributed to several factors such as the stringent response criteria, age of the participants as well as, to the literacy level.

Yet another predominant type of errors was either lack of response (seldom, after stimulus repetition & cues) or ‘do not know’ (frequent) responses. Such responses are often
seen in people with brain damage (e.g. aphasia) and illiterates and these errors do not provide information on the level at which the lexical retrieval process breaks down (Bormann, Kulke, Wallesch, & Blanken, 2008).

In the present study, six error types were clubbed together as semantic errors. These included circumlocutions, coordinate errors, associate errors, superordinate errors, subordinate errors as well as descriptive responses. It may be considered that each of these error types emerge from the underlying lexico-semantic processing deficits (Corina et al., 2010). The addition of descriptive type of errors in the present study was based on the current observations that some participants failed to retrieve the target item and they subsequently described the pictures presented to them (e.g., begging – ‘sitting down holding a plate’). Therefore, such errors indicate the inability to retrieve the target lexical item, thereby belonging to the lexico-semantic category of errors.

The marked occurrence of semantic errors in the clinical group compared to the control group is indicative of the underlying lexico-semantic impairments in the former group. Further, within the semantic error types, the most prevailing type was associate errors (e.g. sukha [happiness] - sampath [wealth]). The predominance of such errors in the RHD population may be explained on the grounds of the ‘suppression deficit hypothesis’ (Tompkin & Lehman, 1998). As mentioned under the discussion of results from the definition-naming task, the ‘suppression deficit hypothesis’ assumes that the damage to the right hemisphere may result in the failure to suppress the multiple lexical alternatives that are activated in the process of lexical selection. Such pathologically sustained lexical alternatives could erroneously be selected into the output, resulting in the production of associate errors in the verbal production. In this context, the predominance of the associate errors in the clinical group may be taken as supportive evidence for the suppression deficit hypothesis as well as for the role of lexico-semantic processing functions of the right hemisphere.

In addition to the associate errors, subjects with RHD showed coordinate errors (e.g., baathukoli [duck] – paarivala [pigeon]), superordinate errors (e.g., benne [butter], thuppa [ghee], peda [a sweet made of milk] – a:ha:ra pada:rtaga:l[u [edible items] [ha:lina utpammaga:l[u – milk products]), subordinate errors (e.g. dancing - yakshagaana) as well as descriptive responses (e.g., ‘sitting down holding a plate’ – begging). The descriptive errors
were most apparent in the verb-generation task. Here, participants showed an inability to retrieve the target names as evidenced by their attempts to describe the stimulus picture. The significantly higher number of semantic errors (see Table 4.6, Results) in the clinical group compared to the control group essentially reveals the role of right hemisphere in lexico-semantic processing functions.

While naming the pictures depicting famous faces, the participants of both groups showed predominantly delayed correct responses, which in turn, was followed by the ‘no responses’. It was also apparent during this task that quite a few of the participants were able to report the significance of the persons depicted in the stimuli (e.g., A. P. J. Abdul Kalam – ‘former president’) despite their difficulty in retrieving the names. This pattern of responses was suggestive of the intact access to the semantic information associated with faces depicted, and the participants’ inability to retrieve the accurate names of the people. The provision of the phonemic/syllabic cues yielded accurate responses in a considerable number of participants both in the clinical and control groups.

5.2.2. Divergent tasks

A set of 11 divergent tasks were included in the present study under the semantic (8) and phonemic (3) criteria. In general, the results (see Table 4.7, Results) from these tasks revealed that subjects with RHD performed poorly on both semantic and phonemic criteria compared to the control subjects. These differences were statistically significant. The result from the phoneme fluency task contradicted the findings of Joanette and Goulet (1986) who reported that subjects with RHD performed significantly poorly in the semantic, but not in the phonemic criterion. Impaired performance on phoneme fluency task, in turn, supported the findings from several other investigations (e.g., Adamovich & Henderson, 1984; Albert & Sandson, 1986; Bolter et al., 1983). Additionally, the results of the current study also showed that the phonemic condition yielded overall poor scores compared to the semantic condition, irrespective of the group membership. This may be attributed to the overall lower literacy level (Crossley, D’Arcy, & Rawson, 1997; Tombaugh, Kozak, & Rees, 1999) of the participants of the present study.
5.2.2.1. Cluster and switch analyses

