Control in Bangla: Agenthood and Processing Complexity

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By

ABHIJIT DEBNATH

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Center for Neural and Cognitive Sciences
School of Medical Sciences, University of Hyderabad
HYDERABAD 500 046

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Abstract

While exploring the processing differences found in two major types of obligatory empty category (EC) control, this dissertation attempts to substantiate a claim, that while processing any control clause, the language processor in human mind tends to link an argument NP with available event(s) in that sentence, showing an increment in processing load if there is an increment in semantic links between this performer and more given events, within the same sentence.

It is claimed here that object control situations provide lesser number of links to process than subject control sentences where there is an increment of such links. This study reports the findings from seventeen self-paced reading experiments carried out in Bangla (an SOV Language in India), explaining preferences towards object control in terms of increment in the number of Agent-Event Association(s), and its interaction with preferences in the type of nominative or oblique roles that the matrix clause subject (semantically associated directly with a matrix event and indirectly with an embedded event) may get from both these events in Bangla. Increase in number of association links between an agent and any number of events (either from the matrix clause or embedded clause or both) showed a significant effect. Independent preference towards a [+AG] subject was also detected but a variation in agent-event association complexity was found to very strongly override even this preference as well, therefore showing a strong influence of Agent-Event Association load.

At the end relevant ungrammatical and implausible sentential constructions are also used as evidence to show how Agent-Event Association load is capable of deciding the grammaticality in a language, clearly indicating that actual, measurable processing constraints have originally shaped certain grammatical restrictions of human language.

To Ma. for patience, near limitless.

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Chapter 1

Introduction: Psycholinguistic issues in processing of Agent Event Integration.

Any piece of information regarding an event shall by all means require the combination of at least two basic pieces of constituents, a performer (or participant) and the activity in which that participant involves. There are obviously certain physical restrictions and obvious patterns in such events which are more frequent and expected in the general world, any person is usually exposed to. These restrictions may also guide the general occurrence of the manner of involvement thereof. And there may also be certain amount of load threshold beyond which a further complex type of event shall not be easily comprehended by the information processing system in the human cognition.

With this plausible impression of the basic starting point, several related questions come up.

- How and in which precise steps of processing are the events integrated with an agent for it in the information processing faculty?
- In what manner may there be any flexibility or restrictions pertaining to such kind of an activity?
- If there is sufficient flexibility, then why do certain configuration of information pieces appear to be less plausible or even ungrammatical compared to certain other types of configuration?
- If there are in fact some kind of restrictions upon the pattern of configuration that the information in certain languages can be combined in, where do such restrictions at all come from?
- Are there memory related issues which apply some kind of least complexity and most efficient strategies in the direction of information comprehension and production?
- If there are such strategies, how may these strategies be detected and accounted for?

Having laid out such a pattern of offshoots of queries, it therefore emerges into a mammoth task to ascertain and account for the strategies that are embedded in the human information processing system which are capable of using and exercising these strategies when and where required.

1.1 Agenda.

The most important attempt made in this endeavor is to try to locate suitable means, according to available and proven psycholinguistic methods, to look up a single isolated phenomenon, that is of agent event integration, and try to locate and track in it, the hidden causes that are capable of guiding it and formulating the grammatical restrictions as a result of such a phenomenon.

In this study, an attempt is made to find out what happens when a choice is given to the processor to actually choose for itself how it wants to integrate an agent with any given number of events as well as an event to any number of agents. This has been made possible by studying suitable sentence structures which appear in appropriate instances of control clauses that allow for object control, subject control as well as arbitrary control. There has also been tests for preferences for the various types of roles, borne by the participants of the events and the sequences of different roles that the same performer identity has to be associated with if it has to be linked to more than one type of event.

The work has been satisfactorily able to find a significant preference for certain instances of role types in the language processor as well as has been able to detect how that very consistent preference may get significantly overridden in the processor, under the influence of some inbuilt strategies of minimal agent to event linkage and association. Therefore a strong interaction between these two phenomenon seem to be consistently in co-existence at any point of time and influences the information processing, encoding as well as production, in some or the other manner. This interaction seems to be guiding the restrictions which in turn is capable of framing some kind of a rule, or grammar for the language which may be realized in various forms of expressions in several tools applied by the language faculty in the resultant attempt to represent the external world.

1.1.1 Agent-event integration

There have been repeated endeavors attempting to delve deeper into the understanding of the laws of nature through available means in the methodology that modern science provides, for

studying the environment, surrounding human observation. These laws are expected to be deeply intermingled into the patterns and structures, extractable and generalizable from the physically observable objects and their behavioral features. Human beings have evolved and developed certain amount of generalization of the same. This can be inferred as having been revealed through an aperture provided by the restrictions, observed and maintained in linguistic cognition available from the behavioral correlates of the same. One needs to take into consideration, the following developmental aspects of linguistic evolution in a child.

1.1.2 Observation of external inputs:

a. **The Need:**

A child actually observes various vital elements in the nature that comprises of the surrounding environment. These vital elements may involve visual or relative activities in the environment that the child is living in. The child may be trying to absorb the algorithms from out of these observations such that it can be able to establish a rule that may define the interaction and relation between the algorithms observed in the natural environment.

b. **The Process:**

In this wholesome process, the child may involve in completely absorbing the visual, tactile, olfactory and all other available sources of sensory inputs that it can find from the surrounding environment in nature. During this intricate process of its novel experience with the environment, the child can however only absorb what is available to it, either restricted to the *allowance* by the sensory organs that enable the intake and observation or to the *immediate environment* itself from which it is having its supply of sensory algorithm intake.

c. **Limitations/Restrictions in the Process:**

In the face of this lively interactive situation, there seems to arise one possibility and that is of the child having to infer the reachable limits of its capacities. The child however then starts to interact with the environment and surroundings and learn the extent of algorithmic possibilities that would actually hold and be verifiable and sensible in the immediate outside world. This would require the making of calculated moves with recurrent check and feedback in the interaction. When the requirement of

a consistent and interaction-capable encoding of the external information comes into light, more algorithm check becomes necessary as the communication has to exist in relation with other encoding systems of the identical algorithm that other children might have evolved or developed. Therefore the requirement of an efficient exchange of the learnt information arises.

d. **Interaction of Facilities and Restrictions:**

If both the facilities and restrictions are completely within the grasp of the environment and we assume that the cognitive system completely grasps and follows the law imposed by nature, as a rule of thumb, then there might not be many exceptions (ungrammaticality being one such example) but we find that within grammatical sentences (which have no trace of doubt as to the acceptability and plausibility of meaning or structure) there are certain structural configurations where presence of a particular lexical element is preferred to another which may again be preferred to yet another still.[1]

This may to some extent suggest that there is an interaction between the environment and the processing system such evolved that the available facilities of environmental provisions (of e.g., patterns in distribution of action for agents) are detected by the processor and comprehended after breaking down the complex situation into a systematic structure of algorithms. The systematic structure, to which the complex is broken down, may actually be a requirement upon the processor (and not any externally observed restriction in the behavior of the nature). Thus the simpler properties, that the processor decomposes any event or information to, while processing it for comprehension, becomes something which has a target format that the processor actually needs to achieve and extract every time it receives an intake of information (from audible, visual or any other sensory source). The amount of processing required to break down the information to that type of a simplex structure may, to some extent, be equated with processing difficulty, or rather, the processing cost.

This assumed, the following assumptions about the behavioral correlates may be entertained as effective under any standard explanatory hypothesis that attempts to account for the increment in levels of processing or rather steps of processing when a piece of information is available for comprehension. The understanding is that the processor should have a target level of decomposition to attain for the sake of comprehension (which may be the simplex).

1 The semantic plausibility of "... *inflating a large carrot*" should be less than "... *inflating a large balloon*".

To attain that level, the processor has to break down (like digestion) chunks of structured and coded information that comes in its way. Now, the amount of break down required indicates the further away that the structure of information is, from the target broken down level. This argument also seems to indicate a general situation, which is that everything available outside the processor is not exactly structured identical to the target structure that the comprehension may be targeting to reach at the simplex level. Therefore everything needs to get decomposed down to a minimum required level to enable comprehension at the level of satisfiable status. This however would predict that there is no possible identical equivalent of a base level representation in any possible external stimuli and that all levels of complexity in the original stimuli must be broken down into a different level of integration for comprehension. As such, an inference may be drawn that there is actually no default in the external stimuli of language that the processor may prefer. Therefore the processing complexity differs as the requirement to comprehend types of complexity in the input stimulus differs.

A further deep understanding of the present situation may involve an adequate scrutiny of the deeper common rule (better known in the literature of syntax as Universal Grammar) that is claimed to control a structure in the language, considered to have a comparably similar or rather identical expression, in some manner, in the human mind. In presence of a requirement upon the processor, to operate on any level of external stimuli, it is therefore required that the information should be broken down to a comprehensible unit, acceptable to and conveniently conforming to the processor's requirement which can only function adequately under the physical and biological setup of the metabolic restrictions and limitations of the functioning at the neural level.

1.1.3 Relevant Questions:

The processing restrictions having been understood thus, one needs to now look into;

a. **How do the various processing complexities differ?**

This needs explanation in terms of the processing criterion which shall be required to distinguish all the minimal semantic as well as structural differences in a comparable set of information chunk. The idea is to look at classifications of certain types of linguistic complexities that can be used to compare, at varied levels of minute differences, the difference in comprehension in terms of breakdown of the string of information chunks to a certain level. The steps required for the breakdown of the string of sequence into which

information chunks have been encoded, need to be equated with some *property* and *features* of the processing (rather than just the cover term of processing complexity).

b. ***Why should features of processing differ and why should it be studied.*** [Why this expectation rises, may be considered a matter of intuitive prediction]**:**

Processing of information needs to be done with some goals. Letting one of them be the requirement of comprehension and decoding of information, one can guess that the variation in the density of information in a particular string will require engagement of similarly varying levels and steps of decomposition. Such a variation can also be expected to represent the properties of the information that causes it. Now assumptions may be made in the direction of direct observation of the variations through external behavioral manners that may be detected through certain physical measurements of the state of the body while such *on-line processing* is in progress. Therefore if the difference in some pattern of behavior in the body, shows some instances of consistent correlates for minimally varying and well controlled or manipulated information properties, then it can be said to be a result of the variation in the required processing that the current property of the provided information requires, to be comprehended. Current studies have shown several correlates of *information processing* with the *behavioral measurements* as a result of the exposure to controlled linguistic stimulus, minimally varying for the type of information that needed to be tested for the variations in the behavioral response there of.

Now these questions may be considered as one of the central issues that rest on the debate of how the external world may be linked to the internal cognitive system of the brain and mind. Otherwise stated, it asks how a certain process of computation and of which kind may be able to establish a strong link from the external world along with the information available in it, to a relevant and relative storage and analysis site in the brain.

1.2 Identifying an adequate method for a feasible analysis of the processing.

In order to employ comprehensive and controlled measures to answer *how the various processing complexities differ*, instances of external stimuli processing must be comparatively analyzed and conveniently graded for realizing the differences, where the following controls may be incorporated.

a. A target comprehension task may be considered for analysis and its properties explored such that a narrow testable question may be developed, to test the features of processing that the task elicits.
b. A method of test may be designed to examine difference in types of complexity. The method should be sensitive enough to be able to elicit sufficient patterns of processing differences that may be attributed to difference in processing cost and nothing more. Such a difference should be measurable in correlation with a behavioral difference such that certain difference in behavior found across the response patterns for different types of appropriately controlled stimulus exposure shall be able to precisely indicate a sharp difference which is statistically analyzable and verifiable for a number of instances, holding across a number of sample human participants on whom the tests may be performed.
c. Appropriate and suitable stimulus may be designed for the test. The processing can be measured only through behavioral correlates and these correlates must not be random but controlled by types of external stimuli controlled for their features of complexity. But now the problem arises such that the levels of complexity in the stimuli, as far as relevance to internal cognitive processing is concerned, has not thoroughly and clearly been accounted for, in terms of the levels of complexity involved in the decomposing of external stimulus, to extract, analyze and store it for comprehension. The problem thus stated, seems to provide a complicated and tough challenge of mapping types of stimuli (of graded complexity) with processing correlates in terms of processing cost and its increment according to various shifts in the gradient (of stimuli types). Thus a feasible method of linking the difference in complexity levels of external stimuli, to the difference of processing cost in the processor, may be required, to find strong correlates between certain external stimuli and a gradient of processing costs as elicited from the difference in behavioral correlates of processing. This entails that the comparison be made between relevant behavioral correlates while processing relevant and relatively linked external stimuli. By this claim, we would have to take the responsibility of selecting a criteria by which the stimuli shall be considered comparable and relative to each other in abstract relations of minimal possible controlled difference.

Thus stated, the task then is to locate patterns of stimuli occurring in the environment that can provide us a control over the variation in properties in such proportions that the properties vary only relatively and there is a strong similarity otherwise, making the stimuli minimally paired (i.e., distinct from each other in the most minimal possible feature). Now, the lesser the variation the more the relative similarity would be between the stimuli. This is then a different task to comprehensively account for and control the variation of these mentioned properties. An appropriate behavioral response may be collected while presenting these stimuli to people (who either see, hear or in any feasible manner perceive the stimuli). The final test of internal processing, difference (as in terms of processing cost and complexity) can be relatively computed and ascertained by computing certain assumed and proven arguable comparable correlates in behavior, measurable in eye-movements, ERP in EEGs, button press latency and patterns for self-paced or auto-paced stimulus progression with attached questionnaire and rating tasks. The computation of processing complexity shall be directly accountable only for the difference in the behavioral correlates, taking the difference in the factors as the independent factor (or the causal factor) behind the processing difference. Building an argument regarding the relation between the properties embedded in the stimulus (and the difference in the properties) and the difference in procured behavioral correlates requires an intricate analysis of properties in stimulus and extracting probable correlates of increment in processing cost and processing level increment. Therefore, certain levels of relative assumptions may be incorporated in this kind of argumentation. The Following two may seem feasible.

1.2.1 Assumptions of Levels of Processing.

a. *Level One*:

The behavioral response to stimuli can be considered as a general effect of some kind of an internal processing mechanism that is operating upon the information available in the stimuli in real time. To understand the internal processing mechanisms, we may be required to analyze this correlation at yet another level of correlation, the relative links between the behavioral correlates and complexity increment.

b. *Level Two*:

The difference between behavioral correlates of processing, needs to be linked to certain inferences drawn in the context of the processing of stimulus information being broken down for comprehension. Therefore a deeper level of correlation has to

be inferred between processing complexity and the information breakdown process (or rather decomposition).

1.2.2 Questions regarding processing complexity.

At this point, certain basic questions regarding processing complexity may also be asked.

a. Complexity may be understood here as a collection of different or similar simple processes, relatively linked and bound to each other in a continuum of step wise execution. It may need to be ascertained whether processing complexity is a matter of finding an algorithm match between such a progression in the given stimulus and experienced or *expected* progressions according to built experiences (in a gradient of frequency rates or a certain manner of sequencing complexity).
b. Processing complexity may also be considered a result of information decomposition complexity, measurable in a gradient of increment in levels and amount of decomposition activity involved in real time while the information in the stimulus is being processed on-line.

It seems that argument (a) would suggest that people's experience with the environment may be a crucial factor in their being able to extract an algorithm and then be able to account for the parameters (toggled relatively across cultures and locations) that vary systematically but on the periphery of the principles or the universal features in the human linguistic faculty.

Argument (a) however delves down to a deeper level and may be able to provide for a natural similarity and sets of restrictions most likely traceable at a genetic level, something that can be claimed to be common to and identical across the human race.

Therefore the *level two* assumption of correlation may usher an entailment of the argument that every piece of information, strung in a syntactically construed configuration is actually a code that exists outside the original, base level system where actual comprehension of concepts prevails. Thus the level of concepts must be having a construal pattern different from the speech, linked and related more closely to the bodily compositions and a construal realizable in the form of neural structures, their linked and synchronized activities as well as the perception thereof in the form of interactions of the memory with in bodily limits and restrictions. Thus argued, this level of correlation can be designed to represent relation and proportionality between assigned and inferred processing complexity and the process of

information breakdown in terms of the number of steps involved in doing it. Therefore in order to analyze the numerosity or rather the increment of steps of decomposition, the types of units that come out of the process need to be inferred in basic conceptual forms which may be represented in terms of conceptual functions that can have certain units of the information as its arguments.

At the current level of experimentation and behavioral prediction, only a working inference can be worked out. Therefore the study shall remain at the second level of drawing a correlation between the behavior and the activity of decomposition. Thus the processing level analysis, which can be correlated with the difference in behavioural discrepancies can be correlated with internal information decomposition and comprehensive restructuring. The target is to understand at the level of such restructuring, what difference in processing can be traced such that a gradable complexity range can be inferred and a causal factor behind this may be attributed to it. The particular causal factor may be inferred in terms of the allotment of arguments, actions, agents, locations, properties of the actions etc., the possible complexity in generating a relative image in the processor as well as linkage and integration of these elements with each other in the processor. Thus at this point, we might suspect certain preferences and facilitations in the processor that may actually cause decrease or increase in the increment of processing cost, therefore controlling the processing complexity. Therefore the attempt is to backtrack down to the cause of the processing complexity, by classifying the behavioural properties, finding their correlates in the properties of the information in the stimulus and therefore inferring the preferences and facilitations while the information complex was being decomposed for comprehension.

1.3 Looking for feasible indicators of the processing algorithm:

Human cognition delves deep into a widely available range of external stimuli. Yet there are some very basic algorithms in the nature that may be noticed by the lowest level of analysis of the activities that surround the person. One such notable example is that of a unitary event complete in itself and fully able to address a totality in comprehension. There may be an agent involved, by whom an activity is being undertaken, experienced, observed or even conceived. Now at this basic level, the comprehension has to take into account two basic types of concept;

a. **The Agent:**

An object or organism that is capable of being related to certain properties conceptualized as alive or dead, being unitarily concrete and tangible, visible at some possible point of reference in space and time and cannot be reduced to a completely abstract and non-existing entity. This living or dead entity, animate or inanimate, is somehow conceptualized as having such attributes in a gradual development of information acquisition in the child, as it slowly learns to distinguish between the foreground and background and further develops the concepts that enable it to detach the former from the later. Thus the concept of an agent gradually develops as something that has the capacity to impress upon the cognition as the active foreground entity that should be kept in the focus of attention that temporarily needs controlled suspension of links with and, therefore, detachment from the background for a while. After complete attention is given to a thus conceived agent, the activities of the agent, as in its manner of interaction with the surroundings as well as the background, may now be needed to be registered into cognition.

b. **The Event:**

In order to fully characterize the agent of the foreground, its properties must be fully analyzed by the cognitive system. Now one of the arguably major features that can be observed in an agent or an object would be the patterns and ways in which it interacts with its surroundings. In this attempt of characterizing the object, the processor may also very well observe algorithms of interaction and co-existence of such objects among each other. The understanding of the laws of interaction between the objects may be captured as a general interaction algorithm. This may be captured by the information processing system as a default, prototype from which the more complex algorithms evolve or are generated and realized as derivation from that prototype with certain increment of complexity. These complex derivations must be linked somehow to the prototype and thus there must be a function that the processor has to define to link the default prototype to its complex versions, so that it may be capable of backtracking to that point whenever required. This complex function must be invented by the cognitive processor in line with available resources in the information that show up relative patterns and relations between the objects and the environment in terms of their interaction.

c. **Relating the Agent and the Event:**

The processor must also take into account a complete range of interaction possibilities and check for proper feedback as to whether the classification of the behavior of an external stimuli, has been proper and consistently undertaken, while accounting for relations between patterns in the system. At this point, one might stretch out the behavior of the processor and check whether certain processing strategies may be involving in more complexities while attending to a certain type of information stimulus than to the other, in terms of objects in the environment or the information about the objects. Therefore it will actually be hard to determine whether the processing system is by default built to break down the information in a certain pattern to be able to extract any algorithm out of it. Therefore an insight into the breakdown process, while the processor engages into analyzing the object-event complex, shall enable proper analysis of the possibilities of whether there could be indications of rigid restrictions and limitations in the processor or strict laws in the external world that restrict the behavioural patterns of the agents to be so (that the processor after all encodes and tracks algorithms from).

This endeavor shall be possible by designing a situation where exclusive interaction patterns between content words are specifically studied for content analysis in which the processor may show up some relevant systematic and accountable difference (across the types of interaction). The situation should be controlled by allowing minimal interaction information in the patterns such that the difference between the patterns vary for the minimal possible property. Then a systematic variation of behavioral correlates according to consistently controlled variation in the properties of agent event interaction shall enable exploring the possibilities of a coherent account of processing differences as correlates of the controlled differences.

1.3.1 Peeping into Human Language:

Language is comprised of various classified units. As detailed by Chomsky (1986 b), it may be divided into major levels of units of representation in the mind. Deep Structure has been considered to be a representation of a structural configuration that attempts to account for why there are certain default rules that constrain the sequence of certain syntactic categories

in a well strung relationship, which when violated, renders a sentence or an utterance, incomprehensible, and incompletely understandable, or in other words, ungrammatical. The existence of the sequence however has been claimed to be universal and the rule that is maintained in the human mind has been attributed to a certain amount of genetic endowment. Clarifications, however, regarding which kind of genetically designed restrictions are at play or rather which features in the environment of the mind actually restrict the language to such a systematic realization of the structure so explained, still need to be extensively carried out. Findings suggest processing complexity to be one of the explanatory factors in deciding preferences for certain choices of sentences, within grammatical constructions but again the question arises as to what algorithms of processing might actually have rendered the processing of one grammatical construction easier and more preferred than the other. Explorations may have to dig deeper into what kind of levels of processing are involved, to have caused behavioral correlates of processing to show up such patterns in the phenomena of comprehension.

While exploring causal factors behind the differences in processing, a correlation at level 2 identification of certain basic activities in the environment must be taken into account. The human cognition is generally reported to be gradually developing from childhood, with the development of resolution in optical, tactile as well as auditory and olfactory sensors. At this stage of development, most of the processing seems to take place while processing inputs rather than in producing outputs. At this stage, certain complex inputs are reported to be ignored (or rather filtered out). Examples of this argument are found in evidences of the stages of acquiring complexities in the grammatical component in a step by step building of proficiency where one kind of sentence construction capacity may be acquired before the other in the child[2]. In such an approach to analyzing the acquisition of linguistic skills, there is an evident factor that may also be assumed to be lurking in the process, the capacity to notice the algorithms in the behaviour of the environment that surrounds the child. Such an algorithm is also prevalent in the human speech system that is somehow capable of encoding the external algorithms that exist in the environment. Now it seems to be an open challenge when one would strive to account for whether the restrictions and preferences to be explored, while analyzing the behavioural correlates, are a result of properties of the algorithm

2 Object control sentence structures are said to be acquired at an earlier age than subject-control structures as reported in Chomsky C. (1969).

encoding process or whether they are embedded in those of the nature itself (that the wide awake cognitive system is after all and at all capable of encoding).

Deriving a resolution to this account will indeed be an endeavor of a substantial magnitude. But the limited resources leading to speculative correlations restrict us for now to the classification of the types of processing features at the instances of on-line information processing, drawing inferences from certain relatively comparable processing strategies in related information processing behavior (e.g., processing behavior at control verbs in selected control sentences involving difference only in the type of control) and arguing for internal processing strategies that may be causing the pattern of behavior, thus observed.

1.3.2 Looking for an appropriate methodology in language processing:

Research has been dependent upon language processing measurements and analysis, in terms of internal cognitive processing, pertaining to certain default structural preferences, lexical processing issues, features of processing correlates for auditory and written stimulus inputs and so on in terms of behavioral correlates, while and after such activities engage the comprehension mechanism in deciphering the information embedded in such an encoded set of information units, which are structurally construed into words, sentences as well as the events that the sentences construe within themselves. The concepts, that such stimulus inputs encode, have information regarding the agents and the activity or event (that they may be involved in). Such an information has to be comprehended and understanding the probable decomposition strategies which come into action in the comprehension activity, should clarify issues regarding how agents and events are actually construed with each other and whether certain processing strategies exist that undergo certain inbuilt processing algorithms while doing so. In order to start with a sketch of such an integration process, sentences having a certain amount of agents and events (which are in some manner related to those agents) are being currently considered, in this study, as far as they may be argued to have the minimally required information that shall be capable of engaging the processor in the required cognitive algorithms for comprehending their integration. The attempt here is to provide for a minimal possible scale in the magnitude of the complexities that shall be compared in the different kinds of interaction properties.

At this point the minimal amount of information that has to be provided to the processor in order to simulate a perception of a complete event, can be created by exposing it to a situation where there is an agent and an event, congruent and suitable to its requirements in terms of plausibility. The number of agents and events must also be kept minimal in order to create a base level complexity with which other levels of complexity can be measured. Within such a base level complexity certain probable processing algorithms must be explored and accounted for. In the current instance of research, the issue of *internal processing preference* is taken into account. The target is to explore probable internal information comprehension features that may result in certain behaviorally measurable preferences. Therefore, appropriate issues related to processing of the integration of given agents with available events, suit best for the current purpose. In this light, the issues in processing of control of an Empty Category provides suitable venue to be explored and analyzed. Therefore an attempt is made to make the control of an EC vary for Subject control and Object control in Bangla and see which kind of control is found to be most preferred (discussed in Chapter 1). The language also has an added issue where the most plausible configuration for subject control is where the subject of the matrix clause has a [–ve] Agent role from the matrix verb and the object control verb gives the subject a [+ve] Agent role (as discussed in chapter 4). As discussed below, the following is the layout of exploration of the issues which have been studied in this work in terms of the internal preferences related to agent-event integration and processing and the interaction of probable internal processing strategies.

1.4 Previous explorations relevant to agent-event relationships:

1.4.1 Argument Structure:

A verb is described as having the property of taking certain arguments (elements that it needs, in order to have a complete comprehension of the embedded information regarding action, the participants of it, their state, situation, location and other such relevant elements). Therefore the structural configuration in which these arguments occur is described as the argument structure, which denotes the kind of elements, a verb (formally a *predicate*) can take (as exemplified in Table 1).

(1) *smile*:	verb;	1		
		NP		
(2) *meet*:	verb;	1	2	
		NP	NP	
(3) *imitate*:	verb;	1	2	
		NP	NP	
(4) *keep*:	verb;	1	2	3
		NP	NP	PP
(5) *give*:	verb;	1	2	3
		NP	NP	NP
		NP	NP	PP

Table 1

This frame (*Table 1*) describes the argument structure of some sample verbs where the first, second and third arguments are described in a sequence. Assuming the requirement for the first NP argument as default, the requirements upon the remaining arguments can be described under the sub-categorization frames as follows,

1.4.2 Sub-categorization Frame:

(1) smile: V, [__]

(2) meet: V, [__ NP]

(3) give: V, [__ NP, NP] or V, [__ NP, PP]

(1) shows that *smile* does not take any argument other than the default, (2) shows that the verb *meet* needs an NP complement with it in order to complete the comprehension of the event of *meet*-ing, describing who was met. Likewise *give* in (3) is described as requiring either two NPs (*whom* something is given and *what* is given) or an NP and a PP (denoting *what* is given and *where* or *to which entity*). The "__" shows the place for the verb in the configuration. Such a structural explanation pertaining to the configuration in which the event word is represented among the participants of it, can form representation of the overt realization of agent-event relationships.

1.4.3 Theta-criterion:

Generative approach to accounting for the roles of the event performers has evolved theta-criteria which associates the arguments (which denote the participants of an event or action)

with the verb (denoting the event or action) in a role assignment relationship where the verb has certain properties, making it capable of allotting certain thematic roles (describing the type of performance that a participant can partake in) to its arguments. The theta-criterion states that

(a) Every governed NP must receive a Θ- role

(b) Every Θ- role must be assigned to an argument.

However, to get a Θ- role, it is stated as a prerequisite that the NP must have Case. But sometimes an abstract case is also observed to show up where it is considered as a realization of Θ-role assignment. Θ-role therefore seems to be the information regarding the particular role that an active agent and a potential passive agent may play in the event depicted by the verb. Keeping that in mind, the exploration of Θ-positions will show considerable light upon the integration of the concept of agent-event integration, in the internal levels of processing, that give rise to the required cognition of the same.

1.4.4 Theta-Grid:

This concerns with the configuration of the grid, stating which of the arguments of the predicate are external and which are internal. The external and internal features are solely structural manifests of the structural account of language, in an attempt to account for the sequence of information units (words with the required case and tense markings on them) related to the verb containing the complete event information.

The theta grid for *give*

Agent source DP	theme DP	goal PP
i	j	k

Table 2

This grid can be said to apply to the following sentence:

$[_S[_{NP}$ Sam$]_i$ gave $[_{NP}$ the book$]_j$ $[_{PP}$ to John$]_k]$

… where *Sam* is the external argument and *book* and *John* are internal arguments of *give*. Now *Sam* and *John* are animate arguments and *book* an inanimate argument. The way the

predicate *give* may integrate with each of its arguments and (syntactically) give the Θ-roles, will be different for each argument while the event is processed or generated in the concept.

1.4.5 Case filter:

Case is an integral module of the generative approach to language structure and is considered to motivate various features and phenomenon in sentence construction, including the overt form of the NPs, their location, the requirement of movement or repositioning from one node to another etc. It simply states that for an NP to become overt, it should have an appropriate case. Cases are given to NPs by their governors, which can be a preposition, the Infl, a verb etc. A summarized description of case pertaining to the structural relations with the case markers, in generative grammar can be given as follows.

1.4.6 Inflection:

Inflection acts upon two major categories, Nouns and Verbs. The inflection upon nouns is known as declension and that upon verbs is known as conjugation. In a syntactic configuration, inflection is set to act upon both the predicate (in terms of agreement, tense aspect and so on) as well as the subject (*Spec IP*, in terms of case). The inflection upon the subject noun is considered as independent of the verb (it gets a default Nominative in a transformation stage) from the Infl and remains related to the predicate of the sentence through the Infl which again passes on its agreement features (corresponding to that of the subject NP) to the predicate. Thus the predicate and the subject of the clause remain indirectly construed and abstractly related in some manner in such a configurational relationship that defines their position in the nodes of the structure. The NP that follows the verb as its complement, however needs to be assigned accusative case and that is assumed to be directly under the effect of the verb itself. It is understood as the internal argument of the verb (as the verb is sub-categorized as containing the object NP), and subject the external. But in the minimalist program, the thematic position of subject NP is considered to be VP internal where it gets its Θ-role from the verb VP internally. The convention of only one case assignment to only one argument is still held consistent and the verb can only assign accusative if it needs to. Thus the structural association of the event information in the verb and the participants of that event, is described such that the subject (of the action in the verb)

is not assigned case by the verb but by the Infl. The subject however is affected by Infl (which somehow carries the essence of the sentence in terms of phi-features, tense, aspect & modality). Infl also affects the verb with its features but it is unable to affect the object of the verb in the D-structure (due to barriers that disallow government of the Comp VP). So one could toy with the assumption that in the configurational account, the Infl is actually posited as the element that is capable of somehow integrating the subject (the active agent) and the verb (the event statement) to some extent in such a manner that such an account captures a phenomenon where the verb is integrated with the subject of the sentence differently from how it is integrated with the object of the sentence.

1.4.7 Binding:

Binding is concerned in capturing the phenomena regarding the ways certain pronominal NPs or empty categories can derive their identity from other overt elements present within the sentence or outside it, in the discourse. These concepts will be thoroughly used in the current work to test agent-event integration through indirect yet commendable processing correlates.

a. *The concept of antecedent*:

In the following sentence, the second NP can be understood to be the same in meaning as the first NP.

John$_{NP1}$ saw himself$_{NP2}$ in the mirror.

But the following sentence construction is not possible if we wanted the same kind of identity for that in a different location (now marked as *NP4*).

John$_{NP1}$ told Sam$_{NP2}$ that Mary$_{NP3}$ saw himself$_{NP4}$ in the mirror. (= ungrammatical)

It therefore seems that the identity of *himself* cannot be equated with a suitable agent if it does not occur in a certain situation, with certain words, in a certain configuration. Such a configuration may seem to be either in accordance with the sequencing of words (with certain types of meaningful concepts intervening the antecedent and NP4) or a particular structure in which the locations of the words, that can be understood as fitted to some nodes, are capable of engaging in certain complex relationships with each other.

In somehow related configurations, different situations can also arise.

John$_{NP1}$ told Sam$_{NP2}$ that Mary$_{NP3}$ saw him$_{NP4}$ in the mirror.

If we were to utter the above statement with the intention of making the identity of *him* to be equatable with *John* or *Sam*, no grammaticality issues crop up at all. But the following situation however is problematic if *him* needs to have an identity equatable with *John*.

John$_{NP1}$ told him$_{NP2}$ that Mary$_{NP3}$ saw him$_{NP4}$ in the mirror.

These types of restrictions have been captured in the Binding rules through C-command and Principles A and B.

b. *C-command:*

Node A c-commands node B if and only if

1. A does not dominate B and B does not dominate A; and
2. the first branching node dominating A also dominates B.

c. *Binding:*

A binds B if and only if

1. A c-commands B;
2. A and B are co-indexed.

Relevant Binding principles:

Elements that can be and need to be bound for a complete comprehension also have been clearly examined for their occurrences in appropriate configurations as follows.

Principle A: An anaphor must be bound in its governing category.

Anaphors have been categorized as the NPs which are dependent on another NP to derive their identity.

Principle B: A pronoun must be free in its governing category.

1.5 Sharing an identity among various arguments at more than one location:

As a sentence is introduced to the processor, the NP argument of a predicate is processed as a probable participant of an event. In case of embedded events, if there is reference to the same participant in more than one event, then the different events must be integrated with the same NP. In such cases, languages undertake various mechanisms of construing comprehension of events, relative to a single NP. In some cases the second integration of an event with the same NP happens through associations of overt pronouns. In such a case, the first NP, with which the processor has associated an event already, can be

associated with the pronoun with an option to avoid that association as the pronoun can refer to another entity altogether. In case of covert subjects such as PRO in non-finite clauses, there must be a reference built for the embedded PRO to another overt NP in the matrix clause.

1.5.1 Association of different events with each identity:

a. *Control*:

Cases of control are situations where more than one event is actually associated to one performer identity of an agent. This kind of complex information has been noticed in the development of syntactic accounts of certain complex sentences, in certain types of theoretical developments, as stated below.

b. *Projection Principle*:

Lexical information is syntactically represented.

This statement asserts that, as there are words used to encode a certain type of information, the symbolic representation of these words shall be such that the information of the lexical content, shall be somehow represented in the syntax. This tends to capture the huge algorithm of what certain words require to be followed by, what they need to be preceded by as well as, what kind of classification should befit their identification, in a multiplicity of similar words and lexical items. Therefore the partial determination of the syntactic configuration by the lexical items has been expected in such a statement.

c. *Extended Projection Principle*:

Not only must lexical properties of words be projected in the syntax, but in addition, regardless of their argument structure, sentences must have subjects.

