CHAPTER 5

GENERAL DISCUSSION AND CONCLUSIONS

The main objective of the present investigation is to study the kinesthetic retention of the blind and sighted subjects and to explore how visual experience contributes in short-term recall of kinesthetic movements. Results of the 3 experiments reported in this research work indicate that the visual experience does not play similar role in the retention of various informations, cues and target lengths. It is also observed that recall delays and prior activities/ biasing activities have distinct effect on the processing of various informations, cues and length of targets. A discussion of the results obtained in the 3 experiments reported in this dissertation is made in the following subsections.

5.1 INFORMATIONS

How useful is visual reference system in short-term retention of kinesthetically learnt location and distance informations? An answer to this question is obtained from the findings of Experiment I and II. The results obtained from Experiment II show that the sighted subjects show better

performance than the blind subjects in reproduction of short constrained location target (10 cm), but on long constrained location target (30 cm) the latter show marginally better performance than the former. It was observed in Experiment II that the sighted subjects were only marginally better than the blind subjects on short constrained location targets (5-10 cm) but on long constrained location targets (20-25 cm) the blind subjects performed better than the sighted subjects. By and large the results of the two experiments suggest that the sighted subjects seem to derive benefit from their visual reference system. On the other hand, these differences narrowed down, or even reversed, on long targets when the performance was under feedback control as the length of targets increased. This finding is very much similar to that of Kool[130].

The data from both Experiments I and II suggest that in reproduction of short constrained distance targets groups do not differ significantly, while in reproduction of long constrained targets the blind subjects are poorer than their sighted counterpart. Results of Hermelin and O'Connor[34] are similar to those observed in the present study. Stelmach and McCracken[37] believe that location and distance informations are interdependent and coding of distance depends upon the relative amount of the two informations available in the movement situation.

In his review on the perceptual abilities, Jones[117] put forth two theories, i.e. visual map and motor organization. The primacy and necessity of vision for the perception of space were emphasized in the visual map theory. The primacy of vision was refuted in the motor organization theory and it was proposed that all sensory feedbacks contribute equally. It was also stated that a handicap in one modality will not cause any impairment, and the vacuum will be replaced by the efficient functioning of other sense modalities. It seems that the motor organization theory offers a better explanation for the processing of location, while the visual map theory explains the processing of distance information more closely.

5.2 PRESELECTION

An attempt to answer the question whether precision in coding caused by preselection is dependent on visual imagery or not has been made in Experiments I and III. It has been shown that preselected movements are more precisely coded than constrained movements, and that in the preselected movements blindfolded sighted subjects seem to seek help from their visual imagery even in the absence of direct visual feedback. Experiment I is a study of isolated location and distance informations presented with and without preselection cue to the blind and sighted subjects. In Experiment III an attempt has been made to study the role of preselection in simple

reproduction of movements of the blind and sighted subjects. In this experiment both location and distance cues were simultaneously available to them.

It is observed in Experiment I that in reproduction of isolated location targets both blind and sighted subjects are able to use preselection cue, though the sighted subjects show stronger effect of preselection than the blind subjects. Only the sighted subjects could take advantage of preselection in coding of distance. Performance of the blind subjects was found to be equally poor in both preselected and constrained distance conditions. Findings of Experiment III on location reproduction are similar to those obtained in Experiment I. The blind subjects have less advantage of preselection than the sighted subjects.

Roy[36] found that recall of active and passive distances did not differ in preselected condition. He concluded that efference is not a crucial component which is responsible for the precise coding under preselected condition, and suggested that prior information about the termination of movement is a major determiner of precision in preselected condition. Moreover, he argued that this prior information may facilitate coding of kinesthetic position cues and may enable the coding of distance into a nonmotor perceptual store like vision. His results do not provide support to the explanations given by Jones[38, 39] and Stelmach, Kelso and Wallace[41]. Our results highlight the role of visual reference system.