Additional insights may also be derived from the analysis of clusters, switches, and time-course of item retrieval in the verbal fluency conditions. In terms of the cluster analysis, the current study showed that the control group retrieved 0.19 clusters more than the clinical group (on an average, at the group level) in the semantic condition. Similarly, in the phonemic condition, the control group retrieved 0.13 additional clusters compared to the clinical group, although this difference was not statistically significant. These observations together show that, irrespective of the criterion, the control participants retrieved more number of clusters in the verbal fluency task. Considering the assumptions behind the clustering in verbal fluency tasks that it involves accessing and using a word store (Chertkow & Bub, 1990; Gruenewald & Lockhead, 1980; Wixted & Rohrer, 1994), the reduced number of clusters in subjects with RHD could be taken as an evidence for their impaired access and retrieval of category exemplars from the semantic store. Additionally, the results of cluster analysis performed in the present study are also in harmony with the findings of Villardita (1987) who reported that damage to the right hemisphere could result in impairment in semantic clustering. Further, Varley’s (1995) study also revealed that subjects with RHD could be impaired on semantic categories. Therefore, the evidence from the previous investigations combined with the results of the current study show that the subjects with RHD exhibit lexico-semantic deficits.

Analysis of the switches also provided some novel insights into the lexico-semantic processing deficits in subjects with RHD. Switching refers to the ability to shift efficiently to a new category, which in turn indicates a cognitive search strategy (Troyer et al., 1997). The results of the present study showed that mean number of switches in the clinical and control groups did not differ both in the semantic and phonemic conditions. Thus, it is apparent from these findings that subjects with RHD did not differ from the control subjects in employing the cognitive strategies while searching the mental lexicon during the verbal fluency tasks.

Combining the results from the analysis of switches with that of the clusters and the mean number of items generated across the divergent tasks, it becomes apparent that subjects with RHD retrieved less number of items and smaller clusters, but with comparable number of switches to that of the control subjects. These observations apparently show that the poor performance of RHD subjects on the verbal fluency task is due to the underlying lexico-
semantic deficits (i.e., less number of items generated as well as smaller clusters) and not due to any underlying cognitive impairments (i.e., switches).

5.2.2.2. Time course analysis

The time course analysis revealed that subjects in the clinical and control group retrieved the items in a similar pattern (see Figures 4.3 & 4.4, Results). That is, both normal subjects and those with RHD retrieved maximum items in the first quadrant of the 60 seconds duration followed by the second and so forth. It is also evident from these figures that across the quadrants, the clinical group retrieved significantly fewer exemplars compared to the control group under both semantic and phonemic conditions. This observation is also in accordance with the findings from switching analysis. That is, both clinical and control subjects did not differ in the strategic retrieval of items across the time. Additionally, the time-course analysis extends Joanette et al.’s (1988) study by confirming one of the two hypotheses proposed by these authors. That is, Joanette et al. (1988) observed a reduction in the retrieval of exemplars under the semantic conditions after the initial 30 seconds of one minute duration. They proposed that it could be due to the less automatic exploration of the semantic organization either due to the impaired scanning process or due to the discrete semantic impairments that prevent the scanning being efficient. The results of the current study are in favor of the second proposal that the observed reduction after 30 seconds in these authors’ study might have been due to the discrete semantic impairments as the current study did not show any differences in the strategic search (i.e., switching) employed by the RHD in comparison with the control (normal) participants.