This statement adds a very important argument to the thrust of the current study in the sense that, some kind of an active participant shall be always present in some or other overt form, (at least either in a dummy or an expletive form). Some languages also have a situation where the subject NP of the sentence can be dropped, but these are instances where the identity of the subject is to a certain extent realized in some kind of a morphological quality of the verb or adjective or some other category for instance. Thus the concept of a minimal participant

for any event to exist in the conceptual level of the sentential comprehension is stressed in such a kind of observation that the rules of syntax tries to capture.

1.6 ECs in Generative Grammar:

Empty categories (EC) have been an integral element in the Mainstream Generative Grammar (MGG). These elements remain covertly implied in the sentence due to the presence of certain overt elements (e.g., a question word, *wh-word*, ensures an EC- *trace* at either the external subject argument or internal object argument position of the predicate, control verbs ensure a pronominal EC- PRO in the subject position of the embedded clause where as in *pro*-drop languages, lack of an overt NP in the subject position of a finite clause ensures an EC- subject *pro* or lack of an overt NP in the object position of such a clause having a transitive verb implies an EC- object *pro*).

This kind of explanatory adequacy is desirably required and maintained due to certain uniformity requirements in the theory that describes the configuration of a clause according to the parsing requirements of the language processor according to a generative approach. As such the generative approach actually generalizes the universal grammar according to options, internally available to the language production faculty, but giving a choice of switching on and off of certain parameters according to the requirement in the environment or a requirement of variation upon the end product output even in similar environments. Such meaningful units which are communicated in speech as well as writing, are actually never spoken or written. These units of concept are however significantly efficient in demonstrating their existence. This is evident in cases where certain manipulations on the configuration of certain sentences are restricted just because their presence cannot be overruled at certain positions in those sentences (e.g., upcoming 8.b, where *John* is originally conceptualized between *want* and *to* in the actual sentence or D-structure). These manipulations would rather have been allowed in a similar configuration if they would have been conceptually absent (e.g., 7.b, where *John* is not conceptualized between *want* and *to* in the D-structure). Therefore a clear observation can be made regarding the processor to have such a configurational origin as a structure of the Universal Grammar (UG) that allows such a restriction to come into existence.

In the context of sentence processing, the EC comes to exist as a result of the requirement of an understanding of the uniformity of the general grammatical behavior in the

language, pertaining to the native speakers' information and their practice in certain syntactic configurations as well as morphology. Certain indicating cues available from the pattern of configuration as well as the sub-categorization frames of certain lexical items in the overt form, enable the conceptualization of these non-overt items in an effective manner such that the local position where they originally belong in the D-structure and the position where they actually appear in the phonologically overt spell-out can be linked in a chain having a single role, the role that the lexical item would have at the position of origin ('*What*' in 5.a actually corresponds to the concept which is linked to the concept originating at a position after the verb *'kill*', as its complement where '*cockroach*' originates in 5).

If we take the following sentences and consider the above point of view of analysis, we shall find that the amount of information actually communicated through 2 and 4 is more than what is spoken or written within in the sentences when compared to sentences 1 and 3.

1. John will come.
2. John promised Mary to come.
3. Mary will come.
4. John persuaded Mary to come.

In (1) and (3), the reader or hearer can comprehend all that is available in the written or spoken sentence. In the minimal pair of (2) and (4), where the only difference is the first verb in the matrix clause, (promised/persuaded), the subject of the verb 'come' varies across the sentences and this variation is controlled by the choice of matrix verb. We have two verbs, in both the sentences, 'promise' in (2), 'persuade' in (4) as the matrix verb and 'come' in both (2) and (4) as the embedded verb. 'promise/persuade' establishes a relation between two NP-s, 'John' and 'Mary'. 'come', however, does not have any overt argument NP. It is understood that there is a possible subject NP for the event of *coming* and that subject concept has to depend on certain external cues in the overtly spelt out sentence. In (2) the embedded subject concept is linked to '*John*' and in (4), '*Mary*'. This might seem to indicate that in the wake of a variation in the matrix verb ('*promise*'~'*persuade*'), there is no default strategy of the parser that could freeze the interpretation of the subject to one of the probable antecedents, for the embedded clause, from among the available options of NP-s in the matrix clause. As such it seems that the processor is guided in interpreting the agent of '*come*' from among the NP-s in the matrix clause, according to the choice, compelled by the matrix verb. Such a control verb

(Manzini 1983) seems to decide the antecedent that shall control the identity of the performer of the action for the embedded verb.

For certain collective reasons discussed in Government and Binding (GB from here on) an NP cannot be the argument of two verbs. This however restricts the NP to be always within the government domain of a single predicate. According to GB framework of explanation, whenever an NP is generated, it is at a location where the thematic structure of the predicate (the verb) allows for a thematic position for it such that the NP fits into a specific semantic role (explained as *theta role*). Such a restriction is reflected in the Theta criterion. Case Theory however also deals with the realization of NPs in a clause. But it rather provides explanations regarding the distribution of NPs in accordance with the restrictions upon the form of the occurred NP as well as certain restrictions upon the occurrence itself. At certain situations, the framework comes across configurations where the case restrictions do not allow the NP to be realized overtly at certain places, but is allowed by the Theta-Criterion at that place. The following discussion will explore the theoretical treatment of such intriguing situations which are of particular interest to the current research.

In light of the above approach, we have the following issues in (2) and (4). (2) seems to have an implicit agent who performs *coming*. One cannot claim an overt NP as a subject for this embedded verb, as the Overt NPs preceding it are subject and object arguments of the other matrix verb. The processor however has to conceptualize a performer of the action in the embedded clause in order to complete the comprehension of the embedded event. Now, in this situation, it has to do so within the restriction of choosing between the earlier encountered matrix subject or object, for resolving the identity. What it chooses seems to be restricted, by the matrix verb. The agent of *coming* may be understood as being already provided as a covert choice and is comprehended according to certain overt indicators which interact in structural and lexical interface. In sentences (2) and (4), the overt indicator is the matrix verb, that can control the variation of the identity of the subject concept of the predicate in the embedded clause, the Control Verb (also known as *equi* verbs for the property of initiating equi-NP-deletion). Nothing other than the verb of the matrix clause in (2) and (4) informs us of this choice of one of the matrix argument as the subject for the embedded clause which seems not to be default. Chapter 2 explains, according to findings in processing of control clauses, that certain processing strategies that indicate the default control processing strategy, as well as show a preference toward a certain type of matrix verb

itself (revealed in terms of processing discrepancies at certain locations, immediately following the verb).

If we look at certain situations, which demand an understanding, in the realm of GB framework, that an NP element be originating somewhere other than where they are apparently being written or uttered we shall be able to understand the requirement of understanding the properties of an EC better.

5. He killed the cockroach.
    a. What did he kill?
6. It is certain that he will win.
    a. He is certain to win.
7. I want to hit John.
    a. It's John I want to hit. (… want *I/myself* to …)
    b. It's John I wanna hit. (… wan→$^{I/myself}$←na …)
8. I want John to go.
    a. It's John I want to go. (… want *John* to …)
    b. *It's John I wanna go. (… *wan→^{John}←na …)

In English, verbs like *kill* take an object NP; *certain*, a proposition and *want* either a proposition or an object followed by a proposition where the object of *want* is the subject of the event mentioned in the proposition. But as seen in the comparison between (7.b) and (8.b), (7.b) allows wan'na contraction when there is a match between the concept of the agent who *hit*s and the person who *wants* to do so, where as in (8.b) wan'na contraction is not allowed as there is a mismatch of the concept of the agent of *want* and *go*. Therefore wanna contraction seems to be restricted by the available factors like match and mismatch of the agents of the two verbs. Here it is evident that this contraction cannot occur when there is a covert NP argument e.g., *John*, conceptualized between *want* and *to* in the generated D-structure.

9. Promise Vs *Persuade*

- a. John promised Bill to come
    - John is supposed to come. (correct interpretation)
    - *Bill is supposed to come. (incorrect interpretation)
- b. John persuaded Bill to come
    - *John is supposed to come. (incorrect interpretation)

- Bill is supposed to come. (correct interpretation)

(9) tells us that it can be a property of the verb which gets to decide whether the proposition following it, takes the object or the subject of the verb as the identity of the subject of the event in the proposition. Therefore *promise* has a subject *John*, an object *Bill* and an embedded proposition *to come* after it. So does *persuade*. But *promise* integrates its subject as the subject of the embedded proposition where as *persuade* integrates its object as the subject of the embedded proposition.

Chomsky in Government and Binding theory suggests an empty [+pronominal] category in the subject position of these types of embedded clauses according to the requirement of EPP. Hornstein et al. suggests this kind of subject positions to be actually consisting of [-pronominal] *trace* of an ungoverned NP argument which has been moved out of this embedded clause for requisitions of Case and other requirements. It is however true that these positions are place markers where a suitable NP can be conceptualized as a subject of such an embedded clause.

The clauses whose subject position identity is controlled by the verb of the matrix clause containing that embedded clause, is a controlled clause and GB postulates a PRO in the subject position of such a clause. Control can be of two major types, obligatory and Non Obligatory. (9) shows obligatory subject control (*a*) and obligatory object control (*b*).

9. *Promise* Vs *Persuade*
    a) John promised Bill [(~~*John*~~) to come]
    b) John persuaded Bill [(~~*Bill*~~) to come]
10. Infinitives and gerunds:
    a) (s^{one}) to err is human, (s^{one}) to forgive divine
    b) ($s^{one's}$) swimming is good for health
11. Embedded gerunds:
    a) The police stopped [(~~*The police*~~ / ~~*Someone*~~) drinking at midnight]

(10) shows Non-Obligatory arbitrary control where the subject of the infinite clause is arbitrary regarding its antecedent, whereas (11) presents an ambiguous reading as to whether the antecedent of the embedded clause subject is the agent in the matrix clause or whether some possible antecedent in the discourse is the agent. It is therefore understood that in the first option the antecedent of the identity of the embedded subject is within the clause and in

the second option, the antecedent is understood to be an arbitrary entity which perhaps is preferably a pointer to generic human identity. Therefore there is an optional control. But in (12) the identity of the subject of the first verb seems to be matching with the NP argument of the next verb. The person who jogs every morning cannot be anyone other than *John.*

12. (**Someone* / *John*) Jogging every morning proved good to John.

Theoretically, John and the subject of *Jogging* can be said to be co-referring to the same entity. But *John* occurring at the end of the sentence is not regarded as the antecedent for the person who jogs.

1.7 Theoretical exploration:

The Mainstream Generative Grammar deals with these empty categories in the following categorization:

1.7.1 Traces of movements

The movement transformations involve two types of argument positions, A-position and Ā-position. In 5.a., the argument of the verb *kill* is *What*, which can be a representative of a word like *cockroach* in (5). Therefore, the verb *kill* must have a semantic argument as its object. *what* must originate in the basic stage of sentence generation, as a complement to the verb *kill* and be a semantic argument to it having the function of its object. This is claimed as the principle and the parameters of actually uttered sentences change according to languages, where in certain languages such an argument can remain at its place even if it is a Wh-word and in certain languages (like English) it has to move to a clause initial as well as a higher position within the structure of the clause. This movement results in landing the wh-word at a position where no arguments of a verb can occur. A predicate cannot have more than one argument behaving as its subject. So the landing site of the wh-word (which is the object of the predicate) lands at a position next to the subject of the verb. Then *do* support or *do* insertion takes place.

There are also movements in case of passivization (13) where the actual object of a verb becomes its passive subject.

13. The cockroach was killed (*by him*).

"*by him*" becomes optional as passivised verbs are said to be un-accusatives and do not take arguments. It remains as an extra information that is not required by *killed* to complete its selectional requirements but may be an optional selection. But the passive subject *the*

cockroach, which is semantically not the subject of the verb, is actually semantically the patient object of the verb. Therefore originally *killed* takes an NP as its object in the deep structure and then by virtue of the verb being unaccusative, creates a situation where the NP has to move to a higher node in the structure to get Structural Case. When such a movement takes place, before uttering the sentence or writing it, the mind must keep note of the place marker where the NP had actually originated with all its semantic role assigners and canonical places of origin. It is by locating these positions that even after movement, the participant of an action (either subject or object) may be understood properly. This role played by the language processor is significant for both the speaker and the listener. The speaker who conceptualises a moved position for the NP has to conceptualise a position where it is first posited before the movement takes place. The listener has to comprehend the heard sentence and possibly reconstruct the original location where the NP was first posited before movement (due to and according to the type of verb).

1.7.2 Dropped NPs

In certain cases NP-s seem to have been dropped and a gap position is created without antecedents. This happens in certain languages like Spanish and most Indian languages where subjects can be generally dropped without having to mention all the details of this dropped NP. The verb that agrees with the subject, indicates through certain measures of rich morphology, some of the Φ-features that the subject of the sentence has.

These null elements of concept seem to have a certain grammatical and functional significance in the sentence,

a) by relating and referring to which, certain other words (NP etc.,), at a different location in the sentence, can retain their role in the sentence (e.g., passive subject NP in (13) and Wh-word in 5.a can actually refer to their traces that head the chain),
b) and which themselves also need to relate to other words (NP etc.,) and denote a concept in their position where some participant role with a similar identity, as available from the other word, is essential for the sake of the comprehension of a complete event with an agent or participant of that event (e.g., controlled identity of the subject of coming in (9))

c) and which sometimes also need to be free to refer to a generic identity of a generalized agent as such (e.g., arbitrary identity of agent in (10) with out any available antecedent identity in the sentence)

d) and which also have the option of either referring to an identity inside the sentence or remain arbitrary (e.g., the identity of the agent of drinking in (11)).

Therefore the above sentences can be discussed as having locally absent constituents which are conceptualized in relation with certain indicators or cues in the environment within which they occur. These indicators may be certain nouns that make the processor expect a particular identity at the identified gap position or certain verbs which according to their various sub-categorization frames can indicate what type of empty categories they take or the type of EC they are capable of making an embedded verb take. These provide cues for the processor to realize the identity of the empty agents to some extent. As such (5.a), (9), (10), (11) and (13) are said to have at least the following conceptual place markers for empty categories (represented by *e*) for the processor in the sentences.

(5.a') What did he kill *e*?

(9) *Promise* Vs *Persuade*

a' John promised Bill [*e* to come]

b' John persuaded Bill [*e* to come]

(10) Infinitives and gerunds:

a' *e* to err is human, *e* to forgive divine.

b' *e* swimming is good for health.

(11') The police stopped [*e* drinking at midnight]

(13') The cockroach was killed *e* (*by him*).

Here *e* denotes the place marker where a relevant concept must be perceived and understood by the processor in order to completely comprehend the event in relation with its participants. The identity and properties of *e* is found and said to vary according to the environment as well as certain lexical specifications of overt elements including NP's, V's as well as discourse and certain other processing defaults.

In Principles and Parameters Theory, empty categories have been categorized into four major types according to their behavior, classified in terms of anaphoric and pronominal behavior.

Empty Categories	*Anaphoric*	*Pronominal*
Ā-trace	–	–
A-trace	+	–
pro	–	+
PRO	+	+

Table 3

e in (5.a') is an *Ā-trace*; (13) an *A-trace*; the first *e* of (15') is pro; (9'), (10'), (11') and the second *e* in (15') is PRO. It is the detection of certain selectional and sub-categorization features of the verbs adjacent to the extraction site that gives the required and influential cues to the processor regarding the property of the empty category posited there.

Empty *traces* pertain to moved elements. The language processor has to go through a temporal axis step by step as it encounters the input stimulus, word by word, and in languages where certain canonical constructions involve obligatory movement, the moved element is found at a place different from the place where it had originated as the argument of the verb. In English, a wh-word appears in the beginning of the sentence (5.a) as a canonical form in a question. As such an expectation for an empty NP trace follows the Wh-word in the processor and similarly in (13) expectation for an empty NP trace follows the passive subject *cockroach*. But in sentences like (9), (10) and (11), there is no movement and still there is an empty category that needs and gets an indexation identity matched with a proper antecedent NP encountered previous to that legitimate position. Therefore there is every probability that as such an overt NP element can be a plausible antecedent for a probable upcoming gap position that will be identified according to sub-categorization information in the matrix verb, adjacent to or somewhere near that gap position. Now the second instance where movement has not taken place is a special one which seems to be an unclear behavior in human language where the subject of a clause is rather dropped deliberately. Reasons may be that linguistic encoding of information for overt production is perhaps restrained by preferences in minimal recursion and avoidance of repetition, for some yet to be explored requirements and/or limitations upon the processor. But at the receiving listener or reader's end, the processor faces the challenge of reintegrating and reconstructing an appropriate location and related semantic and structural information regarding the dropped NP.

Traces are postulated in the framework, in situations where there is at least one antecedent which can be identified within the domain of a single event, carrying the trace at a

location where the antecedent could have suitably been generated. But PRO and *pro* are postulated where within the event, the participants have simply made the agents undergo a complete ellipsis during sentence production. In such a case, the processor at the receiving end may sometimes get a clue to the comprehension of the deleted NP and sometimes get very limited information (available *phi*-features through agreement indication in the verb as in Bangla for *pro*). Various Indo-Aryan languages like Bangla, Hindi etc show the later feature. As such, [+ pronominal] empty categories seem to show certain common distribution properties. It therefore becomes essential to identify and categorize the environments in which certain place markers for ECs have been assigned [+ pronominal] feature in Generative Grammar.

1.7.3 Exploration of the distribution of [+ pronominal] ECs in Generative Grammar:

[+pronominal] ECs are not postulated at locations where there can be an explanation for a trace of movement. As such we have the following properties in a sentence suitable for postulation of such an element.

a. Distribution of PRO:

The postulation of [+pronominal] EC's is restricted to the theta-position that allots a subject like role in the theta-grid, at the location where Nominative Subjects can occur in a tensed clause. Its feature is determined by the binding properties that allow it to take up an identity from an antecedent, only from outside its governing category (in cases of *pro*). The allotment of the matrix clause antecedent, pertaining to its grammatical function (subject or object), that controls the identity of the EC, is determined by the verb in the matrix clause. Therefore the verb is called control verb as it assigns a controller for the EC. But there is no structural consistency as to the type of control. Therefore the only available control information is grasped in a lexically contained restriction. The main thrust in exploring and empirically tracing the processing of control, has been to stir out the levels of processing and the steps involved in the identification and allotment of a controller. Available findings have also dealt with the probabilities of default expectations of control type within the processor while the gradual reading of the sentence elicits behavioral discrepancies if and when the expectations are not met according to *control preferences* as seen in later sections. To study the above processing correlates of the properties and indicators of the EC- PRO, the very environment

in which it occurs becomes an important aspect of investigation in all possible and feasible ways. It also becomes important to study all the relevant locations that might (no matter how subtly) trigger the identification of a control clause and enable certain expectations to take place, after a certain lexical element has been processed as a cue to the relevant information. Therefore the following is a description of the structural information available to the processor in a serially available sequence, that may reveal the upcoming or preceding control information.

As postulated in Minimum Distance Principle (Rosenbaum 1967) control clauses are situations where the most preferred antecedent is always the one which encountered nearest to the place marker for a gap where the EC is postulated. In such a situation, if a certain amount of information is provided before the gap position, the total information provided before the gap position must be processed and sorted before integrating any part of it with the empty category that follows it. So when a probable place marker for a gap position is processed, the processor has to internally process and track back to a previously processed appropriate chunk of information in order to integrate that with the current information (or at least the environment where this gap is identified). In order to be able to trace back the previously stacked information, the processor has go back and keep digging into the stack. The time taken to find the proper antecedent from within the stack can be regarded as an activity that indicates the so called processing complexity. This complexity arises due to the composition of more than one simple step of recovery and integration. Thus if the amount of information that the processor has to trace back to integrate with the gap, is more, then it may be generalized to have undergone a more complex process than if the amount were lesser. This however needs to be aligned with the present line of research which studies whether there is a preference for such a Minimal Distance for an easy retrieval and integration with the gap.

Related findings in Betancort et al. (2005), reporting issues with control processing in Spanish sentences having a *Control-Verb PRO* sequence, also suggest that there is an immediate usage of verb control information to recover the antecedent of the empty category PRO in Spanish Obligatory Control Constructions. The control information stored in the main verb was found to be immediately used to select the controller NP as the ungrammaticality was immediately detected. They conclude that this initial selection of controller NP for an EC seems to rest on lexical factors. A preference for the nearest NP filler

is also found in their experiment showing the effect of structural factors. Therefore both lexical and structural factors are found to be active in affecting the processing of antecedent integration with PRO.

In a series of two experiments, they have examined the location or place marker in a sentence at which early detection of control information takes place. In the first experiment the target was to find out how early any prediction, regarding the type of control, takes place. Attempt was to explore to what extent the control information in the verb guides the selection of the right antecedent for PRO as well as whether this type of information is initially consulted from any lexical cues. They used the matrix clause node for the verb and toggled between subject control and object control information using verbs like *prometer* and *forzar* respectively at that node. Spanish adjectives agree for gender and a predicative adjective was used after the equative *be* in the infinite clause that follows the verb. This adjective was toggled for match/mismatch of gender of the controlling antecedent indicated by the control verb. It was tested whether the processor waits till the sentence is complete, to comprehend the type of control or whether it assigns the controller immediately after processing the control information in the verb of the matrix clause. The major test here was to measure the types of lexical items that can provide sufficient initial information to integrate an antecedent with a gap as well as to test how early this integration takes place. The areas of measure had been arranged according to the following regions in the display.

NP	VP_1(Subj/Obj-Control)	NP_2	PRO-inf	Adjective(M/F)	PP

Table 4

NP_2 area is used to test whether control information is used before or after that region. Adjective agreement match-mismatch toggle area had also been used to test whether control information is processed earlier to that point or later. Eye Tracking experiment was conducted and gaze and movement patterns were recorded and analyzed. In their analysis, it was shown that the object NP in the matrix clause was read significantly faster in case of object-control than subject-control. The rest of the regions did not show any difference. The analysis of *first pass time* showed a reliable effect at the NP2 region, and so did the regression path time and total reading time analysis for this region (which disclosed the type of control effect). Sentences with object-control verbs were read more rapidly than sentences

with subject-control verbs. Subject control verb also induced more time (therefore suggesting increase of processing cost) at NP_2 than Object-control (first pass analysis revealed this effect on NP2 region only and in no other regions). This seemed to ground the antecedent selection strategy upon the lexical information alone. But such was not the case. Recency effects were established as well because preference for the recent NP filler as compared to the distant NP filler was also found concurrent with influence of information in the control verb. They inferred that more time taken to process subject-control verbs shows the effect of Antecedent-PRO Distance. Subject-control verbs introduce more distance between antecedent and PRO than Object-control. Now this distance seems to refer to structural distance as matrix clause subjects are higher than the matrix clause objects when the distance between these arguments and the place marker for the gap is considered. As such it might be understood that the levels of hierarchy may prove to be determining factors while accessing the antecedent for a gap from a higher level above the gap position. Adjective position also showed immediate effect of match-mismatch with the recovered antecedent (evident from regression path duration, second pass reading times and total reading times for several regions) also suggesting that the right antecedent had been immediately recovered at the PRO region. Therefore the initial control preference seems to be guided by the verb rather than the antecedent-gap distance though the area preceding the gap showed processing difficulty in processing a subject-control verb compared to object-control verb.

In the design of their second experiment, control bias inducing prepositions were used that vary for purpose and reason statements. The purpose preposition *por* induced an object-control bias where as the reason preposition *para* induced a subject-control bias. The induced control-type bias is somehow not as strong as the compulsory control-type induced by a control verb. Therefore two possibilities had been tested by successfully biasing the processor to expect a particular control-type suggested by the preposition itself,

- whether the default object-control preference is sustained in the processor even in this flexible and not so strong bias induced by the preposition or
- whether the bias created by the preposition is able to create a new type of behaviour (to be detected at the Adjective region following the bias).

The areas of measure were arranged according to the following regions in the display.

NP_1	VP_1	NP_2	Prep PRO_1 Infinitive	NP_3	PRO_2 Infinitive	Adjective(M/F)	PP

Table 5

Results showed that in contrast with the first Spanish experiment where the control verb was used initially to guide the selection of antecedent for PRO, the control biasing preposition did not have similar effects in the initial choice of antecedent for PRO. Subject-control was found to be less preferred than object-control and this seemed to conform to the processing restrictions upon the distance between filler and gap, suggesting that recent filler (when the filler is in the object position of the main sentence preceding the adjunct adverbial clause) is preferred to distant filler (when the filler is in the subject position of the main sentence).

But one would like to test a situation where the PRO region would also precede the control verb and immediate use of verb control would not be feasible at the PRO region. Thus the two concurrent factors (distance and lexical) need to be dissected and studied in isolation. This attempt would be able to measure the strength of the structural and other probable non lexical factors influencing the initial choice and preferences in types of control and test the magnitude of the findings studying the effect of antecedent-gap distance.

Such a situation is available when there is a different Control-Verb PRO sequence. In languages like Japanese such a sequence (PRO … Control-Verb) is available. A study by Sakamoto (2001) involved a comparative analysis of four experiments. The first experiment was originally reported in Oda et al. (1997) and the second was reported in Ninose et al. (1998). The third and fourth experiments were reported in Sakamoto (1995, 1996). The first two had post-stimulus recognition tasks and the third and fourth had post-stimulus retrieval tasks. Both the recognition task as well as retrieval task experiments had two factors which were compared, subject control matrix verb and object control matrix verb. The findings show that grammatical function of the antecedent (object or subject) is significant for building a preference of the control type that may be initially built by the parser before encountering the verb at the end of the sentence. This remained consistent even in scrambled versions of the same types of sentences, therefore signifying that the node where the argument is generated is important for building up a preference for a following control type. But here as well, any single type of preference could not be traced according to the findings in the behavior. The experiment basically tested two types of post-stimulus behavioral tasks,

recognition and retrieval. Two major types of experiment were used, each having two types, one using a canonical word order and the other using a scrambled word order. In case of the recognition task, the subjects were given a stimulus sentence in audio mode and after it finished playing they were given an audio stimulus which mentioned one of the arguments. They had been instructed to identify, and say in Yes/No response, whether the later mentioned argument was the doer of the action in the infinite clause, i.e., the correct antecedent for PRO. In case of the retrieval task, the subjects were given similar sentences in audio mode. They had been instructed to speak out the antecedent after the sentence finished playing. Total time taken to respond, as well as accuracy of response in both the task types were measured.

Recognition Task (Subject Control most preferred)

i. *Sentences with normal word-order, $Sub_{NP1} \rightarrow Obj_{NP2} \rightarrow PRO \rightarrow Control\text{-}Verb.$*

Stimulus comprised of recorded phrases joined and artificially combined into sentential items. This was done to avoid probable intonation and other phonological cues). Yes/No button response time at the plausible antecedent, mentioned after the sentential stimulus, showed that correct recognition of a plausible antecedent took less time when the last verb had indicated a Subject Control than when it indicated an Object Control. The difference in average RT was significant, (S-Control = 752msec, O-Control = 835msec, Difference = -83 msec, $p < 0.05$ for both F_1 and F_2). Consistency Score for a tendency of correct response was seen more in Subject Control than in Object Control (S-Control = 95.8 %, O-Control = 85.4 %, Difference = 10.4%) though the analysis did not show significant difference ($p > 0.05$ for F_1 and $p > 0.05$ for F_2).

ii. Sentences with a scrambled word-order, $Obj_{NP2} \rightarrow Sub_{NP1} \rightarrow PRO \rightarrow Cont\text{-}Verb.$

Stimulus was in an identical audio mode. Response method was similar to the first experiment. Recognition Time for Subject Control was again significantly less than Object Control (S-Control = 639 msec, O-Control = 714 msec, Difference = -75 msec, $p < 0.005$ for both F_1 and F_2). Consistency of response was significantly more for Subject Control sentences than Object Control (S-Control = 100 %, O-Control = 79.2 %, Difference = 20.8, $p < 0.05$ for both F_1 and F_2).

These findings yield an inference indicating that Subject Control preference is stronger in this task and this remains consistent across word-order variation. However as

stated in Sakamoto (2001), such consistency in both the word-order could be due to a similarity in the response task and the experiment paradigm. Therefore another response task involving retrieval of a plausible antecedent was designed using the same sentences.

Retrieval Task (Object Control most preferred)

Sentences had canonical word-order and consisted of recorded sentences with normal intonation and pauses. Stimulus sentences were the same. Spoken responses were recorded and analyzed for latency in initiation of response.

The subjects responded by speaking out the proper antecedent after having finished listening to the sentence. Response time for speaking out the antecedent showed significant preference for Object Control (S-Control = 666 msec, O-Control = 607 msec, Difference = 59 msec, $p < 0.05$ for both F_1 and F_2). However consistency of response still was not significant (S-Control = 88.9 %, O-Control = 90.2 %, Difference = 1.3 %, $p < 0.5$ for F_1 and $p < 0.68$ for F_2). A different strategy of search seemed to have been engaged in this case which is different from recognition strategy. Seemingly nearest NP_2 is found to be processed more easily. But whether there is a grammatical preference is still not clear. Therefore a fourth experiment was conducted with a scrambled word order.

Stimulus sentences, mode of stimulus as well as type of response were same as third experiment. Response time in initiation of speaking out the antecedent showed that Object-control took significantly less time and therefore was more preferred than Subject Control (S-Control = 749 msec , O-Control = 648 msec, Difference = 101 msec, $p < 0.05$ for F_1 and $p < 0.001$ F_2). Consistency of response was more for object control (S-Control = 84.4 %, O-Control = 90.8 %, Difference = 6.4). This difference was significant according to item wise variation analysis ($p < 0.5$ for F_1) but not significant according to subject wise variation analysis ($p < 0.11$ for F_2).

Analysis: There is a preference for Object Control with significant Response-Time difference for both types of word order for retrieval task and significant consistency of response is found only in scrambled word order.

However, there were also certain comparative findings in Sakamoto's work. In case of Recognition task, scrambling decreased the mean RT measure (Canonical: S-Control = 752 msec, O-Control = 835 msec; Scrambled Sent: S-Control = 639 msec, O-Control = 714

msec). This could mean that as the subject was lower in structure and nearer to the matrix verb, its recency could have had an effect of increased retention facility than when there was an object in its place in the canonical word-order. But in case of Retrieval Task, scrambling increased the average RT (Canonical: S-Control = 666 msec, O-Control = 607 msec; Scrambled Sent: S-Control = 749 msec, O-Control = 648 msec). This should actually mean that there could be a re-instantiation of all the arguments of the verb again at the matrix verb and the preference for subject control in recognition task, as such, undergoes the antecedent priming effect from the re-instantiated order of arguments, therefore decreasing the response time.

Scrambling was also found to have increased the average RT measure for retrieval task. According to the requirements of retrieval task, the object is to be retrieved faster than the subject. But in the cases of scrambling, the object is at a more distant node than the subject. Therefore when argument re-initiation takes place at the matrix verb, the processor has subject as the most recent argument. The difference in the performance in these two tasks is because, recognition task is initiated at the possible antecedent which is provided in audio mode after the re-instantiation is complete, where as retrieval task is immediately after the re-instantiation. It therefore seems to be a measure of difference between two different levels of processing and is therefore not a good minimal pair for the measure of processing difference of two different tasks. These tasks are at two different levels, the recognition task is at a level where the processor is exposed to the matrix verb and then a choice for Yes/No response, and the retrieval task is at a level where the processor has just been exposed to the matrix verb and the processor is perhaps taking time for the re-instantiating of the two arguments of the matrix verb. This re-instantiation has perhaps already taken place at the matrix verb and a recognition task is being measured with a stimulus presented after the matrix verb. Therefore there is a difference of levels between these two tasks. They do not seem to be comparable tasks due to the difference in processing levels. The decrease in time for recognition tasks shows that the processing of probable agents for the verbs, (matrix as well as the embedded) has already taken place at the place marker where the control verb has been found. Then the recognition is actually the second level of processing where the processor has to recall the agents in a sequence that has been already instantiated. Retrieval may have shown increase in RT in case of scrambled word order because while re-instantiating all the agents of the matrix verb, when it encounters the matrix verb, the processor has to do it in an order. Perhaps it

sorts out the subject and the object from the available buffer store and then completes the re-instantiation. This sorting might be incurring an extra processing difficulty due to which retrieval task shows some amount of increase in RT for scrambled structure.

1.8 Suitable measures and predictions in processing Agent-Event integration.

a. Control sentences with subject and object in the matrix clause provide a sensitive environment to test the choice for either of them as an antecedent for PRO. This indirectly provides insight into the integration issues that might have been the cause behind such an existing choice for any one of them.
b. The choice for an antecedent actually indicates, the choice for an agent of an embedded action. Therefore if certain antecedents are not preferred as antecedents, they may actually be least preferred to build associations with the embedded actions. Such preferential restrictions may reveal the internal comprehension strategies that result in such an incapability to accommodate the least preferred antecedent occurring beside the most preferred antecedent in the same sentence.
c. Such different types of agent-predicate association preferences can be thus generalized for exploring certain internal steps and rules of processing, which guide the observed preference to be so. Therefore such structural configurations can be relatively studied with further suitable variations in the configuration such that, if the association expectation were violated and some information in the sentence would grammatically oppose the inbuilt preference, varying patterns of processing discrepancy would show up according to varying patterns the aspects of deviation from the least discrepant information.
d. Explanation in terms of information decomposition may involve a step wise processing approach according to incoming structure of information and the over all processing experience that shall guide the comprehension mechanism to look for conformity with least required complexity (determined in terms of certain measurable correlates of increment in processing steps).
e. Such an approach of measuring incremental grading in complexity for different types of agent-event integration patterns, can be expected to gradually reveal certain basic properties of and issues in agent-event cognition, deeply embedded in the human information processing mechanism and stir out questions regarding the laws that

govern the existence of those issues in the mechanism. The current approach shall be an endeavor, restricted to the exploration of certain plausibility tests pertaining to agents and the kind of linkage with predicates that the processor may be capable of prompting or urging.

This requirement in the design having been set, the idea of EC's and their nature of variability needs to be clarified. The suitable choice of EC's have to be determined from among the available types of EC's and suitable environments (e.g., *pro* in finite clauses, PRO in non-finite clauses, PRO in gerund clauses and neither A-*trace* nor Ā-*trace*) have to be chosen where the proper agent-event integration properties may be tested.