5.3 TARGET LENGTH

Length of a target has also been considered to be a crucial factor in retention of movements. Klapp[60] contended that short movements are predominantly programmed, while long movements are under feedback control. Motor short-term memory studies show that short movements are better reproduced than long movements[21, 34, 59]. Roy and Kelso[91] reported that long movements show more AE than short movements. They also show that recall of location and distance informations differs only on long targets. They suggest that at short targets both location and distance informations are almost equally precise, but on long targets location provides more precise information than distance. CE analysis in the previous researches has shown that short movements are generally overestimated and long movements are underestimated. This directional shift in error was referred as central tendency effect[33, 61] or range effect[62, 63].

In all the 3 experiments reported here, it has been observed that length of a target is a crucial determiner of its retention. By and large, short targets exhibit less AE and VE than long targets. This result suggests that short targets are more precisely coded and are less variable at recall than long targets. This finding is consistent with the one reported above. The CE analysis of all 3 experiments support the central tendency effect or the range effect in the

sense that targets were overestimated or underestimated depending on the length of targets. The interaction effect of targets with informations, groups and cues has been discussed in the previous two sections of this chapter. The findings reported here generally support Roy and Kelso's[91] contention that both location and distance provide equally precise information at short targets but location is more precise than distance at the long targets. At short targets, the sighted subjects take advantage of a visual reference in the processing of location. Of long targets the blind subjects improve their performance considerably, while in reproduction of short distance targets, the sighted subjects show better performance than the blind subjects. This finding is consistent with the results reported by Hermelin and O'Connor[34] and Salmoni and Sullivan[133] that distance information is coded with some help of visual reference mechanism. Stelmach and McCracken[37] suggested that coding of distance is dependent on the relative amount of location and distance information. If some location cue could be attached to distance information, distance would be as much better codable as location.

5.4 RETENTION INTERVAL

Trace decay theorists emphasized the role of lapse of time in forgetting. They argued that lapse of time is a primary and sufficient reason to cause forgetting because the traces decay with time lapse. This hypothesis was examined

in motor short-term memory studies also and it is reported that retention of a kinesthetic movement is lost over time[21, 25, 26]. In these studies a simple reproduction of movement (location plus distance) was examined.

Subsequently, it was found that all movement informations do not have similar retention properties[31, 32]. Laabs[33, 106] showed in a series of experiment that location information could be retained over unfilled delay, while distance information is spontaneously lost with lapse of time. In a subsequent study it was reported that at short targets both location and distance were equally reliable but on long targets distance shows more loss than locations[91].

Jones[39] reported that preselected movements do not show loss over unfilled intervals but constrained movement is lost with lapse of time. Stelmach, Kelso and Wallace[41] reported that both preselected and constrained locations were retained over unfilled delays. In a subsequent study, Stelmach, Kelso and McCullagh[43] reported that in a simple reproduction task a constrained movement was spontaneously forgotten with lapse of time, while a preselected movement was well retained over unfilled time intervals.

In the present study, retention intervals are varied in the first two experiments. In Experiment I two retention intervals are employed, i.e. 5 and 90-sec. In Experiment II,

there are three retention intervals, i.e. 0, 15· and 50 sec. It is found that both AE and VE in motor short-term memory increase as a result of time lapse. The CE analysis indicates that CE shifts in the negative direction as a function of increase in retention intervals.

Further, it was observed in Experiment I that both blind and sighted subjects do not show any loss in retention of preselected and constrained locations at the 90 sec retention interval. Blind subjects show forgetting of both preselected and constrained distance targets, while sighted subjects show spontaneous loss in retention of only constrained distance targets. Moreover, it is indicated that forgetting occurred mainly on long distances.

It is observed from Experiment II that both blind and sighted subjects could retain location targets with little difference over retention intervals. Forgetting of distance was observed over delayed recall in both blind and sighted subjects, the former being poorer than the latter on short retention intervals but this gap is bridged with further delay in recall.

Findings of both the experiments are more or less similar. Both preselected and constrained location targets could be retained by both blind and sighted subjects with little difference. This result is corroborated by the

previously reported results of Stelmach, Kelso and Wallace[41] on blindfolded subjects. It could also be noted that the sighted subjects were taking advantage of preselection in coding of distance. The blind subjects were unable to use preselection and showed forgetting of both preselected and constrained distance targets. This result proves the contention of Roy[36] that distance information can be coded with the help of prior information about the termination of movement in a nonmotor visual store.