In yet another study, Goulet et al. (1997) argued that the generally observed poor performance on phoneme fluency task could be due to the order effect and the fatigability associated with the brain damage (Lezak, 1983). That is, the phoneme fluency tasks are often employed subsequent to the semantic fluency tasks. They claimed, in the light of Lezak’s (1983) proposal that the fatigability associated with brain damage may lead to sub-optimal performance in the phoneme fluency task, especially when employed subsequent to the semantic fluency tasks. Interestingly Goulet et al. (1997) found no difference between the semantic and phonemic criteria when the tasks were randomized. The findings from the present study, however, did not support this argument. That is, despite the randomization of
5.2.3. Literacy and lexical retrieval

The influence of literacy level on the performance on lexical retrieval tasks was apparent during the data collection phase of the study as participants with higher literacy levels performed better across the tasks, irrespective of their group membership. Additionally, considering the fact that the literature has a dearth of studies on lexical retrieval skills as a function of literacy level in subjects with RHD, a posteriori analysis of the data was undertaken in the present study. As is evident from Table 4.9, the literate group’s performance was noticeably better across the tasks, irrespective of the group membership. Although a statistical test of significance could not be performed owing to the small sample in the literate group (n = 5), the results of the descriptive statistics serve as an eye-opener on the influence of literacy on lexical retrieval skills. Similar observations had been reported by Karanth et al. (1991) on a broader set of linguistic tasks. Therefore, it is advocated, based on the observations from the current study that future research may consider literacy level as a major variable in the investigations on lexical retrieval skills.

5.2.4. Site and extent of lesion and lexical retrieval

Most of the participants in this study exhibited lesions in the frontal or in the frontal and adjacent (i.e., temporal and/or parietal) lobes of the right hemisphere. For practical
purpose, these participants were categorized into two groups: viz.: ‘frontal’ and ‘frontal plus.’

As apparent from Table 4.10 (see Results), the results of descriptive statistics of the two
groups across the tasks are largely similar. In this context, considering the facts that the
frontal lobe was commonly affected in most of the participants and that the descriptive
statistics is reflective of a similar performance between the ‘frontal’ and ‘frontal plus’
subgroups, it may be considered that the current results are representative of the role of right
frontal lobe in lexico-semantic processing. Alternatively, the lack of noticeable difference in
test performance between the ‘frontal’ and ‘frontal plus’ subgroups may be explained by the
Hemispheric Asymmetry Reduction in OLD adults (HAROLD) model (Cabeza, 2002).

According to this model, compared to healthy young adults, the (normal) elderly subjects
exhibit reduced hemispheric differentiation in various domains of processing including
sensory, motor, and cognitive. For instance, recent investigations have shown that the elderly
participants exhibit increased right frontal activations compared to young adults while naming
pictures (Wierenga et al., 2008). Comparable findings have also been reported by Obler et al.
(2010). These authors attributed the left and right perisylvian areas as well as the right mid-
frontal regions and the associated pathways and their left counterparts to superior naming
performance in elderly participants. Thus, in the light of these studies, it may be argued that
the right frontal lobe plays a crucial role in lexical processing in the elderly participants.

Therefore, considering the fact that majority of the participants in the clinical group was
elderly (mean age: 61.91; SD: 4.35), the lack of obvious difference in scores between the
‘frontal’ and ‘frontal plus’ subgroups may be attributed to the common right frontal lobe
involvement in these two subgroups of the clinical population.

In sum, it is evident from the present study which employed a comprehensive set of
lexical retrieval tasks including convergent and divergent tasks that, subjects with RHD
exhibit lexico-semantic deficits. The results, in general, suggested that a comprehensive
battery of lexical retrieval tasks combined with stringent response coding criteria, such as in
the current study, could be sensitive to the lexico-semantic deficits associated with right
hemisphere damage. The observations from the study also supported one of the prevailing
hypotheses – suppression deficit hypothesis – in people with RHD. Additionally, it provided
insights into the lack of sensitivity of the definition-naming task in this population. It also
provided certain directives on some terminological issues – definition-naming vs. responsive-
naming – and the danger in the interchangeable use of these terms. The analyses of clusters, switches, and time course of lexical retrieval in the verbal fluency tasks supported and extended the previous proposals on the underlying mechanism of impaired performance by the subjects with RHD. Finally, the current study delineated the role of right frontal lobe in lexical processing and it also served as an eye-opener to the influence of literacy on lexical retrieval skills, which in turn, calls for further research.