1.9 Summary of chapters

Chapter 1 discusses the major goal of the thesis and states a brief layout of the main body of the work and discusses the relevant sequencing and progression of the tests and experimentation that follows. It attempts to build a discussion into how agent event integration may be understood in terms of certain breakdown strategy of the complex information that the processor has to undertake. It also tries to signify the relevance of explaining processing complexity in terms of certain measurable steps of information decomposition. The ECs in Subject position and the question of identity resolution of EC's pertaining to overt NPs, Control information in the Verbs and other cues in the sentence are discussed in relevance to the main question. It also discusses the relevant experiments that have been conducted in other languages. Chapter 2 Reports two experiments pertaining to the issue of preferences in relation with the Minimal Distance Principle. The first is a relevant experiment design in an SOV language, Bangla. It also sums up the findings in Pronominal binding and control strategy. It describes the affect of control type in a minimal pair set of sentences which shows that subject control takes up a significantly increased amount of complexity to be processed. The second experiment in Bangla is conducted with non-finite clauses in comparison with those done in Spanish and Japanese and is again able to detect a preference towards object control. Chapter 3 describes the third experiment pertaining to initial control preferences comparing PRO Arb with Obligatory control types and shows some similarity in the processing of the two. This gives rise to a hypothesis pertaining to agent event linkage complexity which is discussed here, verifying all current findings, in Bangla as well as Spanish and Japanese in this light. Therefore the design of approach is

molded towards an understanding pertaining to some amount of inbuilt preference for Minimal links between Agents and Predicates. This chapter also provides a discussion of the adequacy of a Minimal NP-Predicate Link hypothesis, over other explanations of preferences pertaining to structural factors or grammatical functions and also puts forth the problem of the variation in [+/– Agent] roles given to both the matrix subject and object, that do not seem to remain identical when the sentences are varying for subject and object control. Chapter 4 examines the existence of a probable interaction between the two major factors considered till now, that of control type and that of the variation of roles associated with the controller, through a design of fourteen experiments which are capable of presenting all possible configurations of variations in [+/–AG] role type as well as Control type. Thus it checks the probable influences of all variations [+/– Agent] roles at the edges of the control chain and is able to ascertain that even if there is a strong and statistically significant effect of a particular role type (within the same control type, as detected through the analysis of latency at the embedded and matrix verbs from which the roles arise), the control type seems to have the capacity of overriding even that consistent preference when there is a variation of control information at the verb. Chapter 5 concludes the thesis with a discussion on all the seventeen self-paced reading experiments in Bangla which together ascertain the existence of certain internal processing strategies, that incite some amount of predictions upon the processor. This internal strategy of processing agent to event linkages seems to be controlled by a tendency in the processor which tries to detect the number of links that the processor can build between the participant of an activity and the number of events that the participant may get involved with in the provided chunk of information in the sentence. It seems that association of a matrix clause subject with more than one events is more marked than that of the matrix clause object. This could, in turn, be considered to be able to explain the reasons behind the theta-role configuration and the default hidden principles behind it, observed as a default in most or all languages.

Chapter 2:

Control and the Minimal Distance Principle

2.1. Studies in MDP

The first investigation in this study involves a design such that the strategy of preference of the processor may be traced through behavioral correlates at the certain place marker and time where and when the processor encounters a particular environmental indicator. It is the variation of information in this indicator that tells the processor about the variation in distance. We therefore need to study an empty category at an appropriate configuration where such a variation can be implemented into a particular indicating constituent of the sentence such that the design is sensitive enough to yield a significant difference in behavioral correlates of processing according to indicated difference of structural distance between the plausible antecedent and the dropped EC. Therefore we basically require two comparable structures with a minimal difference corresponding to only a difference in the distance between EC and the processed antecedent. A plausible way to bring about this effect is to construct a minimal pair of two sentences, each having equal length, complexity and number of syllables. Then by manipulating a minimal constituent of the sentence or word into two similar looking constituents, a situation can arise where one type of word implies processing a short distance and the other type requires a longer distance, therefore a difference in structural distance between the EC and the finally processed antecedent. Such a manipulation must take place at the end of the sentence such that the processor should be able to hold on to its expectations of information for a longer time regarding a particular antecedent in mind, which should be inferred to be the result of a preference caused by possible distance constraints. If there is no difference in the processing of the manipulated constituent at the end then it can be inferred that MDP does not hold here. But if either of the constructions is found to be preferred then it can indicate which one is processed faster. If the condition having a shorter distance is preferred (as found in the retrieval task in Sakamoto 2001) then MDP holds but if the condition having a longer distance holds (as found in Sakamoto's Recognition task) then MDP does not hold. In Bangla a similar effect can be achieved in the following constructions.

(1) robi o-ke aS-te bol-e-ch-e

Robi 3Sg-Dat/Acc come-inf tell-ppl-pft-3rd

Robi told him/her to come.

(2) robi o-ke aS-be bol-e-ch-e

Robi 3Sg-Dat/Acc come-fut(3rd) tell-ppl-pft-3rd

Robi told him/her that he will come.

In (1), there is a control structure where PRO is postulated in an infinite clause before *aS-te* where as in (2) there is a tensed clause which has *pro* (having a reference to the subject of the matrix clause). MDP has been postulated in order to specify about a structural distance between an antecedent and the two types of obligatory PRO. The present experiment is designed to determine whether MDP may also apply for the processing of any pronominal empty category when there is a difference of distance between them and their processed antecedent as evident from 1' and 2'.

(1') $robi_i$ $o\text{-}ke_j$ [$PRO_{*i/j}$ aS-te] bol-e-ch-e

Robi 3Sg-Dat/Acc come-inf tell-ppl-pft-3rd

Robi told him/her to come.

(2') $robi_i$ $o\text{-}ke_j$ [$pro_{i/*j}$ aS-be] bol-e-ch-e

Robi 3Sg-Dat/Acc come-fut(3rd) tell-ppl-pft-3rd

Robi told him/her that he will come.

Such a difference is revealed through the absence or presence of agreement marking in the verb of the embedded clause. (1) has no agreement marking in the embedded verb *aS-te* where as (2) has the agreement marking *-be* which is an agreement for 3rd person, therefore referring to an antecedent having 3rd person feature. In each of these sentences, there are three elements in common, a subject, an object and an empty category which is closer to the object than the subject. According to Minimal Distance Principle, a consistent and significant preference for PRO should be found as, in (1') and (2') compared, PRO will have a nearer antecedent compared to *pro*.

Subject control is found to be acquired much later than object control by children learning and acquiring complex predicate structures (Carol Chomsky 1969) Even after subject control has been acquired in adult speakers, object control sentences are found to be processed faster than their subject control counterparts in several findings that follow. Similar

findings are also highlighted in Chapter 4.

According to the distinctions made in MDP, relative clauses and control structures are explained (Rosenbaum 1967) in terms of minimal distance. Instances of dropped pronominals in tensed clauses (as found mostly in pro-drop languages like Bangla, Japanese, Spanish etc.) have not been accounted for by the MDP. In the current experiment, we test whether the processor actually prefers a minimal distance or not, to draw identity from an antecedent, when the EC is inside an embedded tensed clause and needs to be bound by an antecedent from the matrix clause. This experiment also tests whether there is any difference of processing antecedent integration from tensed clause compared to an infinite clause.

2.2 Experiment 1

This experiment used Bangla sentences because of the availability of required design manipulations with out causing any marked readings which might be regarded as implausible in other languages. In this experiment two types of sentences are taken (1') and (2'). Then in order to sensitize the response, the disambiguation point was pushed to the end of the sentence.

(1'') $robi_i$ $o\text{-}ke_j$ bol-e-ch-e [$PRO_{*i/j}$ aS-te]

(2'') $robi_i$ $o\text{-}ke_j$ bol-e-ch-e [$pro_{i/*j}$ aS-be]

This makes sure that the processor does not have enough information regarding what is actually going to be the identity of empty category in the embedded clause unless it detects the tense information (tensed in (2'') and infinite in (1'')) shifted to the last syllable of the last word in the sentence. Therefore, response time measures at the ending word of the sentence can inform about whether certain assumptions had been made about the type of antecedent as well as the type of EC, before the processor encounters the last word. If the processor does not show any significant difference in response time between (1'') and (2'') when the last word is read then it means that there might not be any default preference of antecedent, type of EC or tense for the embedded clause. If however either of the two types is preferred, then the corresponding factors would have been preferred by the processor while on line reading and processing. The preference will be determined in the cases where the last word takes least amount of reading time as inferred from the response time on it. To further sensitize the difference in RT, further information has been inserted between the matrix verb and the last

verb in the sentence in the following manner.

(3) robi$_i$ o-ke$_j$ bol-e-ch-e [PRO$_{*i/j}$ **Sokal-e uTh-e gari kor-e** aS-te]

Robi 3Sg-Dat/Acc tell-ppl-pft-3rd [PRO morning-loc rise-ppl car do-ppl come-inf

Robi told him/her to come in a car, early morning.

(4) Robi$_i$ o-ke$_j$ bol-e-ch-e [*pro*$_{i/*j}$ **Sokal-e uTh-e gari kor-e** aS-be]

Robi 3Sg-Dat/Acc tell-ppl-pft-3rd [*pro* morning-loc rise-ppl car do-ppl come-fut(3rd)

Robi told him/her that I will come in a car, early morning.

By the time the processor reaches the last verb, it must have underwent some or other parsing strategy for the sake of comprehension as evidences suggest that serial processing is taking place. This would lead the processor to predict a preferable lexical item to follow in the configuration so as to be compatible with the previously processed structure. If the concluding indicator regarding the actual structure is at the end then the processor has to proceed with its assumptions till the end. An embedded infinite clause, as indicated by the ending syllable *-te* in (3), would require postulation of PRO as its subject whereas an embedded tensed clause, as indicated by the ending syllable *-be* in (3), would require the postulation of *pro* as its subject. Bangla is a left branching language and the verbs always follow both the object and the subject. The conjugation that the embedded verb undergoes will indicate the structure of the embedded clause. As the structure of the embedded clause is not disclosed till the end, the processor can be checked whether there is a certain amount of effect due to match or mismatch of the structure after the reader finishes the sentence.

A previously assumed structure would be based upon the requirements and restrictions of memory and the allowed loading capacity of the buffer of the memory. If a memory has preference for an initially indicated antecedent then subject control or information related to the subject would be preferred in the embedded clause. If there is a preference for an antecedent which is as near as possible to a probable gap position, then object control or information related to the object would be preferred in the embedded clause. These preference are expected to build up along with the initial processing steps. The present experiment is an attempt to find out whether such preferences are built up initially by default before any cues are provided by the matrix verb and before any cues provided by the verb of the embedded clause. If any default preference is found, the next investigation would be to determine the preference. If the tensed verb at the end is preferred then minimal distance

principle does not hold for *pro* where as if the tensed verb is not preferred, then minimal distance principle holds even for an EC like *pro*.

***Design*:**

The experiment has basically a variation of one factor:

Factors:

(1) Embedded Verb:

(a) Infinite

(b) Finite

The factor which let the processor to have least reading time for processing the last verb in the sentence is attempted to be identified here. 20 (twenty) sentences were prepared from an interaction of 2 factors upon 10 basic sentences. Therefore we have each of the 10 basic sentence constructions having a variation in two types of tense feature in the embedded verb (10 sentence-types * 2 embedded verb types = 20 sentences.

30 filler sentences were prepared in order to provide for some distraction so that the subjects cannot perceive which target sentences are being actually tested, therefore successfully being kept from giving any biased response by detecting and predicting the type of sentence complexity.

The display items were arranged in such a way that each subject sees only one item from each condition in a fully randomized order. The sentences were arranged in the items having an interaction of 3 conditions linger displays it in a manner such that a subject can see a total of 10 (out of 20) target sentences interspersed with a randomized display of all 30 fillers.

***Tools and Softwares*:**

An indic script typing software Baraha was used to prepare the items in Bangla language. Linger software was used to run the experiment where button press response was measured in milliseconds. R- programming language has been used to do a mixed model analysis of the RT measures available from the experiment results conducted in Linger. Data was presented on a 15.6" screen laptop.

***Participants*:**

Forty native speakers of Bangla had been chosen as subjects for a reading experiment. The subjects were all students from University of Hyderabad and were proficient readers of Bangla and were formally exposed to reading and writing Bangla for at least eight to ten years and ranged from 21 to 30 years of age.

***Procedure*:**

The experiment proceeded in steps of introduction and stimulus-response and comprehension question loops for each of the subjects. The experiment was conducted in a controlled environment in an empty room to avoid diversions. In the introduction, beside instructions to read the sentences, the subjects were also given a small training session of the type of stimulus that the actual experiment was going to have. In the introduction, the subjects were asked to press a button to start seeing the stimulus and to proceed through the items and words in the stimulus. Single line sentences were used in the stimulus and a moving window paradigm (Just et al. 1982) was used in the design. In this paradigm, the subject is shown a word in such a manner that only the word is visible in the proper position in the sentence and other words are masked (here only hyphens were available in place of the other words as well as the spaces in between). Thus at each press of a button (here 'F' button), the window would shift forward from left to right. The current word would be unmasked and the word after reading which 'F' button is pressed, is masked again. The subjects were instructed to proceed through the words and complete the sentence as fast as they could having as much comprehensibility and clarity of understanding possible. Reading in reverse direction was prevented in this process and the subjects would not be able to re read a word once they had gone to the next word. After the subject had completed the sentence, a relevant comprehension question was displayed asking about who the subject of the embedded clause was. It was a multiple choice question and there were two choices comprising of both the subject and object of the matrix clause.

***Results and findings*:**

Analysis of mean RT difference showed that the last matrix verb, which is the disambiguation point revealing the type of [+pronominal] feature of the EC, took less time if the EC was 'PRO' (mean latency = 926.4 msec) than if it was '*pro*' (mean latency = 1118.0 msec). Linear mixed model analysis was done by removing the random effects of *Subject* and *Word* and the difference in mean response time was fount to be significant (t-value > 2).

***Discussion*:**

This experiment proves that the minimal distance between the antecedent and the EC seems to hold strongly in terms of processing requirements and integration restrictions due to complexity induced by the distance. Therefore the processor seems to show a negative preference for a construction where the EC is more distanced from the probable antecedent (as indicated by the disambiguating verb in the end). But there is a variation of the type of verb in the embedded clause. The embedded verb has a variation between the properties of tensed and infinite. Moreover the matrix verb is immediately near its two arguments. These factors are to be kept in concern because a consistent hypothesis regarding the minimal factors which decide the variation of correlated behavioral responses must be explained with a prediction allowing minimal error possibilities. From this finding, we have a limited scope in explaining whether the embedded clause has difference in processing cost due to the tense type factor or the Antecedent-EC distance factor. Framing a compatible distance-factor test in Bangla, by ruling out confounding factors like tense type difference, becomes a challenge at this point which is undertaken below.

2.3 Factors Governing Preference of Control-type in Non-Finite Clauses.

As evident from *Experiment 1* discussing the findings on the processing difference in correlation with the difference of distance between the EC and plausible antecedent, the processor seems to prefer a minimal distance between the EC and a plausible antecedent. Theoretically, EC seems to be rather a place marker which is semantically and syntactically significant for the completeness in the comprehension of an action event in a verb. EC can be said to hold as a place marker as an increase in processing complexity can be observed with the increase in the distance between the EC place marker and the place marker for the plausible antecedent.

Mystery remains as to why the integration may at all be dependent upon distance factor when in general it is the control verb in the matrix clause in Bangla that indicates the antecedent for the EC as a plausible agent for the action event in the embedded non-finite verb. It seems that the sequence of information flow influences some kind of serial processing construing the antecedent and EC in a structural relationship by default. There must be certain restrictions upon the processor that gives rise to Minimal Distance Principle to come into existence during construal of an antecedent. After all when both the antecedents

have already been encountered, the processor seems to strongly prefer the nearest antecedent and not the antecedent which is the subject of the sentence (though encountered at the very beginning of the sentence and being capable of priming the processor). Question remains, what kind of processing strategy is responsible for integrating an antecedent when the place marker EC is encountered.

There may be possibilities that may as well be working beside the distance factor to affect the integration difficulty.

i. The gap is posited after the verb, that needs the EC as its semantic argument, is encountered. This verb in the experiment is the embedded verb. The processor cannot find any other indicator that can establish the absence of an argument that went missing in the embedded clause. Therefore it could be actually a default function of the interaction of two verbs, matrix and embedded, that causes the preference to be so.
ii. The gap is perhaps posited as a variable after the non finite verb is encountered and the value of this variable is determined after the processor comes across the matrix verb in relation with or as a function of its arguments.
iii. One of the arguments of the matrix verb is directly integrated with the embedded verb.
    a. The processor finds the arguments of the matrix verb and the nearest argument from either the embedded verb or the matrix verb is preferred for an integration.
    b. The distance factor does not involve an EC but rather involves the matrix verb (even excluding the embedded verb). The processor recollects the object of the matrix verb and integrates it with the embedded verb. Now there might be a preference in the processor to integrate the subject argument of the matrix verb with the matrix verb itself and allow the object of the matrix verb to be integrated with any other verb in the embedded clause. As such, distance factor might not matter at all but a grammatical function of the argument of the matrix verb (or the one-step-higher clause).

The processor has to be tested for usage of one of the above strategies. This chapter deals with the choices in online strategies of integration of an empty category with its most plausible antecedent that would incur least processing cost due to types of structural complexity and reintegration requirements involved. In this experiment, a situation is

simulated where the processor is given an option to find potential antecedents right at the beginning of the sentence itself and after encountering an infinite verb, may have to decide for one of the antecedents as the agent of the event in the infinite verb. Then coming down to the disambiguation point, the matrix verb, at the ending part of the sentence, makes the processor decide which should have been the correct antecedent for PRO, the nearer one or the first mentioned plausible antecedent. In such cases it becomes important to study the properties of behavioral difference of processing scrambled vs canonical constructions and whether this difference of processing holds in any kind of behavioral correlate during online processing of the integration of empty category with an antecedent.

In many Indian languages the control verb follows PRO in linear order. Therefore unlike most of the available empirical findings from studies pertaining to processing of control information where the control verb precedes PRO, the situation is different here. In Bangla we have a PRO -> Control-Verb sequence meaning that PRO precedes the Control-Verb. In such languages, the control verb can also be a complex predicate. Bangla is one such Indo-Aryan language, where similar features prevail. In such NV or AdjV complex predicates, the information regarding the type of control resides in the second part of the complex predicate at the very end of the construction.

(1) ami oke [$_{INFINITE\text{-}CLAUSE}$ boi-Ta di-te] baddho kor-l-am$_{MATRIX\text{-}CLAUSE}$

a. ami$_i$ o-ke$_j$ [PRO$_{*i/j}$ *pro* boi-Ta di-te] baddho kor-l-am
1sg-Nom 3sg-Dat/Acc [PRO *pro* book-CL to.give] compelled-do(pst)-1st
I compelled him/her to give *someone* the book.
OR

b. ami$_i$ *pro*$_j$ [PRO$_{*i/j}$ o-ke boi-Ta di-te] baddho kor-l-am
1sg-Nom *pro* [PRO 3sg-Dat/Acc book-Cl to.give] compelled-do(pst)-1st
I compelled *someone* to give him/her the book.

Two actions are mentioned in (2.3.1), *baddho kor-l-am* (*compelled*) in the matrix clause and *di-te* (*to give*) in the embedded infinite clause. *baddho kor-l-am* can either be interpreted as having two overt arguments *ami* (*1sg-Nom*) and *o-ke* (*3sg-Dat/Acc*) (interpretation (2.3.1.a.)) or as having one overt argument *ami* (interpretation (2.3.1.b.)) in the matrix clause. *di-te* has one overt direct object, *boi-Ta* (*book-Cl*) and either no overt indirect object (interpretation (2.3.1.a)) or one overt indirect object *boi-Ta* (interpretation (2.3.1.b)). But *di-te* does not have

any overt subject. Therefore in both the interpretations (2.3.1.a) and (2.3.1.b), *di-te* seems to draw the index for PRO from an object argument (overt or covert) in the matrix clause.

As shown in (2.3.1), a complex-predicate control verb (with *Adjective-Verb* configuration) *baddho kor-l-am* (meaning *compelled*) follows PRO. Here the verb "kor-l-am" of the complex-predicate "baddho kor-l-am" ensures that PRO is object-controlled, the controller antecedent being "o-ke". In Bangla, this verb appears to be similar to persuade type of verbs in English but by varying the final part of the complex predicate in Bangla we can also see an obligatory subject control as shown in (2.3.2).

(2) ami o-ke boi-Ta di-te baddho ho-l-am

ami_i [$PRO_{i/*j}$ o-ke boi-Ta di-te] baddho ho-l-am

I-Nom [PRO 3sg-Dat/Acc book-Cl to.give] compel be-(pst)-1st

I was compelled to give him/her the book.

Here the *kor-l-am ~ ho-l-am* variation (without changing the adjective baddho) causes the difference in interpretation for obligatory object control and obligatory subject control in the sentence.

Therefore this is a temporarily ambiguous configuration till the penultimate word, where the processor does not have information regarding the type of control until it comes across the disambiguation point at the very last word of the sentence. Therefore the ambiguity of the sentence exists until the last word in the sentence is read or heard.

But why the preference exists towards any particular type of control is an important venue to explore. One might argue that the processor may be showing a preference toward a type of agent for the matrix clause, and if there is another potential agent in the matrix clause which is not being used as the active agent, the processor may keep it aside as a passive agent for events in upcoming clauses which would be embedded within the matrix clause. Therefore there seems to be a structural factor of agent embedding sequence matching with agent sequence in the matrix clause that shows a default preference of matching the sequence in the structure with the sequence of the potential agents. The effect of such structural factors upon the preference (if any) is therefore tested in this experiment by using canonical and scrambled word order, to find out in a real time online processing latency measure, whether a certain control-type (determining the agent for an embedded clause) is preferred across word-

orders while the re-instantiation takes place. This experiment is different from the previously discussed post stimulus measures as it measures the online processing while the target sentence is being read.

2.4 Experiment 2

This experiment is basically a reading experiment to find out whether there can be structural factors that can influence the initial control type choice and the required structural construal for the *antecedent-PRO* binding. It is investigated whether a *Control-Type* is chosen by default in the earlier stage of the sentence and then revised later, if required, when the disambiguation point is reached at the end when the control verb is completely processed.

It is predicted that according to available sequence of the overt arguments of the control verb (2.3.1 & 2.3.2), when an infinite verb is read, the processor might go ahead with a certain type of control (i.e., object or subject) with either (2.3.iii.a) or (2.3.iii.b), as a default structural construal. What may be chosen as an antecedent at this stage, will decide either for a facilitation or difficulty in processing the control verb that follows. This experiment also tries to find whether that initial choice is triggered by structural factors.

This test is achieved by introducing two types of word-order, canonical and scrambled, for each type of sentence in the following manner.

1'. o-ke ami boi-Ta di-te baddho kor-l-am

2'. o-ke ami boi-Ta di-te baddho ho-l-am

1' and 2' mean that the sentences are same in meaning as 1 and 2 except for the position of the grammatical object, which is scrambled out from its canonical position to the front of the sentence. It is predicted that some difference of behavior may be observed at the control verb in sentences type 1/2 and 1'/2' compared.

It also tries to find out whether a certain type of performance task may also effect the post reading performance in recalling the type of control. For this purpose two types of post reading tasks, recognition and retrieval, have been introduced as comprehension question.

To further sensitize the experiment to the complexity (which the readers of the experiment are probably going to face) a set of words between the first and second argument of the matrix verb is evenly introduced in all the eighty target-sentences. In Sakamoto it was

done by introducing a Preposition Phrase in between the two arguments in the following manner.

3. Tamae-ni[Arg1] *kaisya-de* Kooiti-ga[Arg2] Tokyo iki-o wazato moosideta.

Tamae-Dat *company-at* Kooiti-Nom Tokyo going-Acc purposely offered.

'To Tamae, *at the company*, Kooiti purposely offered that he would go to Tokyo.'

Here it is done by introducing a conjunctive participle between the subject and object of the matrix clause. In the following sample the conjunctive participle *shokal-e librari-te giye* meaning "after going to the library" increases the distance between the subject and the object in both types of word order.

4. *ami shokal-e librari-te giye oke boi-Ta di-te baddho kor-l-am*

5. *ami shokal-e librari-te giye o-ke boi-Ta di-te baddho ho-l-am*

6. *o-ke shokal-e librari-te giye ami boi-Ta di-te baddho kor-l-am*

7. *o-ke shokal-e librari-te giye ami boi-Ta di-te baddho ho-l-am*

The first and second argument are beside each other in 1, 2, 1' and 2'. If there is any priming effect upon the parser to use the first argument as an antecedent then it may get neutralized due to other incoming chunks of information in the conjunct participle in 4 to 7. Here the effect of the change of word-order upon the preference built up initially regarding the type of control is also tested. In sentences of type 4 to 7 it is predicted that following effect upon the parser is achieved to be able to find out about the initial preference.

8.a. The parser should not be able to easily sort out and maintain similar initial preference in both the types of word-order.

b. If there is any preference for an antecedent built up due to primacy effect, then we should be able to neutralize this confounding effect and see if difference in structural positions of the arguments can show a difference in control-type preference.

c. We would like to check if the nearest antecedent is preferred for PRO. Therefore primacy effects might be expected to get reduced by introducing some processing complexity between the two matrix clause arguments by using a conjunctive participle which is neither too small nor too large.

d. Therefore while reading a sentence, if any change in control-type preference due to

change in word-order is detected, it is expected to have resulted not from any primacy effects but exclusively due to the structural difference in the position of the antecedents.

Subjects

Forty native speakers of Bangla, who were well exposed to formal reading and writing skills in Bangla were chosen for participating in this experiment. These subjects were chosen from University of Hyderabad and their age ranged from 21 to 30 yrs. They were highly proficient in Bangla and were formally exposed to reading and writing the language for at least seven to eight years.

Method

A self-paced reading experiment, using a moving window paradigm, was conducted in a controlled environment. LINGER was used for conducting the experiment. The beginning of the experiment consisted of general questions regarding required personal details and also regarding formal reading and writing exposure to Bangla. They were to enter these details using the keyboard.

Then they were given an introduction to what they should expect in the experiment. They had to press a key to see the next page, instruction, command and so on. Then they were provided a practice session where they were introduced to self-paced moving window paradigm. The subjects were to press "F" immediately after finishing the sentence and then they would be shown a comprehension question. Within the practice session they were also introduced to each type of post-reading comprehension task. Two such instances were provided in the practice session, one practice item for recognition task and one for retrieval task.

For the recognition task, the subjects were asked a multiple question regarding who performed the action mentioned in the infinite clause. Three choices were provided,

A. The name of the subject argument

B. The name of the object argument

C. "*Someone else*" (indicating none of the above).

Option C was provided as in object-control, *pro* is also a possible antecedent for PRO (as in 1.b).

For the retrieval task, they were asked about who performed the action mentioned in

the infinite clause. For this instance they were provided a response block where they had to type and enter the response by remembering the name of a possible subject for the action in the infinite clause.

Design

80 (eighty) sentences were prepared from an interaction of 3 factors upon 10 basic sentences. The sentence items were designed according to the following factors.

2.4.1 Factors:

a. Word Order:
    i. Canonical
    ii. Scrambled
b. Control-Type:
    i. Object-control
    ii. Subject-Control
c. Task:
    i. Recognition
    ii. Retrieval

Therefore we have each of the 10 basic sentence constructions having a variation in two types of word order (10 sentence-types * 2 word-order = 20 sentences), each of these 20 having a variation in two types of control (20 sentences * 2control-type = 40 sentences) and each of these 40 having a variation of two types of tasks (40 sentences * 2 task-types = 80 sentences). Therefore we have a total of 80 (eighty) uniquely different stimulus which the subjects must go through using the previously mentioned method. At the disposal of each sub-factor, 40 sentences are available (which were analyzed to find the significant effect of the factors upon the preference of the control type).

2.4.2 Sentences available for evaluating each sub-factor:

a. Word Order: 80 sentences
    i. Canonical: 10 sentences * 2 control-types * 2 task-types = 40 sentences
    ii. Scrambled: 10 sentences * 2 control-types * 2 task-types = 40 sentences
b. Control-Type: 80 sentences

i. Object-control: 10 sentences * 2 word-orders * 2 task-types = 40 sentences
ii. Subject-Control: 10 sentences * 2 word-orders * 2 task-types = 40 sentences

c. Task: 80 sentences
i. Recognition: 10 sentences * 2 word-orders * 2 control-types = 40 sentences
ii. Retrieval: 10 sentences * 2 word-orders * 2 control-types = 40 sentences

The 80 sentence items were divided into 4 groups (as displaying all of them would show the same basic sentence in its various forms which might bias the subject towards certain pattern of behavior). Each group contained 20 sentences, with an even distribution and interaction of word-order types, control-type and types of post reading tasks. Besides these 20 sentences, 30 filler sentences were prepared in order to provide for some distraction so that the subjects cannot perceive which target sentences are being actually tested. Besides, these are also used to distract them from forming any kind of bias in either expecting certain types of sentences or differentiating between the types of target sentences.

Linger software arranges the display items in such a way that each subject sees only one item from each condition in a fully randomized order. The sentences were arranged in the items having an interaction of 3 conditions linger displays it in a manner such that a subject can see a total of 10 (out of 20) target sentences interspersed with a randomized display of all 30 fillers. Linger randomizes the order in the display of the sentences and a subject is shown only one of the two types word-order from among only one of the associated task in an item sentence.

Results and Analysis

Findings show that only Control-type has a significant effect upon the processing time taken at the last verb. Mean RT for Subject Control Matrix Verb is 2113 msec and mean RT for Object Control Matrix Verb is 1627 msec and difference is 486 msec. A mixed model analysis was done by removing random effects of subject & word and the difference was found to be highly significant with a t-value of 3.61 where t-value > 2 is considered

significant.

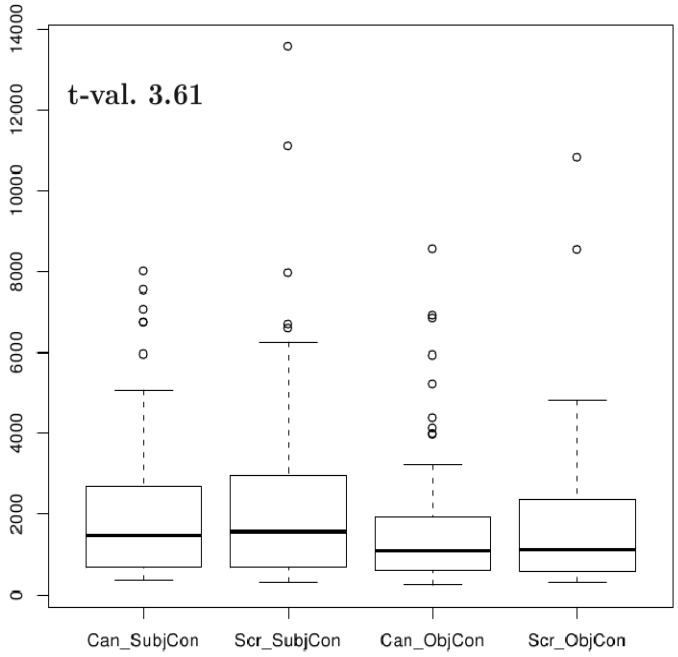

Figure 1

Scrambling seemed to increase the mean RT to some extent (Canonical WO= 1794msec, Scrambled WO = 1946msec) but the difference was not significant (t-val = -0.73)

2.5 Inferences and Discussion:

This experiment proves that online integration of antecedent to a gap resembles a retrieval strategy to some extent. Therefore the findings showed a preference for reconstructing a proper structural origin in case of a scrambled antecedent and construal of an identity of the same with a gap position suggested later in the chunks of information that follows. The gap position that has been identified seems to trigger a search for an available antecedent. As the antecedent is searched, a retrieval process is activated. The memory seems to be most capable of retrieving a most recent plausible antecedent. Therefore the nearest antecedent is processed. But the antecedent is not necessarily near in the linear order. As suggested by lack of significant difference in the processing of scrambled V/s canonical word-order, the linear order of the antecedent does not seem to show any effect upon the processing delay of gap-antecedent integration.

As such, while comparing the findings in Sakamoto, online processing of the integration of the gap with an antecedent, preceding it, resembles the results obtained with

retrieval task rather than those obtained with recognition task. The following is the basic difference between the types of tasks.

- *Retrieval task*: At the recognition of a gap the processor has to track back into a past stage of memory and recover an information appropriate enough for being integrated with the gap. This is more like a recovery method where a strategy of *search→identify→integrate* is perhaps employed.
- *Recognition task*: Expectations in a recognition based integration is that when ever a filler is identified, whatever other potential fillers are encountered after it will have a lesser preference compared to the initially encountered filler. This has been claimed to be *subject priming effect*. Therefore the processor would have been primed by the subject (occurring ahead of and higher than all the other constituents) in the sentence. As Sakamoto explains, this could be an effect of a '*first-in-first-out*' strategy and perhaps some kind of '*primacy effect*' at the cognitive level too.

Sakamoto's findings show that control preference factors do not work in line with recency or structural hierarchy but according to grammatical function. The preference testing in the post stimulus measurements show that there is a consistent similarity in increased processing difficulty for object control in both canonical as well as scrambled sentences when the testing is for recognition of an antecedent. When the testing is for the retrieval of an antecedent, both canonical as well as scrambled sentences show consistent similarity in increased processing difficulty for subject control. Therefore, one could observe a variation according to the types of tasks that have been undertaken to recall an antecedent. But in one sentence, more than one kind of EC-Gap integration strategy cannot exist randomly for identical EC-Gap link. Therefore this finding seems to indicate the effects of complete initial sentential EC-Gap integration upon post-stimulus recall activity.

The RT experiment however has shown that there is a consistent increased difficulty in processing subject control. It seems that both the findings hold and must be integrated into a conjoined explanation. As indicated in possibility (2.3.iii.b), the verb at the end is capable of making the processor recall both the subject and object, retain a subject for itself and leave the object for the embedded verb. This seems to be an initial preference and any mismatch of information in the matrix verb (as found in subject-control samples) is capable of incurring an

extra cost with a processing delay in reallocating the initially assumed subject argument as a semantic object of the verb and then reassigning it as a subject agent of the embedded verb. Whether or not this kind of processing really needs to instantiate an EC and then integrate the newly explored relation with it is still to be validated. However this activity of recalling can occur in a temporal sequence and at the very end of the sentence, two arguments are re-instantiated. The post stimulus tasks which are dependent upon this temporal sequence can also act according to the processing restrictions and therefore have the analysed outcomes. This inference of re-instantiation holds for the experiment in Chapter 3 as well. The subject and object of the matrix verb is re-instantiated at the matrix verb in experiment 1 of Japanese language and there is a preference to process the subject as a default agent of the event indicated in the matrix clause. According to this preference, the object of the matrix clause is left out as an extra agent on which either an action is performed or about which some more information will be provided in attached embeddings possibly coming up in later information sequences.

This inference however presumes that agents instantiated far away from such tasks in a temporal sequence would not be easy to process in post stimulus response tasks and would incur more difficulty than such information pieces which are instantiated recent to the post stimulus task. There might be either increased inconsistency in recalling such antecedents or increased latency in RT while responding to the task as compared to the previous instance where the instantiation was very recent. This test can prove that it is an instantiation at the matrix verb that tries to ensure identical processing preference across word order. Testing this inference with a suitable experiment design would benefit a proper modelling of EC processing by taking into account the location from which an antecedent of an EC is properly determined. This test must also show the steps of processing which are undertaken in determining and assigning an antecedent to an EC.

Therefore it seems that there is a preference on the part of the processor to assume that an agent identity assignment must comply to a certain structural hierarchy as well. The processor seems to prefer a matrix subject to be the agent of a matrix clause event where as it prefers a matrix object to be a potential agent for an embedded clause. This structural factor seems to be strongly maintained throughout all the default preference analysis in the experiments.