5.5 PROACTIVE INHIBITION

The effect of prior motor activities on the retention of kinesthetic location and distance targets was studied in Experiment II. In this experiment 0, 2 or 4 prior activities were used before the learning of a criterion response. A major finding which emerged from this experiment concerns the distinct role of prior activities in retention of location and distance targets. The informations x prior activities interactions found significant for AE, VE and CE indicates that location information deteriorates as a result of interference from the prior motor activities but distance reproduction remains unaffected. It has been shown in the previous section that location information can be retained over unfilled time intervals, while distance is spontaneously lost with lapse of time. Therefore, it may be concluded that forgetting of location information follows the interference hypothesis, while

forgetting of distance information is accountable to trace decay. This interaction effect also throws light on the nature of the coding mechanisms for the two informations. The location information, which could be coded kinesthetically, shows interference from prior motor activities but not the distance information. It has been proposed in previous studies that distance information is coded in terms of some nonmotor perceptual reference system[34, 133]. If it is so, and as confirmed in the present study also, the absence of any adverse effect of prior motor activities on distance reproduction seems natural. Further, in the groups x informations x prior activities interaction effect it is noted that the sighted subjects are not affected by prior motor activities but the blind subjects show proactive inhibition in reproduction of both location and distance.

Proactive inhibition effect in MSTM was first reported by Stelmach[25, 26]. His studies mainly involved simple reproduction task in which both location and distance cues were available. The findings were also supported by Ascoli and Schmidt[92] and Williams[93]. Given their findings, it has been shown in the present study that proactive inhibition is evident in the sighted subjects for location but not for distance; while, on the other hand, the blind subjects show proactive inhibition in reproduction of both location and distance informations.

5.6 RESPONSE BIASING

Using a Stelmach and Walsh[110] type paradigm, response biasing effect has been studied in Experiment III, but time spent at the interpolated target was not varied. It is observed that biasing activities interfered significantly with target length, and this finding suggests that at short targets forward biasing was more effective than backward, while the reverse was true for long targets.

Another very interesting finding of this study emerged in a significant group x preselection x biasing activity interaction effect. It suggests that the sighted group is affected by biasing activity in constrained condition only, while the blind group shows biasing in reproduction of both preselected and constrained movements. The CE analysis indicates that backward biasing causes underestimation of responses, while forward biasing causes overestimation.

These results confirm the findings of Stelmach and Walsh's[110] study which involved only constrained movements. In a subsequent study, Stelmach, Kelso and McCullagh[43] studied response biasing effect in reproduction of preselected and constrained curvilinear movements. They reported biasing effect for both preselected and constrained movements. The results of the present study show that the blind subjects are affected by biasing activities in both preselected and

constrained movements but the sighted subjects are affected only in reproduction of constrained movements. It is because the two studies differ in the biasing procedure. In Stelmach, Kelso and McCullagh's[43] study, the subject moved to the interpolated location from the starting position of the criterion movements, while in the present study this movement started from the criterion target itself.

It is concluded that because preselected movements are more precisely coded and are more stable than constrained movements, biasing could not affect reproduction of preselected movements in the sighted group. However, it shows deleterious effect on constrained movements.

In short, the blind subjects who have enough experience of using kinesthetic modality for movement acquisition can perform better than the sighted subjects on long constrained location targets though the latter may do as well, or somewhat better than the former, on short constrained location targets. On the contrary, blind subjects perform poorer than the sighted subjects on long constrained distance targets, though on very short constrained distance targets the two groups may not differ. These results suggest that precisely isolated location and distance informations underlie different coding mechanisms. Location information can basically be coded in kinesthetic terms; whereas, distance information mainly seem to be dependent on some nonmotor perceptual reference system.

like vision. Effective use of preselection (prior information) also seems to be dependent on the availability of visual reference. Moreover, proactive inhibition effect is found in reproduction of location targets of both sighted and blind subjects. Proactive inhibition effect is evident in distance reproduction of blind subjects but not of sighted subjects. The interpolated biasing activity affects recall of constrained movements of both blind and sighted subjects. When visual reference system is available, preselection is helpful and no biasing is noted.

-oOo-