The results that were previously analysed, support such a structurally constrained antecedent preference as determining the general tendency of the processor in determining the antecedent for a gap. Recency factor, which was given as an account for Object-control preference could not hold in case of scrambled samples of sentences. In order to account for this discrepancy in the efficiency of recency factor, Sakamoto suggests that grammatical role seems to play an important role in determining the antecedent-gap chain in interaction with the type of response performed at the end of the target sentence. This explanation clarifies the object-control preference even in case of scrambled word-order. But the full explanation is not available regarding why this grammatical role can in any case prove to be any restriction when no lexical item appears before PRO to strongly restrict the bias for antecedent control. In short, there is no clear evidence for explaining why objects of the matrix clause are preferred to be controllers of the agent concept identity in an immediately following embedded clause that is not having an overt NP as the agent. Short term memory restriction may not be a very efficient explanation as, temporally, a single sentence may not be complex enough to cost the memory buffer to overload to such an extent. Moreover, tests with scrambled sentences have shown object-control preference. Structural reanalysis approaches would suggest that after a scrambled sentence is completely read or heard, the proper node for the object is generated and for the comprehension of the sentence, the scrambled object is reconstructed in the object node. This could mean that the short term memory restrictions are not strong enough to hamper a re access of the object from the beginning of the sentence before assigning it as a preferred antecedent for the gap. Therefore it seems to be a comprehension of what is expected as plausible and whether that is met or not.

The fact that the non agent object of a matrix clause is preferred to be the agent of an embedded clause seems to be a question of structural plausibility rather than a lexical restriction or any other restriction as such. If an analysis of Sakamoto's findings in retrieval task is done, the processing immediately preceding the retrieval task (retrieval of the subject of embedded infinite clause) might be explained according to the following steps that might have been crucial when the final matrix verb is encountered at the end of the sentence.

- An appropriate subject is assigned for the gap from among the arguments of the matrix clause.
- The nearest argument in the matrix clause is searched that shall be immediately

considered to be the subject of the embedded clause.

- The object of the matrix clause perhaps had been considered as the subject of the embedded clause and when the matrix verb is encountered at the end of the sentence, the processor checks whether lexical information in the matrix verb complies with the previous assumption and antecedent-gap integration. If the matrix verb complies then the processor goes ahead with the retrieval with out extra delay and in case the matrix verb does not comply with the previous assumption, then the processor perhaps tries to re-integrate a proper antecedent as suggested by the matrix verb.

The findings in Bangla, that required an experiment involving measuring of button pressing latency, show that response latency pattern at the matrix verb word is similar to that required in the initiation of retrieval task (i.e., naming of the subject of the embedded infinite clause after having read the matrix verb). Now the question is whether processing of retrieval in Japanese can be equated with the processing of the matrix verb in Bangla. Actually both the response activities (retrieval of the subject of infinite clause in Japanese as well as the pressing of a button after comprehension of the matrix verb in Bangla) take place, after the matrix verb at the end of the sentence, has been completely read and comprehended. Therefore the pressing of button (though not a retrieval task at all) is showing a latency pattern similar to a retrieval initiation. It might therefore mean that in both the cases, it is the processing of the matrix verb that delays the initiation of both button press as well as initiation of retrieval task. Therefore the following may be the sequence of processing, (9) for Japanese sentences and (10) for Bangla sentences.

9. … |[a]_____|[b] Final Processing |[c] Infinite-Clause Subject Retrieval Task
10. … |[a]_____|[b] Final Processing |[c] Proceed-Next Button Press Task

Therefore in both (9) and (10) the place markers (a) (implying the whole sentence) and (b) (implying the post sentence processing immediately after the ending verb) remain constant in their properties. The place marker (c) varies for the type of response activity. The latency of initiation of response activity at (c) in both (9) and (10) is a measure for the level of complexity at place marker (b) directly proportional to the response time. Therefore it is found that if place marker (a) indicates subject-control, the level of complexity at place marker (b) is more than if (a) indicates object-control. Therefore it is actually the similarity of processing at place marker (b) that is being established by the comparison of findings at place

marker (c) in Japanese and Bangla.

However, that the behavioral correlates at (c) are similar in both findings of Japanese and Bangla, must be understood as a coincidence and not as indicating identical processing properties. Only the processing at place marker (b) can be considered as identical processing. At this point one can proceed with an understanding that it is the processing similarity at (b) that is identically delaying the initiation of two different types of responses at (c). As such it might not be precise and accurate if we compare the processing at (b) itself as retrieval of any kind. Therefore it is not clearly analysed, what kind of processing is actually taking place at stage (b) immediately after the matrix verb (which indicates the type of control at the sentence final position).

To find out what seems to be a possible explanation for the processing that takes place at stage (b), a comparative analysis of both recognition and retrieval tasks in Japanese can be done along with the findings in online processing in Bangla. Recognition task assumes that the first argument may prime the processor such that the argument encountered before others, shall be easier to recognize from a given list of arguments. Retrieval task assumes that the last mentioned argument would be the easiest to retrieve when asked to recall a previously mentioned argument. Therefore there seems to be a valid reason that the verb at the end of the sentence is processed in such a way that re-instantiation of all the arguments occur at the end of the sentence. The re-instantiation also seems to be conceptually ordering the arguments in the memory according to a canonical sequence of subject and object. The slight increase of latency when there is scrambling shows that the reordering into a canonical sequence becomes a little difficult when re-instantiation is taking place.

When the RT at the final matrix verb is measured in Bangla, the processor shows increased latency in case of Subject-control verbs in both canonical as well as scrambled word-order. This shows that the delay in case of subject-control is due to the processing complexity experienced at the verb and not at the response task (which may be either a retrieval task or a *GO-NEXT* button press task involving neither retrieval nor recognition). As such it may be concluded that the retrieval task in Sakamoto's experiment cannot be the deciding factor for the delay in case of subject-control sentences. The matrix verb is the cause for the processing time incurred at the end. The retrieval task merely seems to be a tool to recall the subject for the embedded clause. Whether the retrieval task can decisively tell about

the initial processing preference is not clear from this design. When the initial processing takes place, the processor seems to assign an object of the matrix clause as the subject identity for the verb of the infinite clause contained in the matrix clause. It has also not been totally clear where the processor allots the matrix object identity to the EC in the embedded infinite-clause if the indicators of non-finiteness as well as control-type follow the EC. It needs to be determined at which point the processor starts assuming a default object-control. As such suitable control biasing place-markers must be created in the sentence that can precede the neutral infinite verb (which does not decide for any typical control). Such place-markers must be created after the EC slot in the sequence so that it can be tested whether the processor can actually assign a default control-type before even coming across the infinite verb. Certain plausibility-(mis)match tests can also be tested by manipulating the non-finite verb in such left branching languages such that in one version of the infinite verb, it is compatible with the some property of the matrix subject as the controller for the EC subject in the infinite clause where as in the other version it is compatible with that of the matrix object as the controller for the EC subject in the non-finite clause. Therefore a combination of certain control biasing place-markers following the EC but preceding the infinite verb combined with [+-plausible] *infinite-verb ~ EC-Controller relation* can be a good test for determining the position where the initial decision regarding default control-type takes place. This is important to determine what is the first area or lexical item that is capable of indicating that a control requisition has come up in the first place. Then it would be important to test whether certain manipulations at or near that lexical item can hamper the initial default control-type preference before the matrix verb at the end is available.

Chapter 3

Investigation of Arbitrary PRO in EC Processing.

Structural reconstruction may to some extent pertain to a uniform correspondence to the syntactic explanation of the restrictions and preferences in certain construal patterns of words. But realizing the structure itself in terms of neural mechanisms involved in information processing, will be another initiative which hasn't been ascertained yet. What we do know is that certain modular explanations of the structure in the sentence, is modeled to correlate to probable processing phenomena in the brain. But there may not be direct explanation to the mechanisms involved in the brain that may tell us about the restrictions involved in the processing of the same information. Never the less, explanations pertaining to processing difficulty and complexity have attained mostly a descriptive nature, as to which structural configuration makes certain phenomenon (like in Control) more difficult than the other (Subject Control being found more difficult or time consuming to process than Object Control). The increment of difficulty does not find an easy explanation as to what can be considered to be an efficient correlate in the configuration that can be measured in terms of the corresponding increase or decrease. It would at any cost be a more relevant account to measure a simpler increment to more efficiently represent the target increment i.e., that of processing.

As such, a more intuitive alternate method, that may correspond more closely to a processing load increment, could be to setup some kind of a counter that can measure and detect whether increment in any controlled element in the sentence has any significant correspondence to and correlation with any kind of increment in processing latency (available in certain measurable discrepancies of response).

This kind of explanation however seems to be achievable by approaching the problem of accounting for the findings, in terms of *association links* between the controller NP and the number of predicates that it has to be associated with, directly (as the predicate of its native clause) or indirectly (as the predicate of the clause where the EC, PRO controlled by it, exists). In the following discussion, followed by an experiment, I try to arrive at a possible account that may appear to be more incremental in its approach (while detecting appropriate and increment-relevant features in the stimulus inputs) and capable of finding a closer resemblance with probable processing load increment effects that might be directly related to

the processing of relevant factors observed in the control types.

3.1 Comparison of previous findings, analysis and experiment design

In both Betancort as well as Sakamoto, the tests verified and looked into possible implications of structural configuration in terms of a probable configurational preference. The explanation regarding the build for the preference is rather descriptive, rather than an attempt to analyze the internal processing reasons behind the preferences found. What we try to account for may be compared with the different experimental designs and their resulting findings and analysis according to what they were driven to yield.

3.1.1 Comparing the analysis and experiment designs and what they ended up measuring and *not* measuring.

3.1.1.1 Structural Preferences

The available findings are mostly response latency correlates of different structural configurations, in which the comparable minimal pairs of stimulus can be majorly categorized. In view of such an assumption, the following can be inferred from the experiments in Japanese, Spanish and Bangla.

Structural Preferences have been analyzed in Japanese (Sakamoto 2001) where the recency effects did not show up as an influencing factor. The information available in the verb, posited as a disambiguation point at the endmost possible location, seemed to remain consistent in affecting the processing latency according to where the deep structure would have the proper controller located, and therefore the consistency in the correlation to the distance of the controller from the controlled EC, PRO. The findings, however, showed an effect of a factor, existing outside the target stimulus, i.e., the response type. This needs detailed understanding and analysis in terms of the differences in real time processing and the actual differences in the response collection mechanisms that result in measuring a difference in processing correlate of preference in control.

3.1.1.1.a Recognition Task:

Sentence stimuli for the recognition task had been presented in the form of a complete sentence with the disambiguation point situated at the endmost word of the sentence, a verb bearing the control information. After the subjects were given the target sentence stimuli

(stimulus category 1), no immediate measurements in any form were conducted. Then, a short audio stimulus containing only the name of one of the NPs (either the subject or the object) of the matrix clause, was provided as a second stimulus (stimulus category 2) and according to previously given instructions, the subjects performed a recognition task, by pressing a Yes/No choice of buttons confirming whether or not the mentioned name was the eligible antecedent for PRO. Now this particular task involved the following sequence of stimulus and response.

(1) Sentence (*audio*) → **(2)**Probable antecedent (*correct or incorrect name, audio*) → **(3)**Off-line Recognition (*button press* "YES" or "NO")

Given this sequence, it is visible that there are two different events before the final button press event of RT collection, namely the sentence presentation event and the antecedent presentation event. In this situation, the sentence presentation ends with the control information in the final verb and is the actual cue to the antecedent. After that, the renewed presentation of an NP, matching or mismatching with the actual antecedent is a different level of information to process in the control comprehension mechanism. Now in the post sentence processing event, the processor has already processed the comprehension of the appropriate controller of the EC, PRO in the embedded clause. As the scrambled sentences suggest, the processing time seemed to increase for them and yet the preferences significantly remain the same. According to the discussion in Sakamoto,

> "... It is plausible that the parser prefers the first mentioned NP as a possible antecedent for the empty subject. This preference may be explained by the very general cognitive phenomenon called the 'primacy effect.'..."
>
> Sakamoto 2001

The primacy effect is a speculation regarding possible effects of priming of responses which turned out to be effective exclusively on the outputs from recognition tasks and not the retrieval tasks though both occurred sometime after the first event, the stimulus sentence audio. The only basic difference was that the experiments involving the recognition task involved the second event of antecedent presentation, between the first and last events, whereas those involving the retrieval task did not. Such an inclusion seems to have triggered

a post processing comprehension of recognition activities (somehow not clearly understood) that are some how influenced by a primacy effect that immediately followed the antecedent presentation. Therefore the major difference of processing may be taking place at the second event rather than the first event that inevitably incurs some processing at the disambiguation point, evidently not measurable in the recognition task that posits another stimulus immediately after the control information processing at the disambiguation point. As such, the micro events ushered in by the stimulus may be laid out in the following detailed sequence.

(1) Sentence (audio) → **(2)**control comprehension and ambiguity resolution **(3)**Probable antecedent (correct or incorrect, audio) → **(4)**Primacy Effect(or something else) → **(5)**Recognition (button press "YES" or "NO")

3.1.1.1.b Retrieval Task:

Under such circumstances, the retrieval task may need to be investigated with some more detailed analysis. The response for the sentence stimuli, in this task, has been immediately collected after a sequence having only the first and second events i.e., Sentence Presentation and Control Comprehension event in the following manner.

(1) Sentence (audio) → **(2)**control comprehension and ambiguity resolution (just after the sentence final control verb) → **(3)** Retrieval (Spoken out *antecedent*)

Such a sequence seems to put the response collection event, evidently much closer to the *verification of control comprehension* (at the location of the verb). Therefore this position of the response collection event seems to be more likely to actually look at the initial preferences or processing mechanisms, occurring much nearer to the control information than in case of the recognition task designs. Recognition tasks seem to be more like post stimulus comprehension responses whereas the retrieval task seems to correspond to a design having response collection strategy more inclined towards online processing, where inferences of reactions, resulting in responses, are extracted from locations nearest to the area of target stimuli centering which the processing difference is expected to be lurking around. As such recognition tasks and retrieval tasks vary strongly in their design. Various factors that come

between the disambiguating verb information and the response can be considered to be confounding (though consistently showing subject control preference). Retrieval task seems to collect the effects of parse verification immediately without going through any further information processing that does not relate to the difficulties and processing load at the target disambiguation point. As the retrieval task occurs immediately at the last word and the delay of response is actually a measure for the whether there is requirement for reanalysis of the sentences, it can be regarded as an online processing response, different from the recognition task. This having been stated, one can finally start to observe a consistency across findings in online processing preferences of PRO in experiments done with Japanese, Spanish as well as the current Bangla sentences.

Bangla and Japanese both have verb final configuration. As such, both have the control information by default at the end. Initial processing preferences can be therefore detected by observing the delay at such verbs. Spanish however can also show a processing preference reflection immediately when the verb is encountered. But the position of the verb has to be available before the object and the embedded clause is encountered. Therefore the response extracted from the verb location has mixed information pertaining to the lexical processing, beside the structural one. The matter is therefore not totally resolved as to how lexical factors can be completely secluded to test the structural factors only. Also it is not totally clear from all these types of inferences, as to what is actually the cause behind the preference as such, as tests with scrambling in Japanese as well as Bangla tend to disprove of the possibility that recency plays any role in influencing the preferences at all. Therefore neither recency, nor certain structural proximity (Betancort et. al. 2005) can fully account the different observations in light.

3.1.1.2 Syntactic reconstruction.

According to Wolfgang Sternefeld (Sternefeld 1997-'98), "The term syntactic reconstruction refers to the process of moving a constituent back into the position of its trace." This makes the possibilities of understanding the issue further interesting. If the processor is expected to do so at every instance of scrambling, then it is expected to also undertake the task of identifying the traces, restore the scrambled NPs to their legitimate locations and comprehend the structure again to test which is the nearest NP that is required to bind and control PRO. However syntactic reconstruction will be required in case of scrambling. The reconstruction

may be a requirement, called upon the processor once a potential movement has been detected. Therefore, the instance an NP may have been detected to have moved out of its proper location fitting an object, (probably deductible by the non nominative case on it, and identifying a plausible subject in a nominative NP encountered after it), an *Active Filler Strategy* (Frazier 1987) is expected to be triggered in the processing mechanism, resolving the link with the location of the trace before the control verb is encountered or even any clausal boundary is crossed in the incoming stimulus. However in this process of being exposed to the units of information, the languages having SOV word order, take the processor through the embedded clause (containing PRO) before exposing it to the control verb. SVO languages behave differently and expose it to the control information in the control verb, before exposing it to the embedded clause. This basic difference between SOV and SVO languages needs a detailed understanding in order to explore the relation between the findings.

What seems to be happening at the control verb is perhaps a control information processing where the processor runs a validation that the subject of the control verb does not also require to be processed as the subject of the embedded predicate. When it is validated, the control verb at the end has a linkage formed recently with the subject of the main clause, the information of which can also perhaps be confirmed by it through the agreement information. Thus the subject NP, if shown/spoken immediately after the control verb, shall have a fair chance of being recognized and identified as a known candidate (perhaps also being capable of being primed as a strong contender for any recent actions asked about). The object NP which has no agreement associations with the verb, may have been deprived of being integrated as any active agent for the mentioned predicate in the matrix clause. In this light, the subject NP shows processing preference in the recognition task, which therefore does not seem to specifically be examining the initial processing preferences of control, that may be said to be best measured online, through behavioural correlates nearest to the matrix (control) predicate. The findings pertaining to the delay caused by over all scrambling seem to have an interesting effect on the asymmetry observed in response type factor. But keeping the currently unclear findings in that area, one can resume the investigation by maintaining that initial preferences may be best measured online while processing discrepancies are co-occurring with every word that is being read by the participant. As such, understanding the retrieval as closely resembling the design of online processing experiments, it can be

ascertained that designs falling in the group of online processing discrepancy extraction seem to consistently reveal behavioral outputs that indicate that matrix object controllers are the initial preference for determining the identity of controlled ECs.

An understanding of the control processing can also be developed independent of the syntactic descriptions that try to explain the algorithms influencing it. Considering the structural configuration as a descriptive, rather than causal illustration of the grammatical relation between the units of the sentence, it becomes necessary to look into the internal processing mechanisms and strategies themselves that might have caused the structure to have come up to be so. In this light, one needs to examine the adequacy of the inferences drawn from the available findings and analyze them in a singular construal to extract a feasible incremental account capable of capturing the observed discrepancies, efficiently. The manner of load increment can be an effect of processing strategy that undergoes a proper counting of relevant causal factors. To develop the understanding of a processing strategy, it can be a more suitable option to establish a counter based processing model. This model should be rendered capable of extracting certain information which enable a proper counting of measurable units which may represent processing steps. Therefore the processing steps that shall accumulate in the process of comprehending an event, will give the hint to the load that should be claimed to have been an influencing factor upon the total load of the information that the complex event combination (in a control clause embedding) carries. In this light, plausible factors should be listed to test capable formulation of such a counter based load level extraction formula. Initially the most prominent overt elements in the information may be studied and listed. Later subtle covert relationships between these overt elements may also be tested and verified for being counted as a plausible element assumed to be detectable by the load level extraction design, as a causal factor behind load increment.

Relevant Overt Features/Elements:

Noun Phrase: The noun phrase is a key element of information that may be understood as a very central element of focus and attention. The NP contains reference to the most tangible and active/ passive elements in the real world. It is capable of bearing the roles that define the nature of agent that it becomes, in a particular description of event, action, state of being or any other information that enables the processor to establish any association between the NP and any other external factors in the real world (also including any other NP). Therefore the number of NPs can count as a crucial factor that can cause the incurring of

a certain processing load while the information relevant to that NP is being comprehended in the processor. It may also be expected that the number of NPs involved in that complex information may also be capable of resulting in a significant complexity incurring and therefore incrementing processing load. With these assumptions, certain factors may also need clear understanding in terms of features of the roles that the NP is capable of playing as well as the embedded features that may be influential in enabling the NP to play those roles in the first place.

- [+/- Animacy]:

The animacy feature of an NP can influence the expectations of the processor upon the type of situations and activities that it might get associated with in the mentioned piece of information. As evident from the following findings in the distribution of [+/- Animate] subjects and objects in a sentence, it is expected that the processor keep track of the possible occurrences of such features in an NP, while construing it with other available chunks of information in a sentence.

Control sentences have been found to restrict the controller to remain in [+ Animate] feature. This assures that the control processing involves a performer that should be capable of carrying out certain expectations in terms of agency roles and perhaps motivation sources (characteristic of all living beings who are active rather than passive participants in an event). This also certifies that the role of antecedent-hood should be understood to enable the particular NP to carry out responsibilities either currently mentioned or to perhaps come up in an information chunk later on. The particular nature of an animate NP shall also ensure that even if it may not be an active participant involved in an event (e.g., the animate object "Sam" in "John persuaded Sam…"). It may be capable of being associated with another event mentioned by a predicate, in another clause, as actively as the subject of the matrix clause where "Sam" is also the object. The associations with the predicate, at this point, become of vital significance in an attempt to uncover the possible relations that may be comprehended by the processing mechanism.

- Association types between NPs and Event indicating predicates:

Predicates that indicate an event, are classified into two majorly studied verb types, transitive and intransitive, besides ditransitive. The intransitive ones are those verbs which take only one NP, that in the subject position. Therefore the NP which is understood to be the agent of the event, is actively engaged in the participation with the information that the verb

is indicating. Thus it seems to form an association, with the verb as an agent-event relationship. However an intransitive verb is capable of taking another NP, other than the subject. That NP is an object which tends to be associated with the predicate, in a manner, not so active as the subject, about whose state or activity, the predicate mentions. This object, if an inanimate one, is incapable of building similarly active links with any other event information in probably upcoming events. But if this object were an animate NP, it would be able to do so, e.g.,

1. a. John told Sam to teach his students.
   b. *John told the school to teach his students.
2. a. John made Sam teach his students.
   b. *John made the school teach his students.

"*John*", as a subject, is able to establish an active participation link with the predicate of the matrix clause. Whereas the object Sam is not. However "*Sam*" is, in some possible manner, able to establish that link with the predicate "*teach*". But "*school*" is not able to establish any active participator links with any of the predicates. It can only be comprehended to establish any link with the matrix predicate and that is of a non-active link. In the following sentences, the subject can also be seen to have such associations with both the matrix as well as embedded predicates and the object having none (even when it may be animate).

3. a. John went to Sam to teach his students.
   b. John went to the school to teach his students

As visible from the difference in the above pair, from the previous pairs, the subject "John" is capable of being comprehended as having two active participant links, that with the matrix clause predicate "went" and that with the embedded clause predicate. As such, a clear difference may be perceived to emerge between two major types of linkage variety.

3.1.1.3 Linkage Types

i. *NP actively linked to one predicate*: This variety of association linkage can be also understood as showing a one to one active participation linkage. (1.a) and (2.a) show clearly that "John" is actively carrying out some activity implied by "told" and "made" (in 1 & 2) respectively whereas "Sam" is not having the same link with "told" but with "teach". Therefore there are two such singular active participant to predicate linkage, either in embedded or in matrix clause. These kinds of links may allow us the liberty to classify them

as a single, or *non-diverging* association link pattern.

ii. *NP linked to two predicates*: This variety of association linkage may then be understood as showing a one to two active participation linkage. (3.a) and (3.b) show clearly that "John" is actively carrying out some activity implied by "went" and "teach". "Sam" and "school" however do not seem to have any such links established with any of the event predicates in the sentences. Therefore there can be observed to exist linkages from a single participant to two predicates, one in the matrix and the other in the embedded clause. So these links may allow us like wise to classify them as a double or diverging association link pattern.

The current attempt, however, is to examine, whether such a difference can be considered as the actual cause behind the difference of processing discrepancies observed in subject vs object processing. The idea is to provide a link counter strategy in the design where it is the exclusive effect of [+/- Diverge] feature in the link pattern, where any increment in the links coming out of any NP, may be considered a sole factor, or at least a highly significant factor influencing the initial processing preferences observed in the control sentences. This study should also be capable of somehow revising the previous accounts of control processing, in that, perhaps there is no preference involved in the processing at all, but the caused complexity itself, the increment of which, results in directly affecting the difference in processing time, captured at the verb where the difference of link pattern arises due to the controlled manipulation. The decomposition of this complex information in the linkage can therefore be understood as a causal factor behind processing differences.

Incremental complexity *measurement* -vs- structural configuration *preferences*

In the debate for attaining a better and far reaching explanation for the detected preferences in Object control, it will be an efficient simplification of the term "preference" when broken down to measurable processing units. If the units can be measured and hence detected to accumulate one upon another, a competent account can be built to claim, more efficiently, the causal factor behind the complexity as well as the type of complexity that is being actually contemplated about. Therefore if the complexity is to be explained in terms of increment of certain units, that can be derived from the information in the sentence types, these units need to be identified and verified for their consistency in influencing the processing discrepancies, as the sole causal factor for the same. The structural configuration

preferences, therefore, stand explained by an increment explanation. Therefore the increment becomes a micro-level feature that is causing a particular overall effect somewhere in the sentence. Therefore an explanatory adequacy is reached by upholding a cause behind the so minutely studied preferences in structural processing, that has always been troubling the minds trying to explain the unique behavioral patterns observed while the task of sentence processing is undertaken.

With this attempt in mind, a method should be adopted which can map the differences of processing, suitably to a new hypothesis capable of explaining increment due to link type difference. Therefore related EC processing environments need to be explored. The requirement is to find a structure comparable to the previously explored ones, which is identical to at least one of the types of control and see if it significantly differs or matches in average processing time as influenced solely by [+/- Divergence] factor. Various occurrences and distribution of control clauses have been explored and a suitable type of control has been found that is identical in the structure and linkage. To the best of confirmation from available information in control literature, Arbitrary PRO is been experimentally studied for the first time, in comparison with any other obligatory control in Bangla. Here, Object control has been found to form a minimal pair (required for the experiment sentences) with PRO Arb in the following manner.

3.2 Experiment 3: Testing PRO-Arb and measuring the Link complexity count

1. ami onek bujh-i-ye o-ke [PRO Sataar Sekh-a]-r Sujog di-lam (OBJECT CONTROL)
   1st many explain-ppl 3rd-Dat/Acc [PRO swimming learn-ger]-gen chance give-past(1st)
   With a lot of explanation, I gave him/her the chance to learn swimming
2. ami onek bujh-i-ye o-ke [PRO Sataar Sekh-a]-r jukti di-lam (ARBITRARY CONTROL)
   1st many explain-ppl 3rd-Dat/Acc [PRO swimming learn-ger]-gen justification give-past(1st)
   With a lot of explanation, I gave him/her the justification of learning how to swim.

In (1) matrix object has an active link with the embedded event. The matrix subject has an active link with the matrix event only. Therefore (1) may be claimed to fall in the [-Diverge] category. (2) also has [-Diverge] feature in the association link pattern in that the matrix

subject is actively linked to the matrix verb and though the object does not link with the embedded verb of the gerund, there may be an arbitrary, generic concept that may be effectively linked to the verb. In an arbitrary control, however, it is hard to tell whether the conceptualization of a generic controller may incur some processing cost. But extraction of processing delay may tell us whether the similarity in link divergence factor can render these two otherwise dissimilar sentence types, to have no significant difference in complexity content.

Appropriate distribution of PRO for comparable minimal pair: Gerundial clauses have a structure where the subject is not mentioned in the clause, which constitutes the gerund domain. These clauses, like the one embedded in 1 and 2, can allow postulation of PRO in the subject position of the clause, followed by a genitive marker "*-r* " . When compared to the object control sentence, the structure is identical.

The only difference that is introduced here is that the object in object control sentence has to be associated as an active agent of the embedded verb event whereas the object in the Arbitrary control sentence does not require such an association with the embedded verb. In such a minimal pair, the following versions of predictions may be expected to show up in the extracted processing discrepancies at the matrix verb location.

A. Predictions:

(A.1) to (A.4) provides a set of all possible processing complexity gradients in a structure where both Subject and Object are already provided as plausible antecedents ("<" meaning *less complex than* and therefore *more preferred to*, "=" meaning *equal in complexity*).

1. Obligatory < Arbitrary [Obligatory Control Preferred]
    1. Obl(Sub) < Obl(Obj) < Arb
    2. Obl(Obj) < Obl(Sub) < Arb
2. Arbitrary < Obligatory [Non-obligatory Control Preferred]
    1. Arb < Obl(Sub) < Obl(Obj)
    2. Arb < Obl(Obj) < Obl(Sub)
3. Embedded preference gradient [dissolving the processing distinction between Obl-&-

Arb]

1. Obl(Sub) < Arb < Obl(Obj)
2. Obl(Obj) < Arb < Obl(Sub)

4. No significant difference between Arb and Obl(Sub) or Obl(Obj)
    1. Obl(Sub) < Arb = Obl(Obj)
    2. Obl(Sub) = Arb < Obl(Obj)
    3. Obl(Obj) < Arb = Obl(Sub)
    4. Obl(Obj) = Arb < Obl(Sub)

Findings in on-line processing of control, till date, predict against (A.1.1), (A.2.1), (A.3.1), (A.4.1) & (A.4.2). Here, it is tested whether data from our experiment conform to such predictions. If not then it will be striking. Remaining possibilities plausible to findings in the literature are (A.1.2), (A.2.2), (A.3.2), (A.4.3) & (A.4.4). If (A.1.2) shows up then grammatical function may be considered a priming factor for control preference (as literature indicates). If either (A.2.2) or (A.3.2) shows up, then we may be able to claim *Minimal Agent Predicate Link* (MAPL) to be the cause behind the findings in the literature, due to the processing load of the number of links that need to be allotted. Grammatical function priming will be supported by (A.4.3) suggesting a similarity of complexity in postulation of PRO-Arb. *MAPL* will be supported by (A.4.4) suggesting that both PRO-Arb and Object Controlled PRO are similar in Agent-Verb association complexity, both less complex than Subject Controlled PRO. Either ways, we shall be able to trace a significant preference gradient in a scale for Control. But at a finer resolution of analysis, the following statements can be made.

a. (A.1.2) will prove that grammatical function is the criterion and in order to be able to process the grammatical function, obligatory nature of an antecedent within the clause is the minimum requirement. As the arbitrary concept refers to a clause external identity, it may be difficult for the processor to associate that with the embedded verb. Therefore an obligatory controller from within the matrix clause is the first candidate for being integrated with an embedded verb and after determining the grammatical function of all the available antecedents, the antecedent having the grammatical function of object is preferred as the most probable antecedent for a subject role in the embedded clause and is therefore deemed a preferable controller for PRO.

b. (A.2.2) will suggest that minimal number of agent-predicate links is the basic criterion for measuring the complexity that may have resulted in the preference. PRO-Arb gives rise no specific link at all (refers to a *discourse participant*). Then the object control information makes the processor posit a single association chain, one that involves the verb of the embedded clause only. A subject control however makes the processor posit two association links, that with the matrix verb as well as the embedded verb. Probably a generic agent concept gets postulated at the non-finite verb already before the processor encounters the control information in the matrix verb and may be its identity remains uncontrolled by any overt antecedent. Then at the *next stage* the control information in the matrix verb reveals the actual control requirements. If the matrix control verb does not require the identity of the generic agent of the embedded clause to be controlled by any overt antecedent within the matrix clause, then the comprehension is complete. By now the control verb is already linked to a matrix clause subject. If the control verb suggests an association of the embedded verb with any matrix agent, then (according to all findings) matrix object is the next preferred antecedent for that generic identity and the matrix object builds its first association with the embedded verb with an increment in association load. Subject control is therefore the most complex and least preferred of all because in that case its association with the embedded verb leaves the processor with a requirement for processing the load of two agent-predicate associations.

c. (A.3.2) violates the exclusivity of both (a) and (b). If this shows up then grammatical function is coupled with agent-predicate association load while initially processing the control.

d. (A.4.3) would mean that only (a) holds and (b) is not the case. It would also mean that a generic identity is not postulated immediately when an unattended embedded verb is encountered and that it is exclusively the control information in the control verb of the matrix clause that makes the processor look for an agent to be associated with the embedded verb, the matrix-object being preferred. But when an Arbitrary identity is required to be associated with the embedded verb, the new postulation of such a controller is similar in processing complexity to association of embedded verb with a matrix subject. (b) is ruled out as it would have suggested that the processing load for associating PRO-Arb with an embedded verb be significantly preferred to subject

control.

e. (A.4.4) would mean that (a) is not the case and (b) holds with the modification that a default uncontrolled generic identity is not postulated immediately after the unattended embedded verb is encountered. Thus association of the embedded verb with a matrix-object is as preferred as a newly postulated Arbitrary identity, both being equally more preferred to a doubly associated matrix-subject.

Design: Twenty item sentences varying for Arbitrary and Object control were designed. 40 fillers were designed as distractors which were almost equivalent in total length. The subjects were given instructions similar to the Experiment 1 and 2.

Method: A self-paced reading experiment was conducted with Linger presentation software. 40 participants were chosen on the basis of their native proficiency in Bangla. Their age ranged from 22 yrs to 40 yrs of age, and were also asked to fill a questionnaire based on which their eligibility to perform as a subject was decided. When the experiment starts, the participants were given an introduction, followed by a practice session which was finally followed by the main experiment. The introduction provided instruction to press the "f" key to proceed word by word through the sentence. Therefore the subjects were expected to be able to read each of the sentences at their normal pace and they would be therefore attuned to press the key at the rate of the normal progress which is expected to match the pace of their general reading habits. They were also provided comprehension questions immediately after each sentence, item as well as filler. The comprehension question comprised of multiple choice questions. This was provided mostly to keep the subjects engaged in keeping track of the type of the performers of actions, subject or object and therefore pay attention to every item sentence that keeps coming. Therefore they were instructed to keep track of all the information provided in the sentences and try to answer appropriately all the questions. All items were randomly presented by the automatic randomization available in the Linger software and no subject saw identical combination or sequence of items or fillers.

Coding: The sentences were coded for distinguishing Arb and Object Control phenomenon. Therefore condition "a" of an item had a sentence having a verb at the end of the sentence requiring the processor to comprehend a PRO Arb in the embedded non-finite clause and condition "b" of an item had a sentence having a verb at the end of the sentence

requiring the processor to comprehend an Object Control in the embedded non-finite clause. Therefore the RT at the corresponding verbs were compared to find whether the variation of the conditions had a significant effect on the RT extracted from the verb location.

Results & Analysis: A mixed model analysis was performed by removing the random effects of the factors *subject* and *word*. R programming language was used to extract the RTs at the ending verb, from the database created by the experiment and group them into a format which collected the responses along with the information of the subject variation as well as the different words that were available at the verb location. Log of RT was performed and also collected appropriately arranged for the rows. The average difference between the processing time of PRO-Arb and Object Control indicating verb was found to be extremely negligible (less than 50 msec) with an extremely low t-value less than 2. Therefore there was no significant difference between the two different types of associations being tested. This leads to a series of implications and suggests further testing that follows.

3.3 Discussion:

The difference of processing discrepancy seems to lie in the factor of the total links that the NP builds with a required number of event information. The least amount of linkage seems to be the expected norm and even if there are different semantic interpretations (like that between arbitrary and obligatory), if the difference between the linkages are similar, the overall processing discrepancy does not seem to vary significantly at all. This is suggestive of the possibility that the processor expects a less number of linkage from a potential participant to an event. Here the results have even indicated that even if the object does not necessarily need to be linked with the embedded event information, the concept of an arbitrary entity may still have a singular link with an embedded event and therefore the shortage in number of links makes the processing complexity similar in the number of steps that is required to complete the comprehension of the participant-event interaction.

3.3.1 A Link Increment Hypothesis or something more?

This finding tempts one to consider the following options as probably lingering in the processing. The link that is built between the NP and the event is actually through both direct and indirect association linkage. Therefore these two types of linkages should be finally

explored in some probable detail.

3.3.1.1 Direct Linkage:

It can be most feasibly considered that certain NPs are directly related as the performers of certain events. The subject NP is such an element which is capable of forming such a direct link with the matrix verb. This is the default situation in all cases where the subject is always one of the participants of the matrix verb, whether there is an object available or not (as a secondary participant). The object NP of the matrix clause too enjoys an almost similar status of linkage with the matrix verb except for that it is not the active performer of the event or activity mentioned in the matrix verb. Therefore such a kind of linkage seems to be a default with any kind of sentence, either having a control clause embedded or not. In a control sentence, there also seems to be a kind of association between the one of the NPs of the matrix clause and the event or action mentioned in the embedded verb. But the embedded clause some how does not exhibit such a direct relation between the NP of the matrix clause and the non-finite verb.

3.3.1.2 Indirect Linkage:

In the case of a control clause, the subject of the matrix clause is interpreted as the subject of the embedded clause when there is a subject control situation. Whereas the object of the matrix clause is understood as the subject of the embedded clause in case of an object control situation. What is attempted to be made clear is that, there is a concept of an element in the embedded clause that should be understood as the subject of that clause and that particular element needs to be interpreted in terms of certain identity, outside the boundary of the clause. Now such a situation requires either the subject or the object of the matrix clause to be associated with that subject concept entity of the embedded clause. Therefore the problem goes deeper with this observation and calls for a more precise and well thought inspection of the different linkage patterns that may emerge if the properties of the matrix clause NPs and the embedded subject concept entity (claimed as PRO) may be manipulated in an experiment design.

In such a case, it may be expected that the number of links that diverge from an NP along with the properties of the endpoints or nodes (i.e., the NPs and the Verbs) may also together cause certain interesting effects of processing patterns. Therefore, such a phenomenon may

be explored by varying the most feasible properties of these nodes that suit the current question of control preference. Perspective shift seems to be an interesting question to explore in the current context where the shift of properties between the NP that is indirectly associated with the embedded verb and the subject concept that is directly linked with the embedded verb may be changed and manipulated to be able to tease out the possible difference in processing discrepancies that may have been caused exclusively due to the combination of those factors in the nodes. With this in mind, [+/- Agent] role of the NP and the embedded Subject concept or PRO seems to be the most feasible property to control, and test whether or not certain processing features can be observed to be varying either in combination with or independent of the linkage complexity, that appeared to exist in the former experiment findings.

3.3.2 Comparing probable factors behind complexity in processing of control types: Interaction of [+/- Agent] features of the Edges of Binding Chain with Link Complexity

As observed and discussed above, Experiment-3 claims to measure the basic difference between control types, categorized into two different properties of association multiplicity according to the controller NP that binds the EC, PRO. This analysis needs to be broken down into possible internal factors that may be causing or failing to cause certain differences consistent for such a classification of control types. In combination with Experiment-1 and 2, this experiment, in totality, seems to suggest that the number of association chains that may emerge from an NP towards any certain number of events that may follow, could be one of the significant reasons behind the difference observed in the processing of different control types, and not essentially the type of control as such. Having got a hint into what could be a plausible cause, it could be interesting to resolve some amount of curiosity at the level of investigating whether there could be multiple factors within the link complexity that could also show some amount of influence upon the processing complexity. The expectations here, are to find out whether any embedded property within the elements that are linked, can be explored within the same level of complex linkage from where, any influence can be detected and established, and whether that embedded property can also be understood to be a further deeper cause, that actually causes certain types of complex links to be processed with less processing load than others even if they may have identical complexity in terms of association link multiplicity. Such a study can also help determine, the types of factors that

can cause incurring of processing load in the context of EC control processing, better.

The NP-Event link chain may be understood to have the following basic features, a Controller that heads the chain in the sequence, and an event that ends the chain. The NP controller must be an argument of the matrix verb. As such, that verb must assign either only a theta role to it externally (if the NP is the subject) or assign both theta role and accusative case to it (if the NP is an object). These having been said, one needs to glimpse a view of the control phenomenon at yet another level, being discussed here for the first time. The matrix verb may be capable of assigning a type of theta role to an NP, and when the same NP must be linked and associated with another verb (indicating another event), the roles of the second event too have to be indirectly associated, if the association link hypothesis has to be processed completely. Both the subject as well as object of the matrix verb must be understood to have been associated with the matrix verb as a default. But whether one of them, and which, would be associated to the embedded event to be actually capable of causing an incur in processing load must be found out through an appropriate design.

As inferred in the previous chapter, two major types of links, *Direct* and *Indirect*, can be observed between an NP and the events. The **direct** links are compulsory and are a default in any statement of a complete event. The **indirect** counterparts, however, are optional and occur only when there is an embedded clause requiring an association with its verb that does not appear to have an overt NP. In this case, the embedded verb does however need to give a theta role to a concept of subject for itself. Hypothetically it is the PRO that receives it. But in the comprehension system, there is only one original reference to which that role can be attributed, and that is the matrix Controller-NP that needs to be thus associated with the embedded verb. As such, a new range of issues can be framed out of this phenomenon, where the type of [+/- Agent] role gained by the NP, through its association with the matrix verb, in the matrix clause event, may or may not remain similar to that provided to it, by the association of that NP with the embedded verb. As such, this new range of differences, that may cause an evident interaction between the link numerosity and +/- similarity of theta roles received by the same NP may cause significant difference of processing load in the comprehension mechanism, which might be governed by certain expectancies and strategies, that we are yet to uncover. Moving a step even further, it may be claimed that this study may even be capable of proving whether or not the processing discrepancies, observed, had been caused by the interaction of the mentioned factors, or solely by the differences of the roles,

also letting one explore in the mean time, whether certain role similarity is preferred or not, or whether certain role change patterns may actually prove to be a lesser load to process than the other. Over all, this would enable a detection of the type of causal factors that actually define the processing load, in the realm of issues pertaining to control clauses.

3.4 Factors to reconsider from Experiments 1, 2 and 3 and Spanish and Japanese Experiments:

Previous experiments in chapters 3, 4 and 5, as well as those of Spanish Japanese etc have not explored the issue of processing difference in sentences as an effect of similarities or differences between the NP event links in terms of the multiplicity of roles that a single NP may get associated with and the types of roles that it gets, in the complete comprehension process. This approach needs to be studied in two significant levels, the status of the controller and the status of PRO.

3.4.1 Issues in Previous Designs:

Available results have been extracted from critical words which are designed to extract the influences upon processing behavior due to only a randomly considered set of factors that may be lurking uncontrolled, within the factors like Object – Subject role of a controller, structural hierarchy, multiplicity of associations with one or more events etc. This is being discussed in the context of a possibility where the ends of the NP-Event association chains (if so considered) interact in a certain intricate relationship of Theta-Role where the NP can get associated with more than one Theta-Role in the process of getting associated with more than one event. In this context, a considerable reanalysis of the findings may be required, in terms of the above possibility to explore and ascertain how many of such possible patterns have been already considered.

3.4.1.1 Bangla Experiments

Bangla being a SOV language having a verb final structure, shall always make the processor encounter the association of the embedded theta role before it encounters the matrix theta role. This is also the case with Japanese. However, there is a complete reversal of the order of

encountered roles for the singular NP (regarded as the controller) in non verb-final languages, like Spanish etc. Also the two different theta roles, associated onto the NP thereof, may either be of similar nature (as in Subject control) or different (as in Object Control). In certain experiments, the manipulation of the stimulus properties has led to a difference in the pair of theta role types, where as in some, it has remained same without a control for the type of NP (Subject or Object) that receives the role. In many cases, certain languages may be incapable of employing this consistency, and in case of certain languages, control of such a factor may be possible to quite an extent, (if not thoroughly). Therefore, to examine the effect of the types of role on NP, for both Subject as well as Object each, the previous findings may be sorted for the effects and their similarities and differences, according to that of the roles received by them. It may also need to be observed here that though the structural hierarchy of role assigners is Matrix-Event→Embedded-Event, the phrase order of the language renders the sequence of clauses in a standard sequence such that the encountered sequence of role assigners is Embedded-Event→MatrixEvent in an SOV language. The following may be considered a possible way of observing the patterns thereof.

a Properties of Controller NP

The Controller NP is the element that comes in the sequence of NP-Event association link. It has a varying sequence of association types that it needs to engage in, with certain types of events, which are available in the matrix and the embedded clause, both.

a.1 Discussing Experiment 1

In the comparison between the processing of object-controlled PRO Vs subject-bound *pro*, the formulation of factors being manipulated by the matrix verb, gives the following attributes to the controller NP.

a.1.1 Object Control and Association with Matrix Verb & Embedded Verb

Object-controlled PRO has an object which is in receipt of [-Ag] type role from the matrix verb (the only verb, therefore event, that can directly be related to it).

ami_i $o\text{-}ke_j^{[-AG]}$ bol-e-chi [$PRO_{*i/j}^{[+AG]}$ Sokal-e uTh-e gari kor-e aS-te]

1SgNom 3Sg-Dat/Acc tell-ppl-pft [PRO morning-loc rise-ppl car do-ppl come-inf

I told him/her to come in a car, early morning.

The link emerging from it to the embedded verb must vary as the controlled PRO in the sentence is in [+Ag]. It is an uncontrolled manipulation here such that, [+Ag] counterparts of an object controller NP have not been tested in some parallel experiment with Object Control property, in order to investigate the differences between whether and how and to what extent the variation may influence any reading behavior in certain kinds of role sequences in the complex NP-event association.

The counterpart in the minimal pair, does have a [+Ag] controller as a subject NP, but a [+Ag] controller in an object NP would be interesting to test. Unfortunately, (as discussed in chapter 4), [+Ag] in object, seems to create not so plausible sentences for the minimal pair to be formed properly. But in the continuum of available possibilities of [+/-Ag] variation, the effect of such a factor can always be argumentatively validated, through other combinations of [+/- Similarity] manipulations in the stimulus pairs.

a.1.2 Subject binding and Association with Matrix Verb & Embedded Verb

Subject-bound *pro* has a matrix subject which is in receipt of [+Ag] type role from the matrix verb. The link emerging from it to the embedded verb does not vary as the controlled *pro* in the sentence is also in [+Ag].

ami$_i^{[+AG]}$ o-ke$_j$ bol-e-chi [*pro*$^{[+AG]}_{i/*j}$ **Sokal-e uTh-e gari kor-e** aS-bo]

1SgNom 3Sg-Dat/Acc tell-ppl-pft [*pro* morning-loc rise-ppl car do-ppl come-fut(1st)

I told him/her that I will come in a car, early morning.

It is an uncontrolled manipulation here as well such that, [-Ag] counterparts of Controller NP have not been designed for this experiment with Subject Control properties, in order to investigate the differences between how and to what extent the variation may influence any reading behavior in certain kinds of role sequences in the complex NP-event association. This could also throw some light to the fact of whether repetition of [+Ag] property of controller NP could be the

cause behind delay of control clause comprehension.

a.1.3 Discussion of Results

Analysis of the RTs, extracted from the sentence final matrix verb, showed up increased latencies at cases where the controller was in [+Ag]. Considering the possibility of any preference strategy for certain polarity in the role sequences, similarities in associated roles (from different events) seem to be a possible cause of load increment. Another possibility that may be a plausible inference, is that there might be a particular processing mechanism that may prefer a pattern of [-Ag]→[+Ag] shift rather than [+Ag]→[+Ag]. If this needs to be substantiated, ample types of minimal pairs need to be tested for the shift preference and the load incurred thereby. In such a case, it might be interesting to look at whether it is the number of NP-to-event links as performer of more than one events that increases load of processing or if it is a particular polarity shift difference only that may be the sole cause of causing any processing discrepancies. Also considering the counterpart set, [-Ag]→[-Ag] as well as [+Ag]→[-Ag] shift too need to be studied as a follow up of the previous inference. Therefore a clear inference can be sought as to whether a kind of shift is preferred to another. As a result, a new consideration arises which can take care of these lacunae.

[-Ag] properties of PRO have not yet been studied, according to the best of information from available literature, in the context of control processing. This as well will add up to mostly all possible shifts of perspective that the reference in the controller has to undergo in the comprehension, in order to completely break down the complex control sentence, into events and sub events with appropriate allocation of participant agent to each event or its association to one or more events. This is possible if sentence conditions can be explored where a non-agentive role can be extracted from the embedded verb. This may be possible by using verbs like “gaali khe-te” [scolding eat-inf] (to get scolded) in the embedded event where the subject cannot have a [+Ag] role from the action.

Sentence pairs need to be controlled for as many possible equal versions of [+Ag]

and [-Ag] assigned to the controller NPs as well as PRO in well controlled minimal pairs. Therefore two basic sets of factors need to be framed into the design, 2ControlTypes x 2[Ag] roles(in Controller & PRO). This involves a manipulation of control type, or rather, reference anchoring pattern, where the EC as well as the NP needs to be manipulated for all possibilities of [+/- Ag] roles, but certain languages do not provide a suitable comprehension, if the manipulation takes place. This is discussed in details in the final experiment set, coming up.

Modification Plan: As implemented in experiment 2, a proper subject control sentence seems to be a more feasible design and therefore a subject bound *pro* in an embedded finite clause would not be required. Embedded finite clause may as well incur a different type of embedding comprehension and therefore embedding of tensed clauses will be avoided in the design.

a.2 Discussing Experiment 2

In the comparison between the processing of object-controlled PRO Vs subject-controlled PRO, the formulation of factors being manipulated by the matrix verb, gives the following attributes to the controller NP in the two sentence types.

a.2.1 Object Control and Association with Matrix Verb & Embedded Verb

Object-controlled PRO has an object which is in receipt of [-Ag] type role from the matrix verb (the only verb, therefore event, that can directly be related to it).

ami$_i$ o-ke$_j^{[-AG]}$ [PRO$_{*i/j}$ *pro* boi-Ta di-te] baddho kor-l-am

1sg-Nom 3sg-Dat/Acc [PRO *pro* book-CL to.give] compelled-do(pst)-1st

I compelled him/her to give *someone* the book.

The link emerging from "o-ke" to the embedded verb must vary as the controlled PRO in the sentence is in [+Ag]. It is an uncontrolled manipulation here (like the first experiment) such that, [+Ag] counterparts of Controller NP have not been designed in parallel experiment with Object Control property, in order to investigate the differences between whether and how and to what extent the variation may influence

any reading behavior in certain kinds of role sequences in the complex NP-event association. Also a new situation arises where the non-finite embedded clause appears before the finite clause. Of course this is constant in the other condition, namely subject control, but if the [+/-Ag] role of the infinite clause may vary, the sequence of role assigning verbs, may be expected to influence the processing to some extent and would be interesting to investigate as well.

The counterpart in the minimal pair, as discussed about experiment 1, does have a [+Ag] controller as a subject NP, but a [+Ag] controller in an object NP seems to create not so plausible sentences for the minimal pair to be formed properly.

a.2.2 Subject-control and Association with Matrix Verb & Embedded Verb

Subject-controlled PRO, similar to subject-bound *pro* in experiment 1, has a matrix subject which is in receipt of [+Ag] type role from the matrix verb. The link emerging from it to the embedded verb does not vary in role, as the controlled *pro* in the sentence is also in receipt of [+Ag] from the embedded verb.

$Ami_i^{[-AG]}$ [$PRO_{i/*j}$ o-ke boi-Ta di-te] baddho ho-l-am

I-Nom [PRO 3sg-Dat/Acc book-Cl to.give] compel be-(pst)-1st

I had to give him/her the book.

It is an uncontrolled manipulation here as well in that, [-Ag] counterparts of Controller NP have not been designed for this experiment with Subject Control properties, in order to investigate the differences between how and to what extent the variation may influence any reading behavior in certain kinds of role sequences in the complex NP-event association. This could also throw some light to the fact, whether repetition of [+Ag] property of controller NP could be the cause behind delay of control clause comprehension in presence of a non-finite clause event preceding the completion of a finite clause event. Therefore processing of a [+Ag] assigner verb (in the embedded clause) comes ahead of a [-Ag] assigning verb and this might be significant if studied in comparison with other options.

a.2.3. Discussion

The testing of a sequence where information on roles involved in an embedded event is encountered before the ones involved in the matrix event may influence a certain amount of processing strategy. Here if an embedded role type is preferred over the other, independent of any matrix role associated with the same NP, then that needs to be tested. In case any such preference is found, (before encountering any such information in the matrix verb) then the interaction with a different or similar role in the matrix verb that immediately follows it may be interesting to investigate. This will need to be tested by preparing a different set of pairs having the infinite clause following the matrix verb (which is allowed in Bangla without changing meaning or effecting the grammaticality.)

a.3 Discussing Experiment 3

Experiment 3 has for the first time included the testing of Arbitrary PRO. Arbitrary PRO does not initially include an introduction to the controller or anchor for PRO. Most probably the complete sense of an arbitrary controller may be comprehended after the processor has gone through whole of the sentence and has found sufficient cues at the verb or at the non-finite clause boundaries or both. As such the control information, is hidden in the comprehension of the total sentence. The information regarding the Object Control also lies somewhere at the end of the sentence. Both of these information lie at the matrix verb which comes after the non-finite verb. In the comparison between the processing of Arbitrarily-controlled PRO Vs Object-controlled PRO, the formulation of factors being manipulated by the matrix verb, gives the following attributes to the controller NP in the two sentence types.

a.3.1 *Object Control and Association with Matrix Verb & Embedded Verb*

Object-controlled PRO has an object which is in receipt of [-Ag] type role from the matrix verb (the only verb, therefore event, that can directly be related to it).

ami onek bujh-i-ye o-ke[-AG] [PRO Sataar Sekh-a]-r Sujog di-lam (OBJECT CONTROL)

1st many explain-ppl 3rd-Dat/Acc [PRO swimming learn-ger]-gen chance give-past(1st)

With a lot of explanation, I gave him/her the chance to learn swimming.

Object Control designs, here, present the same shortcomings of as in Experiment 1 and Experiment 2. But in parallel, there is a new factor that has been introduced here, which is a gerundial non-finite, that has an EC subject. Gerundial clauses are capable of allowing an arbitrary control, besides allowing a subject or object control, as induced by the matrix verb which can contain the specific control information. Therefore an added facility of introducing a minimal pair with arbitrary control as one of the factors is made possible here.

a.3.2 Arbitrary PRO and Association with Matrix Verb & Embedded Verb

Arbitrary control, however, does not have any overt controller. As such, in this new situation, a different instance of seemingly anchor free linkage arises. Here, [+/- Ag] role of the controller concept, to which the embedded verb shall also need to get associated with, does not overtly exist.

ami onek bujh-i-ye o-ke [PRO Sataar Sekh-a]-r jukti di-lam (ARBITRARY CONTROL)

1st many explain-ppl 3rd-Dat/Acc [PRO swimming learn-ger]-gen justification give-past(1st)

With a lot of explanation, I gave him/her the justification of learning how to swim.

However, the concept of control requires a consideration of the received role by a controller that the embedded event verb needs to project towards it. As the controller concept in an arbitrary control is something generic, the [+/- Ag] property in the generic anchor cannot be determined. Therefore, to study the effect of shift of properties in the controller identity, one cannot include any instance of arbitrary control. As such, arbitrary control cases need to be kept aside in the

analysis of the influence of perspective shift, and the influences in the patterns of double roles, associated with the NP controller, which needs to be specifically overt to be able to be controlled for the features.

a.3.3 Discussion

The arbitrary control instances can capture the link divergence similarities when compared with object control. Therefore it is an apt tool in letting one claim differences between [+/-divergence] effects. Simultaneously it creates the evident problem of controlling the properties in the assumed arbitrary controller concept, and thus it has a problem of disallowing a controlled test of double associations with [+/-Ag] properties projected by the matrix and embedded events, that any control clause presumes. Testing processing differences between Arbitrary and Obligatory control of PRO however also comes with putting up with the problem of a basic difference between covert and overt controller concepts respectively. As such the basic difference between the arbitrariness and obligatory nature is that obligatory control has an overt *anchor* whereas arbitrary controller does not. Also there is a difference between a sentential controller identity and a discourse controller identity. Therefore, the actual difference, even if both the sentences have similar structure, incorporates other levels of dissimilarity.

The issues of controller NPs having been discussed, the stage becomes ready for debating the adequacy of the roles projected from the event of the embedded clause. Therefore it would be clear if the [+/-Ag] properties of PRO is studied.

b Properties of the EC, PRO/pro (associating identical roles to its controller NP).

The Properties of PRO are considerable in terms of similar or dissimilar [+/-Ag] properties that it receives from the embedded event. This corresponds to the association of the same properties with the controller, that the event projects towards it.

b.1 Discussing Experiment 1

In the comparison between the processing of object-controlled PRO Vs subject-bound *pro*, the formulation of factors being manipulated by the matrix verb, gives the following attributes to PRO.

b.1.1 Object Control and Association with Embedded Verb

The embedded clause in an Object Control situation, has an association of [+Ag] coming from the event in the embedded verb.

ami$_i$ o-ke$_j^{[-AG]}$ bol-e-chi [PRO$_{*i/j}^{[+AG]}$ Sokal-e uTh-e gari kor-e aS-te]

1SgNom 3Sg-Dat/Acc tell-ppl-pft [PRO morning-loc rise-ppl car do-ppl come-inf]

I told him/her to come by car, early morning.

The embedded event is realized through a verb that projects only a [+Ag] role to PRO, and therefore, also to the matrix controller. The other counterpart in the minimal pair in this experiment also has [+Ag] PRO. It is an uncontrolled manipulation here such that, [-Ag] counterparts of a PRO have not been tested in some parallel experiment with Object Control property, in order to investigate the differences between whether and how and to what extent the variation may influence any reading behavior in certain different kinds of role sequences in the complex NP-event association.

b.1.2 Subject *binding* and Association with Embedded Verb

The embedded clause in the Subject bound *pro* situation, has an association of [+Ag] coming from the event in the embedded verb for *pro*.

ami$_i^{[+AG]}$ o-ke$_j$ bol-e-chi [*pro*$^{[+AG]}_{i/*j}$ **Sokal-e uTh-e gari kor-e** aS-bo]

1SgNom 3Sg-Dat/Acc tell-ppl-pft [*pro* morning-loc rise-ppl car do-ppl come-fut(1st)

I told him/her that I will come in a car, early morning.

Similarly in the subject binding situation, the EC *pro* in the finite clause, receives a [+Ag] role from the embedded verb. This too does not have a counterpart in a *pro*$^{[-AG]}$ form. Therefore the shift of perspective cannot be studied from the conclusions of this experiment.

b.1.3 Discussion

Roles assigned from an event to *pro* may have different expectations in the processor than those projected toward PRO. PRO originates under situations where the subject of a clause, when non-finite, is not uttered. This situation is common in all languages and there is no option of any overt appearance of the NP identity in the place of that EC. In case of *pro* however, an option always exists for the identity to have occurred in an overt form at the place where the NP is dropped, and a [+ Pronominal] concept is understood as the hidden EC.

b.2 Discussing Experiment 2

In the comparison between object control and subject control clauses, the embedded EC, PRO, can be said to have the following associations with the embedded verb.

b.2.1 Object Control and Association with Embedded Verb

The embedded clause in an Object Control situation, here also has an association of [+Ag] coming from the event in the embedded verb.

ami$_i$ o-ke$_j$$^{[-AG]}$ [PRO$_{*i/j}$$^{[+AG]}$ *pro* boi-Ta di-te] baddho kor-l-am

1sg-Nom 3sg-Dat/Acc [PRO *pro* book-CL to.give] compelled-do(pst)-1st

I compelled him/her to give *someone* the book.

Therefore the role sequence pattern emerging from this design is [-Ag][+Ag] for the controller NP that gets associated with these roles. The other counterpart only has a [+Ag][+Ag] pattern but no [-Ag][-Ag] pattern is compared. This remains uncontrolled for role distribution like the previous experiments and will not be capable of allowing any inference pertaining to the shift of perspective, in the association linkages projected towards the controller NP.

b.2.2 Subject Control and Association with Embedded Verb

In case of subject control in experiment 2, the role given to PRO still remains [+Ag].

$ami_i^{[-AG]}$ [$PRO_{i/*j}^{[+AG]}$ o-ke boi-Ta di-te] baddho ho-l-am

I-Nom [PRO 3sg-Dat/Acc book-Cl to.give] compel be-(pst)-1st

I had to give him/her the book.

Discussion:

Here however, the role pattern is [-Ag][+Ag] and yet the preference still remains towards Object Control. This sentence is different from the object control condition but also has a lurking [+/-Ag] difference, therefore probably rendering a second pair of difference as well into the subject, when compared with the object control where the subject is in receipt of [+Ag] role.

b.3 Discussing Experiment 3

In the comparison between object control and arbitrary control, certain new issues can be observed in the embedded control which shall be discussed as follows.

b.3.1 Object Control and Association with Embedded Verb

The object control in this minimal pair has [+Ag] role associated with the PRO position.

ami onek bujh-i-ye o-ke$^{[-AG]}$ [PRO$^{[AG]}$ Sataar Sekh-a]-r Sujog di-lam (OBJECT CONTROL)

1st many explain-ppl 3rd-Dat/Acc [PRO swimming learn-ger]-gen chance give-past(1st)

With a lot of explanation, I gave him/her the chance to learn swimming.

This design has the same association pattern for PRO as the other object control situations. But in addition, this embedded clause has a gerund form which is known to provide the option of inducing the provision for arbitrary control as well, which the non-gerund non-finite clauses are not capable of introducing in Bangla.

b.3.2 Arbitrary Control and Association with Embedded Verb

The arbitrary control in this minimal pair too has [+Ag] role associated with the PRO position.

ami onek bujh-i-ye o-ke [PRO$^{[AG]}$ Sataar Sekh-a]-r jukti di-lam (ARBITRARY CONTROL)

1st many explain-ppl 3rd-Dat/Acc [PRO swimming learn-ger]-gen justification give-past(1st)

With a lot of explanation, I gave him/her the justification of learning how to swim.

The situation here to tackle is that there is no overt controller and as such no pattern of role sequence can be considered in this manipulated condition. As such the newly considered arbitrary control reveals only the end of the sequence in the role sequence pattern where [+Ag] is the ending role in the sequence. If any effects of role patterns were to be considered at all, only one inference may be drawn from here, which is that, role sequences ending in [+Ag] seem to have no difference with a role sequence which has [-Ag][+Ag] pattern. Such a conclusion would not seem competent in comparing the results of previous experiments where all the ECs had [+Ag] role.

b.3.3 Discussion

This new manipulation, is in-fact capable of including a new parameter, at the cost of disallowing a proper allowance for subject control as well, with the same embedding strategy like the following sentence.

??ami onek bujh-i-ye o-ke$^{[-AG]}$ [PRO$^{[AG]}$ Sataar Sekh-a]-r kotha di-lam (SUBJECT CONTROL)

1st many explain-ppl 3rd-Dat/Acc [PRO swimming learn-ger]-gen promise give-past(1st)

With a lot of explanation, I promised him/her to learn swimming.

The above sentence does not go well with the embedded gerund, probably because certain plausibility issues arise with a gerund where non-subject type control of PRO is the only probability that can be accepted by a native Bangla speaker.

The scrambled counterparts in experiment 2 scrambled the location of the matrix NPs only. It would be interesting to observe the response to a situation where the matrix verb appears before the embedded clause and the sequential information regarding [+/-Ag] received by the NP is switched.

3.4.1.2 Discussing the experiments in Japanese

Japanese is an SOV language and the tasks involved similar sentential pairs in different experiment sets that could reserve the disambiguation point at the sentence end verb. Also in the scrambled pairs, only the order of two matrix NPs were changed and the difference between EmbV→MatV and MatV→EmbV sequences were not studied.

Properties of Controller NP

Controller NPs in Japanese had only [+Ag] in Subject Control and [-Ag] in Object Control. This was paired with different and reversed preferences in different tasks that the subjects were made to perform.

Result of Recognition Task

Recognition Task involved the human parser to encounter the complete sentence, both in canonical or scrambled word order, and then recognize whether a provided NP in an audio stimulus was the probable performer of the embedded event or not. In this task the following relationships existed between the Controller NP and the matrix verbs.

Subject Control and Association with Matrix Verb

Subject Control sentence initiated an association link of [+Ag] with the matrix verb.

Kooiti-ga$^{[+AG]}$ kaisya-de Tamae-ni [PRO Tokyo iki-o] wazato moosideta.

Kooiti-Nom company-at Tamae-Dat Tokyo going-Acc purposely offered.

Kooiti, at the company, purposely offered Tamae that he would go to Tokyo.

Object Control and Association with Matrix Verb

Object Control sentence initiated an association link of [-Ag] with the matrix verb.

Kooiti-ga kaisya-de Tamae-ni[-AG] [PRO Tokyo iki-o] wazato saisokusita.
Kooiti-Nom company-at Tamae-Dat Tokyo going-Acc purposely urged.
Kooiti, at the company, purposely urged Tamae that she would go to Tokyo.

The controller NP in these experiments have been again different for the roles with which they associate. As such it is not explainable whether certain similarities in roles may be able to rule out the difference and render the difference between subject and object control null.

***Discussion*:**

Recognition task seemed to show a preference for subject control. This meant that when the processing task was not specifically comparable to online processing (whereas the retrieval task does seem to be comparable to online processing), some kind of preference toward a [+Ag] performer is preferred or recognized in an event so much as to bias the recognition of a performer of an embedded clause even if the actual performer may not be the one in [+Ag] (i.e., the object of the matrix clause).

Result of Retrieval Task

Retrieval Task involved the human parser to encounter the complete sentence, both in canonical or scrambled word order, and then immediately speak out the name of a person who could be a probable performer of the embedded event. In this task the same relationships existed between the Controller NP and the matrix verb as provided in the Recognition Task. But it was found that Retrieval task showed preference and bias towards the recalling the name of the object performer, which is the NP associated with a [-Ag] role from the matrix verb. This was found to be consistent irrespective of the order of the presentation of the NPs when the scrambled word order was used and was found to be incapable of deterring this preference observed in non scrambled sentences.

Discussion

This could indicate that retrieval strategies may be looking forward to find a [-Ag] participant

of an event. This kind of difference again cannot be fully claimed to answer the influence of [+/-Ag] factor unless both the controller NPs are tested for both the possible forms of the roles that they may be made to receive from the event information.

Properties of PRO

The embedded verb consistently provides a [+Ag] role to the embedded performer concept, PRO, which then is linked with the matrix NP, the controller of PRO. The following linkages can be observed in the embedded clause with PRO.

Result of Recognition Task

Subject Control and Association with Embedded Verb

The role given to the EC in subject control was [+Ag] and did not vary for polarity compared to the controller, which is the subject. The role sequence associated with the controller NP therefore in Subject Control was [+Ag][+Ag] as shown below.

Kooiti-ga$^{[+AG]}$ kaisya-de Tamae-ni [PRO$^{[+AG]}$ Tokyo iki-o] wazato moosideta.
Kooiti-Nom company-at Tamae-Dat Tokyo going-Acc purposely offered.
Kooiti, at the company, purposely offered Tamae that he would go to Tokyo.

Object Control and Association with Embedded Verb

Even in Object control, the role given to the EC in object control was also [+Ag] and did not vary for polarity. The role sequence associated with the controller NP therefore in Object Control was [-Ag][+Ag] as shown below and did not vary for the polarity of roles in the test.

Kooiti-ga kaisya-de Tamae-ni$^{[-AG]}$ [PRO$^{[+AG]}$ Tokyo iki-o] wazato saisokusita.
Kooiti-Nom company-at Tamae-Dat Tokyo going-Acc purposely urged.
Kooiti, at the company, purposely urged Tamae that she would go to Tokyo.

Discussion

Recognition task showed a preference in recognizing the NP which had a similar role polarity. But here again only the positive polarity of the role was tested, and no inferences for

such an influence of similarity can be deducted as the negative edge of the polarity has not been created in PRO itself, to see whether object control then would be preferred in such counter examples.

Result of Retrieval Task

Retrieval task involved the same kind of embedded clause and the results showed a preference toward a role sequence of [-Ag][+Ag].

This could indicate that a difference in polarity is the preferred combination for a retrieval strategy, and perhaps the controller is expected to have a different role given by the matrix verb than that to which it associates through PRO, from the embedded verb. Counter role-sequences need to be tested in retrieval task to explore whether the predictions of such a role based inference shall hold.

3.4.1.3 Discussion of experiments in Spanish

Spanish is an SVO language and as such the indication regarding the first role for the controller NP is from the matrix verb. The second association link from the embedded event is encountered later in the sentence. Therefore the structural hierarchy is similar to the encountered sequence of roles, i.e., Matrix-Event→Embedded-Event.

Properties of Controller NP

a. Discussing the Spanish Experiment 1

Subject Control and Association with Matrix Verb

Subject control induces a verb information immediately after the first NP and therefore there is actually no possibility of forming any intuition, in the processor, about probable default control preferences.

Marí $a_i^{[+AG]}$/prometio /a $Pedro_j$/[PRO_i] ser/bastante cauta/con los comentarios

$Mary_i$/promised/Peter/[PRO_i] to be/quite cautious(f)/with her comments

As such, in this language, a situation cannot be manipulated where both [+Ag] and [-Ag] roles (that in the object by default) have been encountered and the processor can be made to choose or show default preferences in the control processing strategies, by showing up some differences in latencies at the control verb itself. This is the case as there is no possible

difference which an experimenter can be able to create where there is any possible difference before the verb is encountered. This makes the design vulnerable to being incapable of measuring any actual structural preferences, keep aside any inherent cognitive load differences, and end up measuring nothing more than differences exclusively in the lexical domain.

Object control and Association with Matrix Verb

Object control in Spanish, however, has an interesting situation where the information regarding the identity and location of the controller is encountered at the verb which appears before the controller NP.

María$_i$/exigió /a Pedro$_j$$^{[-AG]}$/[PRO$_j$] ser/bastante cauto/con los comentarios

Mary$_i$ /demanded/from Peter$_j$/[PRO$_j$] to be/quite cautious (m)/with his comments

Mary demanded from Peter that he be quite cautious (m) with his comments.

This is different from the subject control situation where this information is encountered after the potential controller NP itself, which is the subject. This is different from the designs in Japanese and Bangla where both the potential controller NPs are encountered before the control verb, or any other verb for instance. It is a situation which is different from all the conditions in all the different experiments discussed so far. This design leads to a split of situations where, in case of subject control, the processor shall see the subject and then the control information and then expect an embedded clause where the mentioned subject shall control the identity of the EC and therefore be indirectly linked with the embedded event, after having already been linked with that of the matrix clause. This expectation is supposed to be incited only after the matrix verb, containing the control information, is encountered. The object control however presents the processor with a situation where the subject NP is encountered, and then the control verb with the object control information and then the object NP which is licensed to be the controller of the EC in the embedded non-finite clause. Therefore a slightly different but similar expectation should legitimately arise in the processor after it has encountered the matrix verb, that a controller should be found and an embedded, subject-less clause should be found, the event of which shall be associated with

the matrix object NP.

Discussion

Results indicated that the subject control verb induced an increased gaze at the object position of the matrix clause than that induced by the object control verb. This could mean that the expectations created in the processor at the matrix clause, to find an embedded clause for the matrix subject to associate with, might be immediate, and hence when the object NP is encountered after the matrix verb, the search for the proper linkage with the object needs to be postponed till after the object information is processed in the comprehension mechanism. This delay does not accurately posit any garden path condition which would have been rather more efficient in measuring the initial preferences than just the processing delay which may have multiple explanations other than that of initial object control preference, all, perhaps, equally commendable. The rigidity of the position of [+/-Ag] roles that were maintained, with out any scrambling test, also cannot tell more about the probable influences of difference in sequence of the roles. The experiment was also not counter tested for any effect of [+/-Similarity] of roles in Controller NP and EC.

b. Discussing the Spanish experiment-2

This experiment did not contain any control verb but rather only a potential bias word in the form of a minimal pair of prepositions which are, *por* (object control) and *para* (subject control). Now, the potential bias is encountered in the preposition which is located after both the potential Controller NPs. Also this cue does not have any association with any of the matrix NPs, which otherwise the control verb does have. This is an option, that the control verbs themselves cannot offer in SVO languages. However, the results showed an increased total reading time taken in Subject Control sentences, compared to Object controlled sentences. The [+/-Ag] role sequence remains identical to that of Experiment 1 in Spanish. Therefore the role sequences cannot say anything about probable differences due to the variation of sequence factor effect of role types.

Properties of PRO

The role of PRO remained in +Ag all the while in both the experiments. As such,

embedded clause always ended in [+Ag]. In subject controlled sentences therefore, the sequence of roles associated with the controller were [+Ag][+Ag] and those associated with the controller in case of object control sentences were [-Ag][+Ag]. It is therefore clearly visible that the pattern of [+/-Ag] properties were restricted to only these types of role sequences in most experiments and therefore nothing can be clearly claimed about independence of the properties of the controller in influencing the processing bias, observed in the latencies extracted from the total sentence, as well as the object position in the relevant experiments.

3.5 Issues in Double Theta Association.

The issue of control, binding, raising and wh-movement can have the binder of a lower element, be entailed to get certain amount of semantic associations from more than one event. This is to imply that a particular NP may, in certain circumstances be associated with more than one verb, directly or indirectly through certain types of feasible semantic relationships. Those relationships may be established in the configuration through direct relationships such as external and internal arguments of a verb and the verb, or through indirect relationships with other verbs mostly through external arguments which the verb theta marks and which the NP binds through c-command and co-indexation relationships. The following are some of the prominently observed cases of preliminary double theta marking issues which shall be considered relevant for providing a link complexity account and also define the properties like, sequence of features of role sequences in the double role sequence, for each anchor NP.

Lisa A. Reed (1996) discusses that certain situations of double theta role assignment can arise in certain verbs. These are lexical factors which bring about more than one role for the object of the matrix clause. Following are some observations in French.

1 Le balai-brosse a travaillé
the mop has worked
The mop worked.
(1) shows a [+Ag] role for "mop" which is obvious due to its association with "*travaillé*" (work). But in (2), a new association is formed with a causative "*travailler le*" (made to-work) which, besides having "mop" get associated with a [+Ag] role, also gets it

associated with a [-Ag] role from the semantic requirements of a theta position that is supposed to be available for *make* in its theta grid.

2 J'ai fait travailler le balai-brosse

I have made to-work the mop

'I made the mop work

Mop should get a theta role of [-AG] fit for the object of *make*, as well as the role of [+AG] fit for the subject of *work* in (2). Likewise in (3) and (4), dog has a comprehension of more than one role which is complex, comprising of both the [-AG] as well as the [+AG] properties, as object of *making _ walk* and *making _ eat* as well as the subject of walking and eating.

3 John walked the dog.

4 John fed the dog.

3.6 Understanding the Complexity load

Control clauses can be compared to such a situation where the controller does get indirectly associated with the theta roles of an embedded event besides being directly associated with the theta roles of the matrix verb of which it is either an internal or external argument.

There is always a possibility that perhaps a variation in processing load arises due to type of Numerosity count of agency associations with number of verbs, or different patterns of [+AG][-AG] role association sequences in such an environment of double theta association. This expectation can be discussed in details in an appropriate format, broken down in terms of differences and similarities in agent-event association types and the different beginning and ending roles. The sequence in hierarchical level also needs to be compared and tested in some manner such that it may be also concluded whether there is any clause level default in the processing strategy which shall render some roles predicted, and therefore more preferred compared to other roles associated to a particular event in a clause. This is formulated in the form of a Double Theta Association Complexity test and Clausal Role Preferences.

3.6.1 Double Theta Association complexity (DTA) test:

Double theta association complexity test shall test certain assumptions that can be grouped broadly into the following levels.

DTA Similarity:

[+Identical] Vs [-Identical]:

It needs to be ascertained in DTAC whether certain amount of similarity in type of role associated with the controller NP may prove to be an influential factor in determining the complexity of the comprehension of control clauses.

DTA sequence:

[+AG] initial

[+Identical] Vs [-Identical]:

Sequences of role association, beginning with [+Ag] may be, in some manner, tested separately to determine whether identical nature of roles associated with the controller NP may be processed differently from non-identical nature of roles in the human processor exclusively when the first role received is [+Ag].

[-AG] initial

[+Identical] Vs [-Identical]:

Sequences of role association, beginning with [-Ag] may be, in some manner, tested separately to determine whether identical nature of roles associated with the controller NP may be processed differently from non-identical nature of roles in the human processor when the first role received is [-Ag].

[+AG] Final

[+Identical] Vs [-Identical]:

Sequences of role association, ending with [+Ag] may be, in some manner, tested separately to determine whether identical nature of roles associated with the controller NP may be processed differently from non-identical nature of roles in the human processor exclusively when the ending role received is [+Ag].

[-AG] Final

[+Identical] Vs [-Identical]:

Sequences of role association, ending with [-Ag] may be, in some manner, tested separately to determine whether identical nature of roles associated with the controller NP may be processed differently from non-identical nature of roles in the human processor exclusively when the ending role received is [-Ag].

3.6.2 Preferences in Embedding of Role Source:

Once the roles have been tested for the sequential complexity, it may be considered almost a terminal requirement to check whether or not there are certain initial, internal preferences for certain role types for certain argument positions in the theta grid, compared for matrix clause level and embedded clause level sources. It will also be a very important task to explore whether a certain role already encountered initially in a certain level of hierarchy, can bias the expectations regarding the upcoming role in another level, either in a hierarchical symmetry or in a hierarchical asymmetry. This can be tested by shifting the embedded clause to a location after the matrix verb in a temporal sequence and compare its processing difference with responses extracted from a sentence where the embedded clause is not likewise shifted, and is available at its usual position.

These tests can be prepared in Bangla as this language (like many other left branching SOV languages and unlike SVO languages) allows the shifting of embedded clause to the end of the sentence, without bringing about any changes in the semantic properties of the complex event.

Chapter 4 discusses the preparation of stimulus of seven plausible pairs for testing the presence of any relevant effect of DTAC and their seven counterparts having shifted embedded clause, to compare with the previous seven pairs and test for presence of in-situ role preferences. Therefore a total of fourteen sets of sentences, combined into seven minimal pairs, have been prepared for the design as separate experiment sets, which have been used as fillers for each other, as the features could not be accommodated into a single set. Total possible interaction of factors would result into twelve pairs but five of the pairs were not

plausible as [+Ag] role for Matrix Object resulted in not so plausible sentences for object control in Bangla. The experiment design, analysis and results are detailed in chapter 4.

Chapter 4

Mapping of Double Theta Association (DTA) onto Controller NP in sentences containing Control Clauses: The effects of Semantic Role Sequence (SRS).

It is significant to accommodate all possible combinations of double theta roles for a controller NP in order to test the mapping of Double Theta Associations. Therefore, an attempt is made to prepare minimal pairs such that the effects can be tested at certain interest areas (or critical words) for each sentence. Each template pair has been used to form 10 sentences which are used as separate experiment sets that independently test the same hypothesis with interactions of different factors. The following factors of minimal pair template are designed using which the minimal pairs for the experiment are collected later. The sentence possibilities have been discussed according to the type of control, the type of role from the event in the matrix clause that it gets associated with and the type of role from the embedded event that it gets associated with.

4.1. Subject Control:

In subject control, the minimal pair has been designed to take care of two basic factors, one where the controller NP is in [+Ag] role and the other where it is in [-Ag] role. Following is the distribution of [+/-Ag] role for PRO in each case.

(a) agentive NP

Agentive controller is considered here in order to account for two other factors. The first case is where the PRO is in [+Ag] and thus the embedded event associates a [+Ag] role for the controller NP. The second case is where the PRO is in [-Ag] and thus the embedded event associates a [-Ag] role for the controller NP. This item is suitable for testing the cases of [+Ag] initial role sequences for the controller NP which is a subject. It also enables the testing of how the processor reacts to a [+Ag] role from the matrix clause event to the subject while testing for clausal preferences in roles in the processing of control types.

i. agentive PRO

Ram$^{[+\,AG][+AG]}$ shokal-shokal [**PRO**$^{[+\,AG]}$ (Shyam-ke) gaal/gaali di-te] ge-lo

Ram(Nom) morning-morning [PRO Shyam-Acc rebuke give-inf] go-past(3rd)

Early in the morning, Ram went to rebuke/scold Shyam.

In this sentence, "*ge-lo*" (went) has direct association with the controller NP "*Ram*" which gets a [+Ag] from the verb and "*gaali di-te*" (to scold) has an indirect association with "*Ram*" through the EC, PRO, which has a [+Ag] role from it. This creates a situation where the sequence entails a [+Ag][+Ag] role pattern onto the controller NP. Such a template can be manipulated and used in different types of minimal pairs, either by certain minor modifications or controlling for certain contextual and structural similarities in testing the responses observed from the processor regarding the following issues:

- What happens when controller NP is associated with more than one similar roles when compared to non-similar roles for that NP?
- How a [+Ag]-final sequence is processed when the initial role in that sequence is [+Ag] and therefore also how a [+Ag]-final sequence is processed when the initial role is identical.
- In a sentence having a shifted control clause, how a [+Ag] role from embedded clause is processed when the matrix clause association (encountered earlier than the association from the embedded clause) also provides a [+Ag] role association to the controller NP.
- How a [+Ag] role, associated from the embedded clause event, is processed when that associated with the matrix clause is [+Ag] and therefore also how a [+Ag] role associated from the embedded clause event is processed when that associated with the matrix clause is identical.
- When compared to a counterpart where the same sentence has its embedded clause shifted to a sentence end position, whether and how the resulting sequence of roles and the very verb (matrix & embedded) may influence the processing when the matrix clause has [+Ag] and embedded clause has [+Ag] role for the controller NP.
    - Also therefore, it can be tested whether a [+Ag] role from the embedded clause can bias the processing of any role from the matrix clause when the verb of the embedded clause is encountered before the matrix verb in subject control, compared to,
    - Whether a [+Ag] role from the matrix clause can bias the processing of any role from the embedded clause when the verb of the matrix clause is encountered before the embedded verb, in a sentence having a shifted embedded clause in subject control.

- Whether there is any significant difference in the total reading time of the complete sentence in the minimal pair, when the sequence is [+Ag][+Ag] when compared to any other type of sequence pair in subject control.
- Whether there is any significant difference in the total reading time of the complete sentence in the minimal pair including another comparable sentence, when the sequence in a shifted sentence is compared to any other type of sequence pair.
- How [+Ag][+Ag] role sequence is processed when the controller is a subject NP, compared to when it is an object NP (discussed later).

This template has been used to create appropriate sentence pairs comparing processing of [-Ag] initial role sequence, [-Ag] final role sequence, shifted control clause with [+Ag][+Ag] role sequence comparing difference between embedded role and matrix role influencing the other, [+Ag] initial sequence in object control, [-Ag] role from embedded clause and [-Ag] role from matrix clause.

ii. non-agentive PRO

Ram$^{[+AG]\,[-AG]}$ shokal-shokal [**PRO**$^{[-AG]}$ (Shyam-er) gaal/gaali k^{h}e-te] ge-lo

Ram(Nom) morning-morning [PRO Shyam-Acc rebuke eat-inf] go-past(3rd)

Ram went early in the morning to get scolded by Shyam.

In this sentence, "*ge-lo*" (went) has direct association with the controller NP "*Ram*" which gets a [+Ag] from the verb and "*gaali k^{h}e-te*" (to get scolding) has an indirect association with "*Ram*" through the EC, PRO, which has a [-Ag] role from it. This creates a situation where the sequence entails a [+Ag][-Ag] role pattern onto the controller NP. Such a template can be manipulated and used in different types of minimal pairs, either by certain minor modifications or controlling for certain contextual and structural similarities in testing the responses observed from the processor regarding the following issues:

- What happens when controller NP is associated with non similar roles when compared to similar roles for that NP in subject control?
- How a [-Ag]-final sequence is processed when the initial role in that sequence is [+Ag] and therefore also how a [-Ag]-final sequence is processed when the initial role is not identical in subject control.
- In a sentence having a shifted control clause, how a [-Ag] role from embedded clause

is processed when the matrix clause association (encountered earlier than the association from the embedded clause) provides a [+Ag] role association to the controller NP.

- How a [-Ag] role, associated from the embedded clause event, is processed when that associated with the matrix clause is [+Ag] and therefore also how a [-Ag] role associated from the embedded clause event is processed when that associated with the matrix clause is not identical.
- When compared to a counterpart where the same sentence has its embedded clause shifted to a sentence end position, whether and how the resulting sequence of roles and the very verb (matrix & embedded) may influence the processing when the matrix clause has [+Ag] and embedded clause has [-Ag] role for the controller NP.
    - Also therefore, it can be tested whether a [-Ag] role from the embedded clause can bias the processing of any role from the matrix clause when the verb of the embedded clause is encountered before the matrix verb in subject control, as compared to a [+Ag] role from it.
    - Whether a [+Ag] role from the matrix clause can bias the processing of any role from the embedded clause when the verb of the matrix clause is encountered before the embedded verb, in a sentence having a shifted embedded clause in subject control.
- Whether there is any significant difference in the total reading time of the complete sentence in the minimal pair, when the sequence is [+Ag][-Ag] when compared to any other type of sequence pair in subject control.
- Whether there is any significant difference in the total reading time of the complete sentence in the minimal pair including another comparable sentence, when the sequence in a shifted sentence is reversed to [-Ag][+Ag] when compared to any other type of sequence pair.
- How [+Ag][-Ag] role sequence is processed when the controller is a subject NP, compared to when it is an object NP (discussed later).

This template has been used to create appropriate sentence pairs comparing processing of [-Ag] initial role sequence, [+Ag] final role sequenjce, shifted control clause with [-Ag][+Ag] role sequence comparing difference between embedded role and matrix role influencing the other, [+Ag] initial sequence in object control, [+Ag] role from embedded clause and [-Ag]

role from matrix clause.

(b) non-agentive NP

Non-agentive controller is considered here in order to account for two other factors. The first case is where the PRO is in [+Ag] and thus the embedded event associates a [+Ag] role for the controller NP. The second case is where the PRO is in [-Ag] and thus the embedded event associates a [-Ag] role for the controller NP. This item is suitable for testing the cases of [-Ag] initial role sequences for the controller NP which is a subject. It also enables the testing of how the processor reacts to a [-Ag] role from the matrix clause event to the subject while testing for clausal preferences in roles in the processing of control types.

i. agentive PRO

Robi$^{[-\,AG][+\,AG]}$ (Amit-er bari gi-ye) [**PRO**$^{[+\,AG]}$ *gala-gal kor-te* (/*kor-e ash-te*)] baddho ho-lo

Robi Amit-gen house go-ppl [PRO scolding do(/to-give and come)] compel be-pst

Robi was compelled to go to Amit's house and scold him.

In this sentence, "*baddho ho-lo*" (had to/was compelled to) has direct association with the controller NP "*Ram*" which gets a [-Ag] from the verb and "*gala-gal kor-te*" (to scold) has an indirect association with "*Ram*" through the EC, PRO, which has a [+Ag] role from it. This creates a situation where the sequence entails a [-Ag][+Ag] role pattern onto the controller NP. Such a template can be manipulated and used in different types of minimal pairs, either by certain minor modifications or controlling for certain contextual and structural similarities in testing the responses observed from the processor regarding the following issues:

- What happens when controller NP is associated with non similar roles when compared to similar roles for that NP in subject control?
- How a [+Ag]-final sequence is processed when the initial role in that sequence is [-Ag] and therefore also how a [+Ag]-final sequence is processed when the initial role is not identical.
- In a sentence having a shifted control clause, how a [+Ag] role from embedded clause is processed when the matrix clause association (encountered earlier than the association from the embedded clause) provides a [-Ag] role association to the controller NP in subject control.

- How a [+Ag] role, associated from the embedded clause event, is processed when that associated with the matrix clause is [-Ag] and therefore also how a [+Ag] role associated from the embedded clause event is processed when that associated with the matrix clause is not identical.
- When compared to a counterpart where the same sentence has its embedded clause shifted to a sentence end position, whether and how the resulting sequence of roles and the very verb (matrix & embedded) may influence the processing when the matrix clause has [-Ag] and embedded clause has [+Ag] role for the controller NP.
    - Also therefore, it can be tested whether a [+Ag] role from the embedded clause can bias the processing of any role from the matrix clause when the verb of the embedded clause is encountered before the matrix verb in subject control, as compared to...
    - Whether a [-Ag] role from the matrix clause can bias the processing of any role from the embedded clause when the verb of the matrix clause is encountered before the embedded verb, in a sentence having a shifted embedded clause in subject control.
- Whether there is any significant difference in the total reading time of the complete sentence in the minimal pair, when the sequence is [-Ag][+Ag] when compared to any other type of sequence pair in subject control.
- Whether there is any significant difference in the total reading time of the complete sentence in the minimal pair including another comparable sentence, when the sequence in a shifted sentence is reversed to [+Ag][-Ag] when compared to any other type of sequence pair.
- How [-Ag][+Ag] role sequence is processed when the controller is a subject NP, compared to when it is an object NP (discussed later).

This template has been used to create appropriate sentence pairs comparing processing of [+Ag] initial role sequence, [-Ag] final role sequence, shifted control clause with [+Ag][-Ag] role sequence comparing difference between embedded role and matrix role influencing the other, [+Ag] initial sequence in object control, [-Ag] role from embedded clause and [+Ag] role from matrix clause.

ii. non-agentive PRO

Robi[– AG][– AG] (Amit-er bari gi-ye) [**PRO**[– AG] *gal-a-gal k^{h}e-te* (/*khe-ye ash-te*)] baddho ho-lo

Robi (Amit-gen house go-ppl) [PRO scolding eat-inf(/eat-ppl come-inf)] compel be-pst

Robi had to come back getting scolded, after going to Amit's house.

In this sentence, "*baddho ho-lo*" (went) has direct association with the controller NP "*Robi*" which gets a [-Ag] from the verb and "*gal-a-gal k^{h}e-te*" (to scold) has an indirect association with "*Robi*" through the EC, PRO, which has a [-Ag] role associated from it. This creates a situation where the sequence entails a [-Ag][-Ag] role pattern onto the controller NP. Such a template can be manipulated and used in different types of minimal pairs, either by certain minor modifications or controlling for certain contextual and structural similarities in testing the responses observed from the processor regarding the following issues:

- What happens when controller NP is associated with more than one similar roles when compared to non-similar roles for that NP in subject control?
- How a [-Ag]-final sequence is processed when the initial role in that sequence is [-Ag] and therefore also how a [-Ag]-final sequence is processed when the initial role is identical.
- In a sentence having a shifted control clause, how a [-Ag] role from embedded clause is processed when the matrix clause association (encountered earlier than the association from the embedded clause) also provides a [-Ag] role association to the controller NP.
- How a [-Ag] role, associated from the embedded clause event, is processed when that associated with the matrix clause is [-Ag] and therefore also how a [-Ag] role associated from the embedded clause event is processed when that associated with the matrix clause is identical.
- When compared to a counterpart where the same sentence has its embedded clause shifted to a sentence end position, whether and how the resulting sequence of roles and the very verb (matrix & embedded) may influence the processing when the matrix clause has [-Ag] and embedded clause has [-Ag] role for the controller NP.
    - Also therefore, it can be tested whether a [-Ag] role from the embedded clause can

bias the processing of any role from the matrix clause when the verb of the embedded clause is encountered before the matrix verb in subject control, compared to [+Ag] role from it.

- Whether a [-Ag] role from the matrix clause can bias the processing of any role from the embedded clause when the verb of the matrix clause is encountered before the embedded verb, in a sentence having a shifted embedded clause in subject control.

- Whether there is any significant difference in the total reading time of the complete sentence in the minimal pair, when the sequence is [-Ag][-Ag] when compared to any other type of sequence pair in subject control.
- Whether there is any significant difference in the total reading time of the complete sentence in the minimal pair including another comparable sentence, when the sequence in a shifted sentence is compared to any other type of sequence pair.
- How [-Ag][-Ag] role sequence is processed when the controller is a subject NP, compared to when it is an object NP (discussed later).

This template has been used to create appropriate sentence pairs comparing processing of [+Ag] initial role sequence, [+Ag] final role sequence, shifted control clause with [-Ag][-Ag] role sequence comparing difference between embedded role and matrix role influencing the other, [-Ag] initial sequence in object control, [+Ag] role from embedded clause and [+Ag] role from matrix clause.

4.2. Object Control/ Object Bound

In object control, the minimal pair has been designed to take care of two basic factors, one where the controller NP is in [+Ag] role and the other where it is in [-Ag] role. Following is the distribution of [+/-Ag] role for PRO in each case.

(a) agentive NP[1]

Agentive controller is considered here in order to account for two other factors. The first case is where the PRO/*pro* is in [+Ag] and thus the embedded event associates a [+Ag] role for the controller NP. The second case is where the PRO/*pro* is in [-Ag] and thus the embedded event associates a [-Ag] role for the controller NP. This item is suitable for testing the cases

1 [+Ag] Object NP is problematic as the controller of an EC (at least for PRO) in Bangla.

of [+Ag] initial role sequences for the controller NP which is a subject. It also enables the testing of how the processor reacts to a [+Ag] role from the matrix clause event to the object while testing for clausal preferences in roles in the processing of control types.

This construction is designed using embedded finite clause as Bangla does not seem to allow a control clause in a configuration where the matrix object, which is desired to be the controller is in receipt of [+Ag] role from the matrix event. This seems to be a new situation detected in terms of distribution of [+/-Ag] roles in a controller. As such control clauses are not compatible to test the effect of role sequence for [+Ag][+Obj] property of the Controller NP.

i. agentive PRO

Shyam **Mohon**-er$^{[+\,AG][+AG]}$ hat^{h}-e t_i opoman-ito holo [$_i$ ***pro***$^{[+\,AG]}$ shob-ar shamn-e (o-ke) gal-a-gal di-e-ch-e bole]

Shyam Mohan-gen hand-Loc humiliation-Ger be-pst [*pro* everyone-gen infront-Loc (3rd-Acc) scolding give-ppl-pst-3rd tell-pst(say-CP)]

Shyam was humiliated by Mohan because he (Mohan) scolded him in-front of everyone.

The current sentence does provide a situation where *pro* is bound in a tensed clause and does create a situation where the object controller can be in a place, with receipt of a [+Ag] role from the matrix event. This configuration has been brought about by adding an explanatory CP after the main clause, explaining how the *humiliation* was caused.

In this sentence, "*opoman-ito ho-lo*" (was humiliated) has direct association with the controller NP "*Mohon*" which gets a [+Ag] from the event though it is an object. This is possible because *Mohon* is presented as the person who is humiliating *Shyam* and not otherwise ("*hat^{h}-e*" does the trick here). "*gal-a-gal di-e-ch-e*" (gave a scolding) has an indirect association with "*Mohon*" through the EC, *pro*, which has a [+Ag] role from it. This creates a situation where the sequence entails a [+Ag][+Ag] role pattern onto the controller NP. Such a template can be manipulated and used in different types of minimal pairs, either by certain minor modifications or controlling for certain contextual and structural similarities in testing the responses observed from the processor regarding the following issues:

- What happens when controller NP is associated with more than one similar roles when compared to non-similar roles for that NP in object control?
- How a [+Ag]-final sequence is processed when the initial role in that sequence is [+Ag] and therefore also how a [+Ag]-final sequence is processed when the initial role is identical in an object control.
- In a sentence having a shifted embedded clause version of the above sentence where the explanatory CP is made to occur before the matrix verb, how a [+Ag] role from matrix clause is processed when the embedded clause association (encountered earlier than the association from the matrix clause) also provides a [+Ag] role association to the controller NP.
- How a [+Ag] role, associated from the embedded clause event, is processed when that associated with the matrix clause is [+Ag] in object control and therefore also how a [+Ag] role associated from the embedded clause event is processed when that associated with the matrix clause is identical.
- When compared to a counterpart where the same sentence has its embedded clause in place, whether and how the resulting sequence of roles and the very verb (matrix & embedded) may influence the processing when the matrix clause has [+Ag] and embedded clause has [+Ag] role for the controller NP.
    - Also therefore, it can be tested whether a [+Ag] role from the embedded clause can bias the processing of any role from the matrix clause when the verb of the embedded clause is encountered before the matrix verb in subject control, compared to,
    - Whether a [+Ag] role from the matrix clause can bias the processing of any role from the embedded clause when the verb of the matrix clause is encountered before the embedded verb, in a sentence having a shifted embedded clause in subject control.

  It seems that generally native speakers of Bangla do not resort to this kind of construction where the explanatory finite clause, where *pro* can exist, can be appropriately embedded with in the main event.
- Whether there is any significant difference in the total reading time of the complete sentence in the minimal pair, when the sequence is [+Ag][+Ag] when compared to any other type of sequence pair in object control.

- Whether there is any significant difference in the total reading time of the complete sentence in the minimal pair including another comparable sentence, when the sequence in a shifted sentence is compared to any other type of sequence pair.
- How [+Ag][+Ag] role sequence is processed when the controller is an object NP, compared to when it is a subject NP.

This template can be used to create appropriate sentence pairs comparing processing of [-Ag] initial role sequence, [-Ag] final role sequence, shifted embedded clause with [+Ag][+Ag] role sequence comparing difference between embedded role and matrix role influencing the other, [+Ag] initial sequence in subject control, [-Ag] role from embedded clause and [-Ag] role from matrix clause.

ii. non-agentive PRO

Shyam dour protijogita-y **Mohon**-er$^{[+\,AG][-\,AG]}$ hat^{h}-e t_i poraj-ito holo [$_i$***pro***$^{[-\,AG]}$ kono rokom jit-iye de-wa ho-lo bol-e][2]

Shyam race competetion-Loc Mohan-Gen hand-Loc defeat-Ger [*pro* any manner make-Causative give-Ger be-pst tell-pst(say-CP)]

Shyam faced defeat in the hands of Mohan as he (Mohan) was made to win somehow.

The current sentence also provides an adequate situation where *pro* is bound in a tensed clause and does create a situation where the object controller can be in a place, with receipt of a [+Ag] role only from the matrix event. This configuration has been brought about by adding an explanatory CP after the main clause, explaining how the *defeat* was caused.

In this sentence, "*poraj-ito holo*" (faced defeat) has direct association with the controller NP "*Mohon*" which gets a [+Ag] from this event though it is an object. This is possible because *Mohon* is presented as the person who is defeating *Shyam* and not otherwise. "*gal-a-gal di-e-ch-e*" (gave a scolding) has an indirect association with "*Mohon*" through the EC, *pro*, which has a [-Ag] role from it. This creates a situation where the sequence entails a [+Ag][-Ag] role pattern onto the controller NP. Such a template can be manipulated and used in different types of minimal pairs, either by certain minor modifications or controlling for certain contextual and structural similarities in testing the responses observed from the processor

2 Sentence modification as suggested by Probal Dasgupta; personal communication.

regarding the following issues:

- What happens when controller NP is associated with non similar roles when compared to similar roles for that NP in object control?
- How a [-Ag]-final sequence is processed when the initial role in that sequence is [+Ag] and therefore also how a [-Ag]-final sequence is processed when the initial role is not identical in an object control.
- In a sentence having an embedded clause version of the above sentence where the explanatory CP is made to occur before the matrix verb, how a [+Ag] role from matrix clause is processed when the embedded clause association (encountered earlier than the association from the matrix clause) provides a [-Ag] role association to the controller NP.
- How a [-Ag] role, associated from the embedded clause event, is processed when that associated with the matrix clause is [+Ag] in object control and therefore also how a [-Ag] role associated from the embedded clause event is processed when that associated with the matrix clause is not identical.
- When compared to a counterpart where the same sentence has CP clause in place, whether and how the resulting sequence of roles and the very verb (matrix & embedded) may influence the processing when the matrix clause has [+Ag] and embedded clause has [-Ag] role for the controller NP.
    - Also therefore, it can be tested whether a [+Ag] role from the matrix clause can bias the processing of any role from the embedded clause when the verb of the matrix clause is encountered before the embedded verb in object control, compared to,
    - Whether a [+Ag] role from the matrix clause can bias the processing of any role from the embedded clause when the verb of the matrix clause is encountered before the embedded verb.

  It seems that generally native speakers of Bangla do not resort to this kind of construction where the explanatory finite clause (where *pro* can exist) can be more appropriately embedded with in the main event.
- Whether there is any significant difference in the total reading time of the complete sentence in the minimal pair, when the sequence is [+Ag][-Ag] when compared to any other type of sequence pair in object control.

- Whether there is any significant difference in the total reading time of the complete sentence in the minimal pair including another comparable sentence, when the sequence in a shifted sentence is compared to any other type of sequence pair.
- How [+Ag][-Ag] role sequence is processed when the controller is an object NP, compared to when it is a subject NP.

This template can be used to create appropriate sentence pairs comparing processing of [-Ag] initial role sequence, [+Ag] final role sequence, embedded clause with [-Ag][+Ag] role sequence comparing difference between embedded role and matrix role influencing the other, [-Ag] initial sequence in object control, [+Ag] role from embedded clause and [-Ag] role from matrix clause.

(b) non-agentive NP

Non-agentive controller is again considered here in order to account for two other factors. The first case is where the PRO is in [+Ag] and thus the embedded event associates a [+Ag] role for the controller NP. The second case is where the PRO is in [-Ag] and thus the embedded event associates a [-Ag] role for the controller NP. This item is suitable for testing the cases of [-Ag] initial role sequences for the controller NP which is an object. It also enables the testing of how the processor reacts to a [-Ag] role from the matrix clause event to the object while testing for clausal preferences in roles in the processing of control types.

i. agentive PRO

Robi **Amit**-ke$^{[-\text{AG}][+\text{AG}]}$ shokal shokal [**PRO**$^{[+\text{AG}]}$ *gala-gal di-te*] baddho kor-lo

Robi Amit-Dat/Acc morning morning [PRO scolding give-inf] compel do-pst

Robi compelled Amit to scold s^{one} early morning.

In this sentence, "*baddho kor-lo*" (compelled) has direct association with the controller NP "*Amit*" which gets a [-Ag] from the verb and "*gala-gal di-te*" (to scold) has an indirect association with "*Amit*" through the EC, PRO, which has a [+Ag] role from it. This creates a situation where the sequence entails a [-Ag][+Ag] role pattern onto the controller NP. Such a template can be manipulated and used in different types of minimal pairs, either by certain minor modifications or controlling for certain contextual and structural similarities in testing

the responses observed from the processor regarding the following issues:

- What happens when controller NP is associated with non similar roles when compared to similar roles for that NP in object control?
- How a [+Ag]-final sequence is processed when the initial role in that sequence is [-Ag] and therefore also how a [+Ag]-final sequence is processed when the initial role is not identical.
- In a sentence having a shifted control clause, how a [+Ag] role from embedded clause is processed when the matrix clause association (encountered earlier than the association from the embedded clause) provides a [-Ag] role association to the controller NP in object control.
- How a [+Ag] role, associated from the embedded clause event, is processed when that associated with the matrix clause is [-Ag] and therefore also how a [+Ag] role associated from the embedded clause event is processed when that associated with the matrix clause is not identical.
- When compared to a counterpart where the same sentence has its embedded clause shifted to a sentence end position, whether and how the resulting sequence of roles and the very verb (matrix & embedded) may influence the processing when the matrix clause has [-Ag] and embedded clause has [+Ag] role for the controller NP.
    - Also therefore, it can be tested whether a [+Ag] role from the embedded clause can bias the processing of any role from the matrix clause when the verb of the embedded clause is encountered before the matrix verb in an object control, as compared to when there is a [-Ag] from the embedded clause.
    - Whether a [-Ag] role from the matrix clause can bias the processing of any role from the embedded clause when the verb of the matrix clause is encountered before the embedded verb, in a sentence having a shifted embedded clause in object control.
- Whether there is any significant difference in the total reading time of the complete sentence in the minimal pair, when the sequence is [-Ag][+Ag] when compared to any other type of sequence pair in object control.
- Whether there is any significant difference in the total reading time of the complete sentence in the minimal pair including another comparable sentence, when the sequence in a shifted sentence is reversed to [+Ag][-Ag] when compared to any other

type of sequence pair.

- How [-Ag][+Ag] role sequence is processed when the controller is an object NP, compared to when it is a subject NP.

This template has been used to create appropriate sentence pairs comparing processing of [+Ag] initial role sequence, [-Ag] final role sequence, shifted control clause with [+Ag][-Ag] role sequence comparing difference between embedded role and matrix role influencing the other, [+Ag] initial sequence in object control, [-Ag] role from embedded clause and [+Ag] role from matrix clause.

ii. non-agentive PRO

Robi **Amit**-ke$^{[-\text{AG}][-\text{AG}]}$ shokal shokal [**PRO**$^{[-\text{AG}]}$ *gala-gal k^{h}e-te*] baddho kor-lo

Robi Amit-Dat/Acc morning morning [PRO scolding eat-inf] compel do-pst

Robi compelled Amit to get a scolding early morning.

In this sentence, "*baddho kor-lo*" (compelled) has direct association with the controller NP "*Amit*" which gets a [-Ag] from the verb and "*gal-a-gal k^{h}e-te*" (to get scolded) has an indirect association with "*Robi*" through the EC, PRO, which has a [-Ag] role associated from it. This creates a situation where the sequence entails a [-Ag][-Ag] role pattern onto the controller NP. Such a template can be manipulated and used in different types of minimal pairs, either by certain minor modifications or controlling for certain contextual and structural similarities in testing the responses observed from the processor regarding the following issues:

- What happens when controller NP is associated with more than one, similar roles when compared to non-similar roles for that NP in object control?
- How a [-Ag]-final sequence is processed when the initial role in that sequence is [-Ag] and therefore also how a [-Ag]-final sequence is processed when the initial role is identical.
- In a sentence having a shifted control clause, how a [-Ag] role from embedded clause is processed when the matrix clause association (encountered earlier than the association from the embedded clause) also provides a [-Ag] role association to the controller NP.
- How a [-Ag] role, associated from the embedded clause event, is processed when that

associated with the matrix clause is [-Ag] and therefore also how a [-Ag] role associated from the embedded clause event is processed when that associated with the matrix clause is identical.

- When compared to a counterpart where the same sentence has its embedded clause shifted to a sentence end position, whether and how the resulting sequence of roles and the very verb (matrix & embedded) may influence the processing when the matrix clause has [-Ag] and embedded clause has [-Ag] role for the controller NP.
    - Also therefore, it can be tested whether a [-Ag] role from the embedded clause can bias the processing of any role from the matrix clause when the verb of the embedded clause is encountered before the matrix verb in object control, compared to when the embedded clause gives a [+Ag].
    - Whether a [-Ag] role from the matrix clause can bias the processing of any role from the embedded clause when the verb of the matrix clause is encountered before the embedded verb, in a sentence having a shifted embedded clause in object control.
- Whether there is any significant difference in the total reading time of the complete sentence in the minimal pair, when the sequence is [-Ag][-Ag] as compared to any other type of sequence pair in object control.
- Whether there is any significant difference in the total reading time of the complete sentence in the minimal pair including another comparable sentence, when the sequence in a shifted sentence is compared to any other type of sequence pair.
- How [-Ag][-Ag] role sequence is processed when the controller is a subject NP, compared to when it is a subject NP.

This template has been used to create appropriate sentence pairs comparing processing of [+Ag] initial role sequence, [+Ag] final role sequence, shifted control clause with [-Ag][-Ag] role sequence comparing difference between embedded role and matrix role influencing the other, [-Ag] initial sequence in subject control, [+Ag] role from embedded clause and [+Ag] role from matrix clause.

Other than the above minimal pair type templates discussed within each control type, selected sentence templates have also been considered for comparing subject control and object control differences, by keeping other factors [+/-Ag] associations constant for the controller

NP. The basic design of the experiment set is discussed as follows.

4.3. Experiment 4:

Potential Agent/NP→Predicate link complexity/numerosity Hypothesis Vs effect of [+/– AG] Role Variation patterns of NP in NP → Predicate Association in control situations.

Factors = 3

(Control_Type + Controller_ NP θ + PRO_θ)

Sentence Types = 2x2x2=8

(Control Type=2, Controller NP θ=2, PRO θ=2)

4.3.1 *Factors*:

1. Subject Control
   - (a) [+AG]Controller NP
     - i. [+AG]PRO
     - ii. [–AG]PRO
   - (b) [–AG]Controller NP
     - i. [+AG]PRO
     - ii. [–AG]PRO
2. Object Control
   - (a) [+AG]Controller NP
     - i. [+AG]PRO
     - ii. [–AG]PRO
   - (b) [–AG]Controller NP
     - i. [+AG]PRO
     - ii. [–AG]PRO

Following are all the possible 28 comparison pairs can be extracted from the above factors

4.3.2 Comparison Pairs and Minimal Pairs(MP)

1. (1.a.i) (1.a.ii) MP
2. (1.a.i) (1.b.i) MP
3. (1.a.i) (1.b.ii)
4. (1.a.i) (2.a.i) MP
5. (1.a.i) (2.a.ii)
6. (1.a.i) (2.b.i)
7. (1.a.i) (2.b.ii)
8. (1.a.ii) (1.b.i)
9. (1.a.ii) (1.b.ii) MP
10. (1.a.ii) (2.a.i)
11. (1.a.ii) (2.a.ii) MP
12. (1.a.ii) (2.b.i)
13. (1.a.ii) (2.b.ii)
14. (1.b.i) (2.a.i)
15. (1.b.i) (1.b.ii) MP
16. (1.b.i) (2.a.ii)
17. (1.b.i) (2.b.i) MP
18. (1.b.i) (2.b.ii)
19. (1.b.ii) (2.a.i)
20. (1.b.ii) (2.a.ii)
21. (1.b.ii) (2.b.i)
22. (1.b.ii) (2.b.ii) MP
23. (2.a.i) (2.a.ii) MP
24. (2.a.i) (2.b.i) MP
25. (2.a.i) (2.b.ii)
26. (2.a.ii) (2.b.i)
27. (2.a.ii) (2.b.ii) MP
28. (2.b.i) (2.b.ii) MP

Out of the above pairs, 12 proper minimal pairs can be identified for the following major types of comparison.

- Subject Control Pairs: (1), (2), (9) & (15)
- Object Control Pairs: (23), (24), (27) & (28)
- Subj Control Vs Obj Control Pairs: (4), (11), (17) & (22)

4.3.3 Test Plan:

Major sentence Features according to [+/-Ag] sequence.

1. [+AG][+AG]
2. [+AG][–AG]
3. [–AG][–AG]
4. [–AG][+AG]

The following minimal pairs, (a) to (d) feature wise minimal pairs can be represented in a cycle as follows:

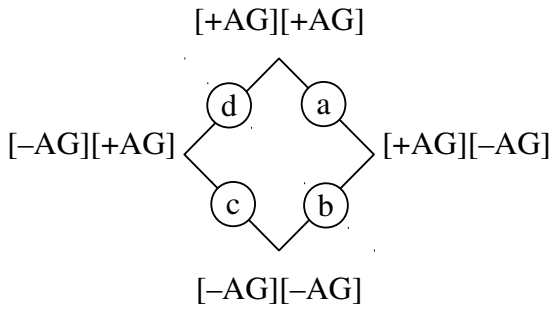

Figure 2

Therefore the feature wise minimal pairs are.

a) [+AG][+AG] ~ [+AG][–AG]
b) [+AG][–AG] ~ [–AG][–AG]
c) [–AG][+AG] ~ [–AG][–AG]
d) [+AG][+AG] ~ [–AG][+AG]

The self-paced reading experiment has a requirement of arranging the required minimal pairs using these four minimal pairs such that various sub-experiments can also be designed within the total experiment set to make the comparison of the effects of *Link Association Increment* and *Semantic Role Sequence* as balanced as possible. Therefore inclusion of all the issues need a framing of twelve minimal pairs that can test all the issues listed previously. Each pair has an instance of shifted control clause within the set which will be compared with its default order counterpart as well as its similarly configured, [+/-Ag] role sequence counterpart. As discussed earlier, certain plausibility constraints in Bangla do not allow control clauses when the controller is made an object and is given [+Ag] role. Therefore, sentences requiring such a property in the role sequence pattern has been kept aside and only 7 minimal pairs containing proper control clause has been used. The extraction of RT have been taken from the mentioned verbs in the complex predicates (from both embedded as well as matrix clause event) as well as the word immediately preceding it (so as to see if any related information in the previous word is already processed significantly conforming to the expected effects, in-case any strong effect is not found in the second word of the complex

predicate).

4.3.3.1 *Subject* Control:

1. MP (a)

   Pair (1) = (1.a.i) (1.a.ii)

   This minimal pair has been designed to test a variation of role in PRO and therefore the role type association from embedded clause, keeping the role from the matrix clause constant.

   (a) **[Subj-Control:CNP$^{[+AG]}$:PRO$^{[+AG]}$]**

   This property has been tested for the default word order and also for shifted control clause.

   Default Word Order:

   The default word order in a complex sentence in Bangla has the embedded clause posited before the matrix verb. This configuration has the following properties pertaining to roles given to the controller NP.

   - Hierarchical role sequence: {[+Ag], [+Ag]}
   - Real time role association sequence: {[+Ag], [+Ag]}
   - Matrix clause role: [+Ag]
   - Embedded clause role: [+Ag]

   I.

   Ram$^{[+AG]}$ [**PRO**$^{[+AG]}$ shokal-shokal Shyam-er bari gi-ye (Shyam-ke) gaali di-te] raji ho-lo

   Ram [PRO morning-morning Shyam-gen house go-ppl (Shyam-Dat/Acc) scolding give-inf] agree be-pst

   Ram agreed to go to Shyam's house early morning and give a scolding.

   Shifted Control Clause:

   - Hierarchical role sequence: {[+Ag], [+Ag]}
   - Real time role association sequence: {[+Ag], [+Ag]}
   - Matrix clause role: [+Ag]
   - Embedded clause role: [+Ag]

II.

Ram$^{[+\,AG]}$ shokal-shokal Shyam-er bari gi-ye (Shyam-ke) raji ho-lo [**PRO**$^{[+\,AG]}$ gaali di-te]

Ram morning-morning Shyam-gen house go-ppl (Shyam-Dat/Acc) agree be-pst [PRO scolding give-inf]

Ram agreed to go to Shyam's house early morning and give a scolding.

(b) **[Subj-Control:CNP$^{[+AG]}$:PRO$^{[-AG]}$]**

Default Word Order:

- Hierarchical role sequence: {[+Ag], [-Ag]}
- Real time role association sequence: {[-Ag], [+Ag]}
- Matrix clause role: [+Ag]
- Embedded clause role: [-Ag]

III.

Ram$^{[+\,AG]}$ shokal-shokal Shyam-er bari gi-ye [**PRO**$^{[-\,AG]}$ gaali k^{h}e-te] raji ho-lo

Ram morning-morning Shyam-gen house go-ppl [PRO scolding eat-inf] agree be-pst

Ram agreed to go to Shyam's house early morning and get a scolding/ get scolded.

Shifted Control Clause:

- Hierarchical role sequence: {[+Ag], [-Ag]}
- Real time role association sequence: {[-Ag], [+Ag]}
- Matrix clause role: [+Ag]
- Embedded clause role: [-Ag]

IV.

Ram$^{[+\,AG]}$ shokal-shokal Shyam-er bari gi-ye raji ho-lo [**PRO**$^{[-\,AG]}$ gaali k^{h}e-te]

Ram [PRO morning-morning Shyam-gen house go-ppl (Shyam-Dat/Acc) agree be-pst scolding eat-inf]

Ram agreed to go to Shyam's house early morning and get a scolding/ get scolded.

Hypothesis:

If the factor of Link Association Increment holds solely for previously observed processing

complexity differences then any significant difference will not show up within subject control at the extraction points for I, II, III and IV. Else if the distribution of the pattern of [+/- Ag] roles mapped onto the controller NP (CNP) is a crucial explanatory factor, then the relevant extraction points should show some significant behavioral differences by indicating it (as discussed in the predictions below) within the subject control sentence. However if the interaction of both link association complexity and [+/-Ag] pattern are taking place in the processor, then some behavioral correlates of both the explanatory factors should show up in some complex manner. The following are the predictions in detail. There are two major extraction points, one where the embedded clause disambiguates for [+/-Ag] role association with the controller NP and the other where the matrix clause disambiguates for [+/-Ag] role for that NP.

Predictions:

Predictions on outputs from processing load extraction points have been listed as follows:

Extraction point 1

Embedded Verb "di-te" and the Vs "k^he-te" and its previous word:

***Hierarchically lower role preferences*:**

In both default as well as shifted control clause sentences, if "*di-te*" in (I) shows up to have significantly lesser latency compared to "k^h*e-te*" in (II) then the preferred embedded role will be inferred to be [+Ag]. If the difference between the two embedded verbs is not significant then the processing will be considered to be independent of [+/-Ag] role differences when the controller is a subject and the word order is default.

***Real time initial role preferences*:**

If there is any default initial role preference in real time, then the first verb "*di-te*" in (I) and "ho-lo" (II) and (IV) should not show any significant difference from each other. But these verbs should show either equally lesser latency than "k^h*e-te*" in (III), indicating a [+Ag] first preference or equally more latency than "k^h*e-te*" to indicate a [-Ag] first preference. If however there is no significant difference observed in the comparisons here then the processing will be considered to be independent of the initial role encountered by the

processor at least in case of subject control. However, if all possible minimal pairs show an increased latency in case of all the initially occurring verbs in default order in subject controlled clauses when compared with the matrix verb occurring initially in shifted control clause sentences, then the difference in other types of information load before the embedded verb (as is available in the default order only), shall be considered the causal factor. But if this verb is found to be processed faster than the matrix verb in all such subject control cases, then it could provide a hint that when a control verb is encountered before a control clause, the processor detects it instantly and having found this unusual, has also engaged in a search for the shifted clause instantly. Therefore it could be the process of this detection and search initiation (Clifton & Frazier, 1989) that may be constantly causing the extra delay compared to when it is encountered after the embedded verb and no such phenomenon is possible.

***Embedded role association preferences*:**

If there is any preference for a role association from the embedded clause, then the latency of "*di-te*" in (I) should not significantly vary from that in (II) and the latency of "*k^he-te*" in (III) should not significantly vary from that in (IV). But both (I) and (II) should be different from (III) and (IV). In that case, if a [+Ag] role is preferred for the embedded clause then "*di-te*" shall show up lesser latency than "*k^he-te*", whereas if a [-Ag] role is preferred then "*k^he-te*" shall show up lesser latency than "*di-te*". However if there is no significant difference between latency observed at the matrix verb and the embedded verb at any level, then the processing will be inferred to be independent of the role from embedded event (at least in subject control cases for the shifted clause cases).

***Effect of Shifted Clause at last verb*:**

The shifted control clause can provide information about whether an embedded role revealed at the sentence end, may be biased by the previously projected role from the matrix verb which occurs before the shifted clause as compared to the bias upon the role expectation at the sentence end matrix verb caused by the embedded verb occurring earlier in a non shifted default position. According to such an expectation, if there is no such effect, sentence (I) and (II) should not show any difference at "*di-te*" and sentence (III) and (IV) should not show up any difference at "*k^he-te*" whereas if there is any bias caused, "*di-te*" in (I) should have a different latency than that in (II) and "*k^he-te*" in (III) should show up a latency

difference with "*k*^{h}*e-te*" in (IV).

***Inferences on Hierarchical and real-time role bias and their possible interaction*:**

As discussed previously, real-time role bias may be revealed if the last verb appears to behave according to the role that the processor has encountered previously. Hierarchically the roles are independent of the real time role sequence. It needs to be observed whether an interaction between hierarchical and real-time role may exist and whether a match of the sequences can inherently affect the processing at any of the extraction points in subject control.

Extraction point 2:

***Matrix Verb "ho-lo"*:**

***Hierarchically higher role preferences*:**

In both default as well as shifted control clause sentences, "*ho-lo*" should not show up to have significantly different latencies at (I), (II), (III) & (IV) as the roles are identical in all of them. This set does not allow testing of processing difference in matrix clause but sentence (4.III) and (4.IV) does. If any difference shows up in any of them, the causes shall be inferred to be other than any hierarchical factors.

***Real time final role preferences*:**

If there is any default final role preference in real time, then the last verb "*ho-lo*" in (I) and (III) and "*di-te*" in (II) should not show any significant difference from each other but should equally show either a lesser latency than "*k*^{h}*e-te*" in (IV) to indicate a [+Ag] final preference or equally more latency than it to indicate a [-Ag] final preference. If however there is no significant difference observed in the comparisons here then the processing will be considered to be independent of the final role encountered by the processor at least in case of subject control. However, if all possible minimal pairs show an increased latency in case of all the finally occurring verbs in default order in subject controlled clauses when compared with the matrix verb occurring initially in shifted control clause sentences, then the difference in other types of information load before the final verb (as is available in the default order only), shall be considered the causal factor. But if this verb is found to be processed faster than the embedded verb in all such subject control cases, then it could provide a hint that

when a control verb is encountered after a control clause, the processor is expecting it after it has encountered the embedded verb, and integrates whatever information is available in the matrix verb. It may also be inferred that after the embedded clause is encountered, there is very little information to integrate between the embedded verb and matrix verb, whereas the chunk of information is bigger before the embedded verb.

***Matrix role association preferences*:**

In this minimal pair, there is no difference between the role associations from the matrix clause and therefore matrix role associations cannot be tested at this point in the experiment. Minimal pairs (2) and (4) however do involve such a comparable variation at the position of the subject of the matrix clause. However, if there is any preference for role association from matrix clause, then the latencies at that verb should not vary at all in (I), (II), (III) and (IV) irrespective of their final or non-final position in the manipulation.

***Effect of Shifted Clause at matrix verb*:**

The shifted control clause can also provide information about whether a matrix clause revealed before the embedded clause, may be processed differently than it is, at the end of the verb. It is significant to check whether a matrix role association (here [+Ag] in all cases) will be processed faster or slower than if it it at the end of the sentence, after the embedded clause has been processed.

***Inferences on Hierarchical and real-time role bias and their possible interaction*:**

If there is an internal comprehension of default structural hierarchy where the nodes of the verbs originate, and the processor is also capable of comparing whether the roles are encountered in a sequence parallel to the role hierarchy, then (III), where there is an in-congruency between structural and real-time role association sequence, show up some behavioral discrepancy detectable at the matrix verb as well. Hierarchically the roles are independent of the real time role sequence. It needs to be observed whether an interaction between hierarchical and real-time role may exist and whether a match of the sequences can inherently affect the processing at any of the extraction points in subject control.

Method:

A self-paced reading experiment, using a moving window paradigm, was conducted in a controlled environment. LINGER experiment software was used for conducting the experiment. The beginning of the experiment consisted of general questions regarding required personal details and also regarding formal reading and writing exposure to Bangla was asked, and they were to enter these details using the keyboard.

Then they were given an introduction to what they should expect in the experiment. They had to press a key to see the next page, instruction, commands and so on. Then they were provided a practice session where they were introduced to self-paced moving window paradigm. This paradigm used the technique of displaying a masked sentence visible on the screen and each word is revealed step by step with its relevant position on the sentence area with each press of "F" key on the keyboard. The subjects were instructed to press "F" immediately after finishing the sentence and then they would be shown a comprehension question. Within the practice session they were also introduced to each type of post-reading comprehension task. After that the experiment would begin.

***Participants*:**

Forty native speakers of Bangla, who were well exposed to formal reading and writing skills in Bangla were chosen for participating in this experiment. These subjects were chosen from University of Hyderabad and their age ranged from 21 to 30 yrs. They were highly proficient in Bangla and were formally exposed to reading and writing the language for at least seven to eight years.

***Results and Analysis*:**

Independent variables and dependent variables relevant to the available factors in this experiment have been collected and analyzed for significance of effects. The following are the effects that have been found.

Analysis 1.

Effect of initially encountered role emerging from embedded verb upon matrix verb:

This confirms whether any effect of initially encountered role emerging from the embedded verb is significant upon the processing of the sentence end matrix verb (having a +AG emerging out of it). This effect can check whether a [-AG → +AG] or [+AG → +AG] sequence may be preferred once the initial *embedded* role is encountered in an embedded clause.

1.a Effect on 2nd verb ["ho-lo" (*be-pst*) type] of Matrix Complex Predicate.

Roles		Affected RT		Significance	
Role @ EV	Role @ MV	Mean RT @ MV_2		**t value**	**F.value**
+ AG	+ AG	1000.0	174	t value= -2.209	F.value= 4.8808
– AG	+ AG	1174.0	msec	Pr(>|t|)= 0.0278 *	Pr(>F)= 0.02778 *

Table 6

1.b Effect on 1st verb type ["raji" (*agree*) type] of Matrix Complex Predicate.

Roles		Affected RT		Significance	
Role @ EV	Role @ MV	Mean RT @ MV_1		**t value**	**F.value**
+ AG	+ AG	681.5	94.9	t value= -2.547	F.value= 6.4849
– AG	+ AG	776.4	msec	Pr(>|t|)= 0.0113 *	Pr(>F)= 0.0113 *

Table 7

Inferences:

[+AG → +AG] seems to be a significantly preferred sequence here (t value > 2, Pr(>|t|) < 0.05). It is also indicated here that probably a role match might be a prediction once a type of role is encountered from the embedded event. Also an initial encounter of [-AG] role from an embedded clause may be understood to be able to significantly bias against a [+AG] role from a sentence end matrix event.

Analysis 2.

***Effect of initially encountered role upon the ending verb* (*irrespective of whether the initial verb is matrix or embedded*).**

This confirms whether any role emerging from an initially encountered event can influence the processing of the role emerging from another event that follows it and is associated with the same NP that has associated with the previous role. In this experiment, this study can tell us whether a final [+AG] role is discrepant or not according to a previously varying role from the earlier encountered event (having roles varying for [+AG] and [–AG]) independent of whether any of those roles have emerged from a structurally higher or lower node.

2.a Effect on 2nd verb of the last Matrix Complex Predicate

Effect on 2nd verb of the last predicate was not significant (Pr(>|t|) > 0.05, t value < 2).

2.b Effect on 1st verb of the last Matrix Complex Predicate

Roles		Affected RT		Significance	
Initial Role	Final Role	Mean RT @ MV_1		**t value**	**F.value**
+ AG	+ AG	650.9	125	t value= -3.229	F.value= 10.427
– AG	+ AG	776.4	msec	Pr(>|t|)= 0.00133 **	Pr(>F)= 0.001327 **

Table 8

Inferences:

Again, [+AG → +AG] seems to be an over all preferred role sequence, irrespective of the location of the event from where the role emerges, but this seems to be evident only from the first verb of the complex predicate, similar to *Analysis 1*.

Analysis 3.

Test for a preferred role from an initially encountered event* (*independent of the origin of

***the role*).**

This confirms whether or not any particular role is preferred to begin with in a role sequence encountered in an events complex.

Effects on both 1st and 2nd verb did not show any significant effects for the difference of RT at different roles (Pr(>|t|) > 0.05, t value < 2).

Inferences:

Initial role does not seem to have any effect upon the RTs observed at the initial events, which are not sorted for matrix or embedded origin and as such, over all effects of beginning role does not seem to exist.

Analysis 4.

***Test for a preferred role from a finally encountered event* (*independent of the origin of the role*).**

This confirms whether or not any particular role is preferred to end with in a role sequence encountered in an event complex.

Effects on both 1st and 2nd verb did not show any significant effects upon the difference of RT at different roles (Pr(>|t|) > 0.05, t value < 2).

Inferences:

Final role does not seem to have any effect upon the RTs observed at the final events, which are not sorted for matrix or embedded origin and as such, over all effects of ending role does not seem to exist.

Analysis 5.

Test for a preferred role emerging from an embedded event at an initial location.

This confirms whether or not any type of role is preferred to be comprehended as emerging from an initially occurring embedded clause in a non scrambled sentence.

5.a. Effect on 1st verb of the embedded clause

Effector	Affected RT		Significance	
Roles	Mean RT @ EV_1		**t value**	**F.value**
+ AG	591.7	91.3	t value= -2.113	F.value= 4.4629
– AG	683	msec	Pr(>|t|)= 0.0353 *	Pr(>F)= 0.03534 *

Table 9

5.b. Effects on 2nd verb of the embedded clause did not show any significant effect upon the RT (Pr(>|t|) > 0.05, t value < 2).

Inferences:

The preference for an initial embedded role is shown only at the 1st verb of the matrix complex verb and [+AG] seems to be the preferred role. Therefore, it seems that roles emerging from an embedded event in a control clause needs to be able to engage the controller into an active participant status in the initial occurrence.

Analysis 6.

Test for a preferred role emerging from an embedded event at a final location.

This confirms whether or not any type of role is preferred to be comprehended as emerging from an initially occurring embedded clause in a sentence having the embedded clause in its normal position.

Effects on both 1st and 2nd verb of the embedded clause did not show any significant effect upon the RT (Pr(>|t|) > 0.05, t value < 2).

Inferences.

This shows that at the embedded clause in a sentence end position, once the matrix clause role has already been comprehended before it, the role emerging from the embedded clause does not seem to show any particular processing preference. It could also mean that once the matrix clause has been processed, the information at the embedded clause is simply processed after the information regarding the [+/– AG] is finally processed at the embedded verb.

2. MP (b)

   Pair (9) = (1.a.ii) (1.b.ii)

   This minimal pair has been designed to test a variation of role upon the controller NP and therefore the role type association from matrix clause, keeping the role from the embedded event constant.

   (a) **[Subj-Control:CNP$^{[+AG]}$:PRO$^{[-AG]}$]**

   This property has been tested for the default word order and also for shifted control clause.

   Default Word Order:

   The default word order in a complex sentence in Bangla has the embedded clause posited before the matrix verb. This configuration has the following properties pertaining to roles given to the controller NP.

   - Hierarchical role sequence: {[+Ag], [-Ag]}
   - Real time role association sequence: {[-Ag], [+Ag]}
   - Matrix clause role: [+Ag]
   - Embedded clause role: [-Ag]

I.

Ram$^{[+AG]}$ shokal-shokal [**PRO**$^{[-AG]}$ (Shyam-er) gaal/gaali k^{h}e-te] raji ho-lo

Ram morning-morning [Shyam-Gen scolding eat-inf] agree be-pst

Ram agreed to get a scolding (from Shyam) early in the morning.

Shifted Control Clause:

- Hierarchical role sequence: {[+Ag], [-Ag]}
- Real time role association sequence: {[-Ag], [+Ag]}
- Matrix clause role: [+Ag]
- Embedded clause role: [-Ag]

Ram$^{[+AG]}$ shokal-shokal raji ho-lo [**PRO**$^{[-AG]}$ (Shyam-er) gaal/gaali k^{h}e-te]
Ram morning-morning agree be-pst [Shyam-Gen scolding eat-inf]
Ram agreed to get a scolding (from Shyam) early in the morning.

(b) **[Subj-Control:CNP**$^{[-AG]}$**:PRO**$^{[-AG]}$**]**

Default Word Order:

- Hierarchical role sequence: {[-Ag], [-Ag]}
- Real time role association sequence: {[-Ag], [-Ag]}
- Matrix clause role: [-Ag]
- Embedded clause role: [-Ag]

III.

Ram$^{[-AG]}$ shokal-shokal [**PRO**$^{[-AG]}$ (Shyam-er) gaal/gaali k^{h}e-te] badd^{h}o ho-lo
Ram morning-morning [PRO (Shyam-Gen) scolding eat-inf] compel be-pst
Ram had to get a scolding (from Shyam) early morning.

Shifted Control Clause:

- Hierarchical role sequence: {[-Ag], [-Ag]}
- Real time role association sequence: {[-Ag], [-Ag]}
- Matrix clause role: [-Ag]
- Embedded clause role: [-Ag]

IV.

Ram$^{[-AG]}$ shokal-shokal badd^{h}o ho-lo [**PRO**$^{[-AG]}$ (Shyam-er) gaal/gaali k^{h}e-te]
Ram morning-morning compel be-pst [PRO (Shyam-Gen) scolding eat-inf]
Ram had to get a scolding (from Shyam) early morning.

Hypothesis:

If the factor of Link Association Increment holds solely for earlier observed processing complexity differences, then any significant difference will not show up within subject control at the extraction points for I, II, III and IV. Else if the distribution of the pattern of [+/- Ag] roles mapped onto the controller NP (CNP) is a crucial explanatory factor, then the relevant extraction points should show some significant behavioral differences by indicating it (as discussed in the predictions below) within the subject control sentence. However if the interaction of both link association complexity and [+/-Ag] pattern are taking place in the processor, then some behavioral correlates of both the explanatory factors should show up in some complex manner. The following are the predictions in detail. There are two major extraction points, one where the embedded clause disambiguates for [+/-Ag] role association with the controller NP and the other where the matrix clause disambiguates for [+/-Ag] role for that NP.

Predictions:

Predictions on outputs from processing load extraction points have been listed as follows:

Extraction point 1

Embedded Verb "k^he-te":

***Hierarchically lower role preferences*:**

If there are any hierarchically lower role preferences, then there should not be any differences between "*k^he-te*" in (I), (II), (III) and (IV). If there is any difference in processing latency observed in any of the sentences, then it must be due to other factors or even interaction of other factors with the hierarchically lower role preference, which will need to be studied in detail through complex analysis of interaction.

***Real time initial role preferences*:**

If there is any default initial role preference in real time, then the first verb "*k^he-te*" in (I), (II), (III) and (IV) should not show any significant difference of processing latency from each other. But these verbs should show either equally lesser latency than "*ho-lo*" in (II), indicating a [-Ag] first preference or equally more latency than "*ho-lo*" to indicate a [+Ag]

first preference. If however there is no significant difference observed in the comparisons here then the processing will be considered to be independent of the initial role encountered by the processor at least in case of subject control. However, if all possible minimal pairs show an increased latency in case of all the initially occurring verbs in default order in subject controlled clauses when compared with the matrix verb occurring initially in shifted control clause sentences, then the difference in other types of information load before the embedded verb (as is available in the default order only), shall be considered the causal factor. But if this verb is found to be processed faster than the matrix verb in all such subject control cases, then it could provide a hint that when a control verb is encountered before a control clause, the processor detects it instantly and having found this unusual, has also engaged in a search for the shifted clause instantly. Therefore it could be the process of this detection and search initiation that may be constantly causing the extra delay compared to when it is encountered after the embedded verb and no such phenomenon is possible.

***Embedded role association preferences*:**

If there is any preference for a role association from the embedded clause, then the latency of "*k*^{h}*e-te*" in (I) should not significantly vary from that in (II), (III) and (IV). If there is any difference in processing latency observed in any of the sentences, then it must be due to other factors or even interaction of other factors with the embedded role preference, which will need to be studied in detail through complex analysis of interaction.

***Effect of Shifted Clause at last verb*:**

The shifted control clause can provide information about whether an embedded role revealed at the sentence end, may be biased by the previously projected role from the matrix verb which occurs before the shifted clause as compared to the bias upon the role expectation at the sentence end matrix verb caused by the embedded verb occurring earlier in a non shifted default position. According to such an expectation, if there is no such effect, sentence (I) and (II) should not be different in the latency extracted from "*k*^{h}*e-te*" and sentence (III) and (IV) should not be different in the latency extracted from "*k*^{h}*e-te*" whereas if there is any bias caused, "*k*^{h}*e-te*" in (I) should have a different latency than that in (II) but "*k*^{h}*e-te*" in (III) should not show up a latency difference with "*k*^{h}*e-te*" in (IV).

***Inferences on Hierarchical and real-time role bias and their possible interaction*:**

As discussed previously, real-time role bias may be revealed if the last verb appears to behave according to the role that the processor has encountered previously. Hierarchically the roles are independent of the real time role sequence. It needs to be observed whether an interaction between hierarchical and real-time role may exist and whether a match of the sequences can inherently affect the processing at any of the extraction points in subject control.

Extraction point 2:

***Matrix Verb*:**

***Hierarchically higher role preferences*:**

In both default as well as shifted control clause sentences, if any hierarchical role doesn't hold as an explanatory factor, then "*ho-lo*" should not show up to have significantly different latencies at (I), (II), (III) & (IV) in subject control. However, if [+Ag] role is preferred then "*ho-lo*" in (I) and (II) should not have different latency, and "*ho-lo*" in (I) and (II) should both have a significantly lesser latency than "*ho-lo*" in (III) and (IV). Likewise if [-Ag] role is preferred then "*ho-lo*" in (I) and (II) should both have a significantly higher latency than "*ho-lo*" in (III) and (IV).

***Real time final role preferences*:**

If there is any default final role preference in real time, then the last verb "*ho-lo*" in (I) should be processed differently from the last verb "*k^he-te*" in (II) and (IV) and "*ho-lo*" in (III). "*ho-lo*" in (I) should equally show either a lesser latency than the other mentioned extraction sites to indicate a [+Ag] final preference or equally more latency than them to indicate a [-Ag] final preference. If there is no significant difference observed in the comparisons here then the processing will be considered to be independent of the final role encountered by the processor at least in case of subject control. However, if all possible minimal pairs show an increased latency in case of all the finally occurring verbs in default order in subject controlled clauses when compared with the matrix verb occurring initially in shifted control clause sentences, then the difference in other types of information load before the final verb (as is available in the default order only), shall be considered the causal factor. But if this verb is found to be processed faster than the embedded verb in all such subject

control cases, then it could provide a hint that when a control verb is encountered after a control clause, the processor is expecting it after it has encountered the embedded verb, and integrates whatever information is available in the matrix verb. It may also be inferred that after the embedded clause is encountered, there is very little information to integrate between the embedded verb and matrix verb, whereas the chunk of information is bigger before the embedded verb.

***Matrix role association preferences*:**

If a role association preference exists for the matrix event, then a [+Ag] preference can be inferred if "*ho-lo*" in (I) and (II) are not different from each other, and are equally processed faster when compared to "*ho-lo*" in (III) and (IV). A [-Ag] preference can be inferred if "*ho-lo*" in (I) and (II) are equally processed with more latency when compared to "*ho-lo*" in (III) and (IV). However if no such preference exists, then no difference should show up in the subject control case.

***Effect of Shifted Clause at matrix verb*:**

The shifted control clause can also provide information about whether a matrix clause revealed before the embedded clause, may be processed differently than it is, at the end of the verb. It is significant to check whether a matrix role association (here [+Ag] in all cases) will be processed faster or slower than if it it at the end of the sentence, after the embedded clause has been processed.

***Inferences on Hierarchical and real-time role bias and their possible interaction*:**

If there is an internal comprehension of default structural hierarchy where the nodes of the verbs originate, and the processor is also capable of comparing whether the roles are encountered in a sequence parallel to the role hierarchy, then (III), where there is an in-congruency between structural and real-time role association sequence, show up some behavioral discrepancy detectable at the matrix verb as well. Hierarchically the roles are independent of the real time role sequence. It needs to be observed whether an interaction between hierarchical and real-time role may exist and whether a match of the sequences can inherently affect the processing at any of the extraction points in subject control.

Method:

A self-paced reading experiment, using a moving window paradigm, was conducted in a controlled environment. LINGER experiment software was used for conducting the experiment. The beginning of the experiment consisted of general questions regarding required personal details and also regarding formal reading and writing exposure to Bangla was asked, and they were to enter these details using the keyboard.

Then they were given an introduction to what they should expect in the experiment. They had to press a key to see the next page, instruction, commands and so on. Then they were provided a practice session where they were introduced to self-paced moving window paradigm. This paradigm used the technique of displaying a masked sentence visible on the screen and each word is revealed step by step with its relevant position on the sentence area with each press of "F" key on the keyboard. The subjects were instructed to press "F" immediately after finishing the sentence and then they would be shown a comprehension question. Within the practice session they were also introduced to each type of post-reading comprehension task. After that the experiment would begin.

***Participants*:**

Forty native speakers of Bangla, who were well exposed to formal reading and writing skills in Bangla were chosen for participating in this experiment. These subjects were chosen from University of Hyderabad and their age ranged from 21 to 30 yrs. They were highly proficient in Bangla and were formally exposed to reading and writing the language for at least seven to eight years.

Results and Analysis:

Independent variables and dependent variables relevant to the available factors in this experiment have been collected and analyzed for significance of effects. The following are the effects that have been found.

Analysis 7.

Effect of initially encountered roles as emerging from the matrix clause upon the role emerging from the embedded clause as encountered after them.

This tests whether any role sequence preference may be existing when matrix clause is encountered previous to the embedded clause in a sentence having shifted embedded clause.

7.a. **Effect of matrix role upon 2nd embedded predicate verb.**

Roles		Affected RT		Significance	
Mat Role	Emb Role	Mean RT @ EV_2		**t value**	**F.value**
+ AG	– AG	1258	85	t value= -2.115 *	F.value= 4.4733
– AG	– AG	1343	msec	Pr(>|t|)= 0.0351 *	Pr(>F)= 0.03512 *

Table 5

7.b. **Effect of matrix role upon 1st embedded predicate verb.**

The RT at first embedded predicate verb did not show any significant effect under the influence of the variation of matrix roles (Pr(>|t|) > 0.05, t value < 2).

Inferences:

As of now, it seems that what ever be the final role, if the initial role is [+AG] then the ending event is processed faster than if it were [–AG]. Therefore it is evident till now that the [+AG] role in the beginning is not able to bias against a different role after it.

Analysis 8.

Effect of initially encountered role upon finally encountered role.

This tests whether any role sequence is preferred irrespective of the origin of the role from a particular embedded or matrix location.

RTs at the ending event for both 1st as well as 2nd verb did not show any significant difference as a result of the variation of role types emerging from the initially encountered events (Pr(>|t|) > 0.05, t value < 2).

Inferences:

Compared to [+/–AG] sequence in minimal pair (a) (tested for sentences ending with a [+AG] role), analysis 8 shows that sequences ending in [–AG] do not show a significant effect when the preceding role type is changed.

Analysis 9.

***Test for a preferred role from an initially encountered event* (*independent of the origin of the role*).**

The findings were similar to *analysis 3* and no significant effects were found.

Analysis 10.

***Test for a preferred role from a finally encountered event* (*independent of the origin of the role*).**

Significant effects of the role type were found on the 2nd word of the complex predicate and not on the first word.

Effector	Affected RT		Significance	
Final Roles	Mean RT @ W_4		**t value**	**F.value**
+ AG	1006	304	t value= -3.199	F.value= 10.232
– AG	1310	msec	Pr(>|t|)= 0.00144 **	Pr(>F)= 0.001438 **

Table 6

Analysis:

This suggests that if there are effects of role types upon a particular event, then [+AG] seems to be the preferred role at the end of the role association sequence.

Analysis 11.

Test for a preferred role from an initially encountered matrix event.

This tests for any effects of role type as encountered to be associated from any matrix event that may be located initially in the sequence of mentioned events. Such a situation is available in sentences having the embedded clause shifted to a sentence end position.

Significant effects were not shown at any of the initially occurring matrix verbs in this minimal pair set.

Analysis 12.

Test for a preferred role from a matrix event encountered at a sentence end position.

Significant effects were found at the 2nd word (only) of the matrix predicate sentence end position.

Effector	Affected RT		Significance	
Final Roles	Mean RT @ MV_2		**t value**	**F.value**
+ AG	1006	321	t value= -3.037	F.value= 9.2246
– AG	1327	msec	Pr(>|t|)= 0.00256 **	Pr(>F)= 0.002561 **

Table 7

Analysis:

Here too it seems that for an ending event, here matrix clause, the preferred role type remains of the type [+AG].

3. MP (c)

Pair (15) = (1.b.i) (1.b.ii)

This minimal pair has been designed to test a variation of role upon the embedded PRO and therefore the role type association from embedded clause, keeping the role from the matrix event constant.

(a) **[Subj-Control:CNP$^{[-AG]}$:PRO$^{[+AG]}$]**

This property has been tested for the default word order and also for shifted control clause.

Default Word Order:

The default word order in a complex sentence in Bangla has the embedded clause posited before the matrix verb. This configuration has the following properties pertaining to roles given to the controller NP.

- Hierarchical role sequence: {[-Ag], [+Ag]}
- Real time role association sequence: {[+Ag], [-Ag]}
- Matrix clause role: [-Ag]
- Embedded clause role: [+Ag]

I.

Robi$^{[-AG]}$ (Amit-er bari gi-ye) [**PRO**$^{[+AG]}$ *gaal-a-gal kor-te*] baddho ho-lo

Robi (Amit-Gen) house go-pst [PRO scolding do-inf] compel be-pst

Robi was compelled to go to Amit's house and scold him(/s^{one})

Shifted Control Clause:

- Hierarchical role sequence: {[-Ag], [+Ag]}
- Real time role association sequence: {[+Ag], [-Ag]}
- Matrix clause role: [-Ag]
- Embedded clause role: [+Ag]

II.

Robi$^{[-\,AG]}$ (Amit-er bari gi-ye) baddho ho-lo [**PRO**$^{[+\,AG]}$ *gaal-a-gal kor-te*]

Robi (Amit-Gen) house go-pst compel be-pst [PRO scolding do-inf]

Robi was compelled to go to Amit's house and scold him(/s^{one})

(b) **[Subj-Control:CNP**$^{[-AG]}$**:PRO**$^{[-AG]}$**]**

Default Word Order:

- Hierarchical role sequence: {[-Ag], [-Ag]}
- Real time role association sequence: {[-Ag], [-Ag]}
- Matrix clause role: [-Ag]
- Embedded clause role: [-Ag]

III.

Robi$^{[-\,AG]}$ (Amit-er bari gi-ye) [**PRO**$^{[-\,AG]}$ *gaal-a-gal k^{h}e-te*] baddho ho-lo

Robi (Amit-Gen) house go-pst [PRO scolding eat-inf] compel be-pst

Robi had to get a scolding at Amit's house.

Shifted Control Clause:

- Hierarchical role sequence: {[-Ag], [-Ag]}
- Real time role association sequence: {[-Ag], [-Ag]}
- Matrix clause role: [-Ag]
- Embedded clause role: [-Ag]

IV

Robi$^{[-\,AG]}$ (Amit-er bari gi-ye) baddho ho-lo [**PRO**$^{[-\,AG]}$ *gaal-a-gal k^{h}e-te*]

Robi (Amit-Gen) house go-pst compel be-pst [PRO scolding eat-inf]

Robi had to get a scolding at Amit's house.

Hypothesis:

If the factor of Link Association Increment holds solely for earlier observed processing complexity differences then any significant difference will not show up within subject control at the extraction points for I, II, III and IV. Else if the distribution of the pattern of [+/- Ag]

roles mapped onto the controller NP (CNP) is a crucial explanatory factor, then the relevant extraction points should show some significant behavioral differences by indicating it (as discussed in the predictions below) within the subject control sentence. However if the interaction of both link association complexity and [+/-Ag] pattern are taking place in the processor, then some behavioral correlates of both the explanatory factors should show up in some complex manner. The following are the predictions in detail. There are two major extraction points, one where the embedded clause disambiguates for [+/-Ag] role association with the controller NP and the other where the matrix clause disambiguates for [+/-Ag] role for that NP.

Predictions:

Predictions on outputs from processing load extraction points have been listed as follows:

Extraction point 1

Embedded Verb "*k^{h}e-te*" Vs "*kor-te*":

***Hierarchically lower role preferences*:**

In both default as well as shifted control clause sentences, if "*kor-te*" in (I) and (II) shows up to have significantly lesser latency compared to "*k^{h}e-te*" in (II) and (III) then the preferred embedded role will be inferred to be [+Ag]. If the difference between the two embedded verbs is not significant then the processing will be considered to be independent of [+/-Ag] role differences when the controller is a subject and the word order is default.

***Real time initial role preferences*:**

If there is any default initial role preference in real time, then the first verb "*ho-lo*" in (II) and (IV) as well as "*k^{h}e-te*" in (III) should not show any significant difference from each other. But these verbs should show either equally lesser latency than "*kor-te*" in (I), indicating a [-Ag] first preference or equally more latency than "*k^{h}e-te*" to indicate a [+Ag] first preference. If however there is no significant difference observed in the comparisons here then the processing will be considered to be independent of the initial role encountered by the processor at least in case of subject control. However, if all possible minimal pairs

show an increased latency in case of all the initially occurring verbs in default order in subject controlled clauses when compared with the matrix verb occurring initially in shifted control clause sentences, then the difference in other types of information load before the embedded verb (as is available in the default order only), shall be considered the causal factor. But if this verb is found to be processed faster than the matrix verb in all such subject control cases, then it could provide a hint that when a control verb is encountered before a control clause, the processor detects it instantly and having found this unusual, has also engaged in a search for the shifted clause instantly. Therefore it could be the process of this detection and search initiation that may be constantly causing the extra delay compared to when it is encountered after the embedded verb and no such phenomenon is possible.

***Embedded role association preferences*:**

If there is any preference for a role association from the embedded clause, then the latency of "*kor-te*" in (I) should not significantly vary from that in (II) and the latency of "*k*^{h}*e-te*" in (III) should not significantly vary from that in (IV). But both (I) and (II) should be different from (III) and (IV). In that case, if a [+Ag] role is preferred for the embedded clause then "*kor-te*" shall show up lesser latency than "*k*^{h}*e-te*", whereas if a [-Ag] role is preferred then "*k*^{h}*e-te*" shall show up lesser latency than "*kor-te*". However if there is no significant difference between latency observed at the matrix verb and the embedded verb at any level, then the processing will be inferred to be independent of the role from embedded event (at least in subject control cases for the shifted clause cases).

***Effect of Shifted Clause at last verb*:**

The shifted control clause can provide information about whether an embedded role revealed at the sentence end, may be biased by the previously projected role from the matrix verb which occurs before the shifted clause as compared to the bias upon the role expectation at the sentence end matrix verb caused by the embedded verb occurring earlier in a non shifted default position. According to such an expectation, if there is no such effect, sentence (I) and (II) should not show any difference at "*kor-te*" whereas if there is any bias caused, "*kor-te*" in (I) should have a different latency than that in (II). "*k*^{h}*e-te*" cannot be compared in this context as the sentence containing it has the matrix originating role as similar.

***Inferences on Hierarchical and real-time role bias and their possible interaction*:**

As discussed previously, real-time role bias may be revealed if the last verb appears to behave according to the role that the processor has encountered previously. Hierarchically the roles are independent of the real time role sequence. It needs to be observed whether an interaction between hierarchical and real-time role may exist and whether a match of the sequences can inherently affect the processing at any of the extraction points in subject control.

Extraction point 2:

***Matrix Verb "ho-lo"*:**

***Hierarchically higher role preferences*:**

In both default as well as shifted control clause sentences, "*ho-lo*" should not show up to have significantly different latencies at (I), (II), (III) & (IV) as the roles are identical in all of them. This set does not allow testing of processing difference in matrix clause but sentence (4.III) and (4.IV) does. If any difference shows up in any of them, the causes shall be inferred to be other than any hierarchical factors.

***Real time final role preferences*:**

If there is any default final role preference in real time, then the last verb "*ho-lo*" in (I) and (III) and "*kor-te*" in (II) should not show any significant difference from each other but should equally show either a lesser latency than "*k*^{h}*e-te*" in (IV) to indicate a [+Ag] final preference or equally more latency than it to indicate a [-Ag] final preference. If however there is no significant difference observed in the comparisons here then the processing will be considered to be independent of the final role encountered by the processor at least in case of subject control. However, if all possible minimal pairs show an increased latency in case of all the finally occurring verbs in default order in subject controlled clauses when compared with the matrix verb occurring initially in shifted control clause sentences, then the difference in other types of information load before the final verb (as is available in the default order only), shall be considered the causal factor. But if this verb is found to be processed faster than the embedded verb in all such subject control cases, then it could provide a hint that when a control verb is encountered after a control clause, the processor is expecting it after it has encountered the embedded verb, and integrates whatever information is available in the

matrix verb. It may also be inferred that after the embedded clause is encountered, there is very little information to integrate between the embedded verb and matrix verb, where the chunk of information is bigger before the embedded verb.

***Matrix role association preferences*:**

In this minimal pair, there is no difference between the role associations from the matrix clause and therefore matrix role associations cannot be tested at this point in the experiment. Minimal pairs (2) and (4) however do involve such a comparable variation at the position of the subject of the matrix clause. However, if there is any preference for role association from matrix clause, then the latencies at that verb should not vary at all in (I), (II), (III) and (IV) irrespective of their final or non-final position in the manipulation.

***Effect of Shifted Clause at matrix verb*:**

The shifted control clause can also provide information about whether a matrix clause revealed before the embedded clause, may be processed differently than it is, at the end of the verb. It is significant to check whether a matrix role association (here [-Ag] in all cases) will be processed faster or slower than if it it at the end of the sentence, after the embedded clause has been processed.

***Inferences on Hierarchical and real-time role bias and their possible interaction*:**

If there is an internal comprehension of default structural hierarchy where the nodes of the verbs originate, and the processor is also capable of comparing whether the roles are encountered in a sequence parallel to the role hierarchy, then (I), where there is an in-congruency between structural and real-time role association sequence, show up some behavioral discrepancy detectable at the matrix verb as well. Hierarchically the roles are independent of the real time role sequence. It needs to be observed whether an interaction between hierarchical and real-time role may exist and whether a match of the sequences can inherently affect the processing at any of the extraction points in subject control.

Method:

A self-paced reading experiment, using a moving window paradigm, was conducted in a controlled environment. LINGER experiment software was used for conducting the

experiment. The beginning of the experiment consisted of general questions regarding required personal details and also regarding formal reading and writing exposure to Bangla was asked, and they were to enter these details using the keyboard.

Then they were given an introduction to what they should expect in the experiment. They had to press a key to see the next page, instruction, commands and so on. Then they were provided a practice session where they were introduced to self-paced moving window paradigm. This paradigm used the technique of displaying a masked sentence visible on the screen and each word is revealed step by step with its relevant position on the sentence area with each press of "F" key on the keyboard. The subjects were instructed to press "F" immediately after finishing the sentence and then they would be shown a comprehension question. Within the practice session they were also introduced to each type of post-reading comprehension task. After that the experiment would begin.

***Participants*:**

Forty native speakers of Bangla, who were well exposed to formal reading and writing skills in Bangla were chosen for participating in this experiment. These subjects were chosen from University of Hyderabad and their age ranged from 21 to 30 yrs. They were highly proficient in Bangla and were formally exposed to reading and writing the language for at least seven to eight years.

Results and Analysis:

Analysis 13.

Effect of initially encountered role emerging from embedded verb upon the processing of that emerging from matrix verb:

This confirms whether any effect of initially encountered role emerging from the embedded verb is significant upon the processing of the sentence end matrix verb (having a -AG emerging out of it). This effect can check whether a [-AG → -AG] or [+AG → -AG] sequence may be preferred once the initial *embedded* role is encountered in an embedded

clause.

RT at both the words of the complex predicates did not show any significance of effects of the embedded predicate.

Inferences:

This seems to show here that in case of role association sequences, the if the matrix clause ends with a [-AG] there may not be any effect of match or mismatch once a [+AG] or [-AG] role has been processed in the previously occurred embedded clause as an initial role association.

Analysis 14.

***Effect of initially encountered role upon finally encountered role*.**

This tests whether any role sequence is preferred irrespective of the origin of the role from a particular embedded or matrix location when the ending role is [-AG].

Effects were found at the 2nd word only of the sentence end complex predicate.

Roles		Affected RT		Significance	
Initial Role	Final Role	Mean RT @ W_4		**t value**	**F.value**
+ AG	– AG	1160	292	t value= -2.068	F.value= 4.276
– AG	– AG	1452	msec	Pr(>|t|)= 0.0391 *	Pr(>F)= 0.03911 *

Table 8

Inferences:

This again suggests (comparable to findings in analysis 2 where the ending role is [+AG]) that, what ever the ending role, it is preferred that the initial role, encountered, be [+AG]. Therefore the processing correlates at the ending event is simply corresponding to the initial role encountered and not in any manner to the ending role itself.

Analysis 15:

***Test for a preferred role from an initially encountered event* (*independent of the origin of the role*).**

The findings were similar to *analysis 3* and no significant effects were found.

Analysis 16:

***Test for a preferred role from a finally encountered event* (*independent of the origin of the role*).**

Significant effects of the role type were found on the 1st word of the complex predicate and not on the 2nd word.

Effector	Affected RT		Significance	
Final Roles	Mean RT @ W_4		**t value**	**F.value**
+ AG	624	94.8	t value= -2.97	F.value= 8.8182
– AG	719.2	msec	Pr(>|t|)= 0.00308 **	Pr(>F)= 0.003076 **

Table 9

Inference:

Here, [+AG] seems to be most preferred type of role to be comprehended as being associated at the end of the sentence, and therefore the sequence.

Analysis 17:

***Test for a preferred role emerging from an embedded event at an initial location*.**

This confirms whether or not any type of role is preferred to be comprehended as emerging from an initially occurring embedded clause in a non scrambled sentence.

No significant effect was found at the initial embedded event. Therefore nothing can be confirmed about the effect of the initial position upon the processing of initially encountered event role.

Analysis 18:

Test for a preferred role emerging from an embedded event at a final location.

Significant effects of the role type were found on the 2nd word of the complex predicate and not on the 1st word.

Effector	Affected RT		Significance	
Final Roles	Mean RT @ EV_2		**t value**	**F.value**
+ AG	1513	174	t value= -2.219	F.value= 4.924
– AG	1687	msec	Pr(>|t|)= 0.0271 *	Pr(>F)= 0.02711 *

Table 10

Analysis:

This seems to indicate that the processor may have a preference of associating a [+AG] role from the embedded event as well as from the ending location of the sentence.

Discussion:

4. MP (d)

   Pair (2) = (1.a.i) (1.b.i)

   This minimal pair has been designed to test a variation of role upon the matrix NP and therefore the role type association from matrix clause, keeping the role from the embedded event constant.

   (a) **[Subj-Control:CNP[+AG]:PRO[-AG]]**

   This property has been tested for the default word order and also for shifted control clause.

   Default Word Order:

The default word order in a complex sentence in Bangla has the embedded clause posited before the matrix verb. This configuration has the following properties pertaining to roles given to the controller NP.

- Hierarchical role sequence: {[+Ag], [+Ag]}
- Real time role association sequence: {[+Ag], [+Ag]}
- Matrix clause role: [+Ag]
- Embedded clause role: [+Ag]

I.

Ram$^{[+AG]}$ shokal-shokal [**PRO**$^{[+AG]}$ (Shyam-ke) gaal/gaali di-te] raji ho-lo
Ram morning-morning [PRO (Shyam-Gen) scolding give-inf] agree be-pst
Ram agreed to scold Shyam early morning.

Shifted Control Clause:

- Hierarchical role sequence: {[+Ag], [+Ag]}
- Real time role association sequence: {[+Ag], [+Ag]}
- Matrix clause role: [+Ag]
- Embedded clause role: [+Ag]

II.

Ram$^{[+AG]}$ shokal-shokal raji ho-lo [**PRO**$^{[+AG]}$ (Shyam-ke) gaal/gaali di-te]
Ram morning-morning [PRO (Shyam-Gen) scolding give-inf] agree be-pst
Ram agreed to scold Shyam early morning.

(b) **[Subj-Control:CNP**$^{[-AG]}$**:PRO**$^{[+AG]}$**]**

Default Word Order:

- Hierarchical role sequence: {[-Ag], [+Ag]}
- Real time role association sequence: {[+Ag], [-Ag]}
- Matrix clause role: [-Ag]
- Embedded clause role: [+Ag]

III.

Ram$^{[-AG]}$ shokal-shokal [**PRO**$^{[+AG]}$ (Shyam-ke) gaal/gaali di-te] badd^{h}o ho-lo

Ram morning-morning [PRO Shyam-ke scolding give-inf] compel be-pst

Ram was compelled give a scolding (to Shyam) early morning.

Shifted Control Clause:

- Hierarchical role sequence: {[-Ag], [+Ag]}
- Real time role association sequence: {[+Ag], [-Ag]}
- Matrix clause role: [-Ag]
- Embedded clause role: [+Ag]

III

Ram$^{[-AG]}$ shokal-shokal badd^{h}o ho-lo [**PRO**$^{[+AG]}$ (Shyam-ke) gaal/gaali di-te]

Ram morning-morning compel be-pst [PRO Shyam-ke scolding give-inf]

Ram was compelled give a scolding (to Shyam) early morning.

Hypothesis:

If the factor of Link Association Increment holds solely for earlier observed processing complexity differences then any significant difference will not show up within subject control at the extraction points for I, II, III and IV. Else if the distribution of the pattern of [+/- Ag] roles mapped onto the controller NP (CNP) is a crucial explanatory factor, then the relevant extraction points should show some significant behavioral differences by indicating it (as discussed in the predictions below) within the subject control sentence. However if the interaction of both link association complexity and [+/-Ag] pattern are taking place in the processor, then some behavioral correlates of both the explanatory factors should show up in some complex manner. The following are the predictions in detail. There are two major extraction points, one where the embedded clause disambiguates for [+/-Ag] role association with the controller NP and the other where the matrix clause disambiguates for [+/-Ag] role for that NP.

Predictions:

Predictions on outputs from processing load extraction points have been listed as follows:

Extraction point 1

Embedded Verb "di-te":

***Hierarchically lower role preferences*:**

If there are any hierarchically lower role preferences, then there should not be any differences between "*di-te*" in (I), (II), (III) and (IV). If there is any difference in processing latency observed in any of the sentences, then it must be due to other factors or even interaction of other factors with the hierarchically lower role preference, which will need to be studied in detail through complex analysis of interaction.

***Real time initial role preferences*:**

If there is any default initial role preference in real time, then the first verb "*di-te*" in (I) and (III) should not show any significant difference of processing latency from each other and from "*ho-lo*" in (II) But these verbs should show either equally lesser latency than "*ho-lo*" in (IV), indicating a [+Ag] first preference or equally more latency than "*ho-lo*" to indicate a [-Ag] first preference. If however there is no significant difference observed in the comparisons here then the processing will be considered to be independent of the initial role encountered by the processor at least in case of subject control. However, if all possible minimal pairs show an increased latency in case of all the initially occurring embedded verbs in default order in subject controlled clauses when compared with the matrix verb occurring initially in shifted control clause sentences, then the difference in other types of information load before the embedded verb (as is available in the default order only), shall be considered the causal factor. But if this verb is found to be processed faster than the matrix verb in all such subject control cases, then it could provide a hint that when a control verb is encountered before a control clause, the processor detects it instantly and having found this unusual, has also engaged in a search for the shifted clause instantly. Therefore it could be the process of this detection and search initiation that may be constantly causing the extra delay compared to when it is encountered after the embedded verb and no such phenomenon is possible.

***Embedded role association preferences*:**

If there is any preference for a role association from the embedded clause, then the

latency of "*di-te*" in (I) should not significantly vary from that in (II), (III) and (IV). If there is any difference in processing latency observed in any of the sentences, then it must be due to other factors or even interaction of other factors with the embedded role preference, which will need to be studied in detail through complex analysis of interaction.

***Effect of Shifted Clause at last verb*:**

The shifted control clause can provide information about whether an embedded role revealed at the sentence end, may be biased by the previously projected role from the matrix verb which occurs before the shifted clause as compared to the bias upon the role expectation at the sentence end matrix verb caused by the embedded verb occurring earlier in a non shifted default position. According to such an expectation, if there is no such effect, sentence (I) and (II) should not be different in the latency extracted from "*di-te*" and sentence (III) and (IV) should not be different in the latency extracted from "*di-te*" whereas if there is any bias caused, "*di-te*" in (I) should not have a different latency than that in (II) but "*di-te*" in (III) should show up a latency difference with "*di-te*" in (IV).

***Inferences on Hierarchical and real-time role bias and their possible interaction*:**

As discussed previously, real-time role bias may be revealed if the last verb appears to behave according to the role that the processor has encountered previously. Hierarchically the roles are independent of the real time role sequence. It needs to be observed whether an interaction between hierarchical and real-time role may exist and whether a match of the sequences can inherently affect the processing at any of the extraction points in subject control.

Extraction point 2:

***Matrix Verb*:**

***Hierarchically higher role preferences*:**

In both default as well as shifted control clause sentences, if any hierarchical role doesn't hold as an explanatory factor, then "*ho-lo*" should not show up to have significantly different latencies at (I), (II), (III) & (IV) in subject control. However, if [+Ag] role is preferred then "*ho-lo*" in (I) and (II) should not have different latency, and "*ho-lo*" in (I) and (II) should both have a significantly lesser latency than "*ho-lo*" in (III) and (IV). Likewise if

[-Ag] role is preferred then "*ho-lo*" in (I) and (II) should both have a significantly higher latency than "*ho-lo*" in (III) and (IV).

***Real time final role preferences*:**

If there is any default final role preference in real time, then the last verb "*ho-lo*" in (I) should not be processed differently from the last verb "*di-te*" in (II) and (IV). "*ho-lo*" in (I) should show either a lesser latency than "*ho-lo*" in (III) to indicate a [+Ag] final preference or equally more latency than "*ho-lo*" in (III) to indicate a [-Ag] final preference. If there is no significant difference observed in the comparisons here then the processing will be considered to be independent of the final role encountered by the processor at least in case of subject control. However, if all possible minimal pairs show an increased latency in case of all the finally occurring verbs in default order in subject controlled clauses when compared with the matrix verb occurring initially in shifted control clause sentences, then the difference in other types of information load before the final verb (as is available in the default order only), shall be considered the causal factor. But if this verb is found to be processed faster than the embedded verb in all such subject control cases, then it could provide a hint that when a control verb is encountered after a control clause, the processor is expecting it after it has encountered the embedded verb, and integrates whatever information is available in the matrix verb. It may also be inferred that after the embedded clause is encountered, there is very little information to integrate between the embedded verb and matrix verb, whereas the chunk of information is bigger before the embedded verb.

***Matrix role association preferences*:**

If a role association preference exists for the matrix event, then a [+Ag] preference can be inferred if "*ho-lo*" in (I) and (II) are not different from each other, and are equally processed faster when compared to "*ho-lo*" in (III) and (IV). A [-Ag] preference can be inferred if "*ho-lo*" in (I) and (II) are equally processed with more latency when compared to "*ho-lo*" in (III) and (IV). However if no such preference exists, then no difference should show up in the subject control case.

***Effect of Shifted Clause at matrix verb*:**

The shifted control clause can also provide information about whether a matrix clause

revealed before the embedded clause, may be processed differently than it is, at the end of the verb. It is significant to check whether a matrix role association will be processed faster or slower than if it is at the end of the sentence, after the embedded clause (here [+Ag] in all cases) has been processed.

***Inferences on Hierarchical and real-time role bias and their possible interaction*:**

If there is an internal comprehension of default structural hierarchy where the nodes of the verbs originate, and the processor is also capable of comparing whether the roles are encountered in a sequence parallel to the role hierarchy, then (III), where there is an in-congruency between structural and real-time role association sequence, show up some behavioral discrepancy detectable at the matrix verb as well. Hierarchically the roles are independent of the real time role sequence. It needs to be observed whether an interaction between hierarchical and real-time role may exist and whether a match of the sequences can inherently affect the processing at any of the extraction points in subject control.

Method:

A self-paced reading experiment, using a moving window paradigm, was conducted in a controlled environment. LINGER experiment software was used for conducting the experiment. The beginning of the experiment consisted of general questions regarding required personal details and also regarding formal reading and writing exposure to Bangla was asked, and they were to enter these details using the keyboard.

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***Participants*:**

Forty native speakers of Bangla, who were well exposed to formal reading and writing skills in Bangla were chosen for participating in this experiment. These subjects were chosen from University of Hyderabad and their age ranged from 21 to 30 yrs. They were highly proficient in Bangla and were formally exposed to reading and writing the language for at least seven to eight years.

Results and Analysis:

Analysis 19:

Effect of initially encountered roles as emerging from the matrix clause upon the role emerging from the embedded clause as encountered after them.

This tests whether any role sequence preference may be existing when matrix clause is encountered previous to the embedded clause in a sentence having shifted embedded clause when the embedded event projects a [+AG] role.

Effect of matrix role upon 2nd word of the embedded predicate verb (and not the 1st word) was found significant (as follows).

Roles		Affected RT		Significance	
Mat Role	Emb Role	Mean RT @ EV_2		**t value**	**F.value**
+ AG	+ AG	1189	229	t value= -2.511 *	F.value= 6.3061
– AG	+ AG	1418	msec	Pr(>|t|)= 0.0125 *	Pr(>F)= 0.01247 *

Table 11

Inferences:

Here too it seems that a matrix event role in the beginning, having a [–AG] role, shows up a significantly increased RT for any role ([+/– AG]) in the upcoming event.

Analysis 20.

***Effect of initially encountered role upon finally encountered role*.**

This tests whether any role sequence is preferred irrespective of the origin of the role from a particular embedded or matrix location when the ending role is [-AG].

20.a. Effects of initially encountered role upon 2nd matrix predicate word.

Roles		Affected RT		Significance	
Initial Role	Final Role	Mean RT @ MV_2		**t value**	**F.value**
+ AG	+ AG	1130	288	t value= -3.912	F.value= 15.306
– AG	+ AG	1418	msec	Pr(>|t|)= 0.000103 ***	Pr(>F)= 0.0001026 ***

Table 12

20.b. Effects of initially encountered role upon 1st matrix predicate word.

Roles		Affected RT		Significance	
Initial Role	Final Role	Mean RT @ MV_1		**t value**	**F.value**
+ AG	+ AG	770.2	288	t value= -3.912	F.value= 15.306
– AG	+ AG	617.8	msec	Pr(>|t|)= 0.000103 ***	Pr(>F)= 0.0001026 ***

Table 13

Inferences:

This difference in preference between the 1st word (where [–AG]-initial sequence is preferred) and 2nd word (where [+AG]-initial sequence is preferred) of the ending event predicate, suggests that there may be a dynamic phenomenon that has just been detected. The first word here shows a preference towards [–AG, +AG] sequence which is also detected to have got instantaneously reversed towards a [+AG, –AG] preference.

Analysis 21.

***Test for a preferred role from an initially encountered event* (*independent of the origin of the role*).**

The findings were similar to *analysis 3* and no significant effects were found.

Analysis 22.

***Test for a preferred role from a finally encountered event* (*independent of the origin of the role*).**

This confirms whether or not any particular role is preferred to end with in a role sequence encountered in an event complex.

Effects on both 1st and 2nd verb did not show any significant effects upon the difference of RT at different roles ($Pr(>|t|) > 0.05$, t value < 2).

Inferences:

Final role does not seem to have any effect upon the RTs observed at the final events, which are not sorted for matrix or embedded origin and as such, over all effects of ending role does not seem to exist.

Analysis 23.

***Test for a preferred role from an initially encountered matrix event*.**

This tests for any effects of role type as encountered to be associated from any matrix event that may be located initially in the sequence of mentioned events. Such a situation is available in sentences having the embedded clause shifted to a sentence end position.

Significant results showed up only in the 2nd word of the initially occurring matrix predicate event.

Effector	Affected RT		Significance	
Initial Roles	Mean RT @ MV_2		**t value**	**F.value**
+ AG	610.6	38.5	t value= -2.258	F.value= 5.0971
– AG	649.1	msec	Pr(>|t|)= 0.0246 *	Pr(>F)= 0.02456 *

Table 14

Inferences:

The [+AG] role from the matrix verb, which is also in the initial position seems to be preferred over a [–AG] role from it. This seems to confirm that the initial role encountered by the processor is strategically preferred to be a [+AG] and therefore this is indicative of a possibility that [+AG] role is the most preferred role for any event representation if there is any preference at all.

Analysis 24.

Test for a preferred role from a matrix event encountered at a sentence end position.

Significant effects were found at the 1st word (only) of the matrix predicate in sentence end position.

Effector	Affected RT		Significance	
Final Roles	Mean RT @ MV_2		**t value**	**F.value**
+ AG	868.8	321	t value= 2.761	F.value= 7.6213
– AG	728.3	msec	Pr(>|t|)= 0.00606 **	Pr(>F)= 0.006062 **

Table 15

Analysis:

Here for the first time the preference seems to have been changed towards a [–AG] role from the matrix clause event at the end. This seems to raise questions towards the complete difference all the cases observed previously. If we look at the sentences, the types of the 1st word of the matrix verb are *raji* (agree) and *badd*^{h}*o* (compel), varying for [+AG] and [–AG] respectively. Now *raji* type words used in the stimulus (such as *utshahi*, *icchuk*, *agrohi* and so on) are only compatible with [+AG] roles of Subject control giving [+AG] role to the matrix subject controller and cannot have [–AG] counterparts with Object control giving

[+AG] to the matrix clause subject and [–AG] to the matrix object controller, with the 2nd word (where **utshahi-korlo*, **icchuk-korlo*, **agrohi-korlo* etc are not possible).

However, *badd^{h}o* type words (such as *utshahito*, *prolubhito*, *shonmanito* and so on) are compatible for both subject control as well as object control cases as both *badd^{h}o ho-lo* (compel be-past3rd) as well as *badd^{h}o kor-lo* (compel do-past3rd) respectively. Therefore, it seems that in case of previous findings in the second experiment (mentioned in chapter 3), the matrix subject of the sentence did get a [–AG] role in case of the sentence end subject control verb (*badd^{h}o ho-lo*) compared to the matrix subject in the object control counterpart where it does get a [+AG] role from the object control verb. The experiment showed increased RT at cases of Object control, which coincided with the subject having a [–AG] role from the matrix control verb compared to cases where it had [+AG]. So two factors were overlapping in that case. Here the control type is kept constant for Subject Control and the role to be associated with the matrix subject has been varied for [+AG] and [–AG]. If there would have been any traces of effect of role type upon the processing in the earlier experiment independent of control types, then here too the processing would have remained consistent for the preference towards a [+AG] matrix subject. But findings seem to suggest otherwise, that the control type possibility of object control, which is found lacking in the [+AG] type matrix verbs, increases the processing time consistently compared to that where the possibility exists, i.e., in [–AG] type verbs. Therefore here, contrary to all the [+/–AG] preferences observed in all the previous experiments, a [–AG] role is preferred. It therefore seems that the processor is always engaged in a strategy where an object control having least amount of participant to active event linkage is searched for or preferred. This argument seems to be a feasible explanation which may be capable of relating the findings in preferences towards an object control type in several languages and the current exception towards a [–AG] role for the subject among all other findings which suggest a preference towards [+AG] role for any controller.

4.3.3.2 *Object* Control:

5. MP (a)

   Pair (23) = (2.a.i) (2.a.ii)

   Examples for (*2.a*) *have problematic issues of Control in Bangla*

6. MP (b)

   Pair (27) = (2.a.ii) (2.b.ii)

   (*2.a*) *problematic*

7. MP (c)

   Pair (28) = (2.b.i) (2.b.ii)

   This minimal pair has been designed to test a variation of role upon the embedded PRO and therefore the role type association from embedded clause, keeping the role from the matrix event constant.

   (a) **[Obj-Control:CNP$^{[-AG]}$:PRO$^{[+AG]}$]**

   This property has been tested for the default word order and also for shifted control clause.

   Default Word Order:

   The default word order in a complex sentence in Bangla has the embedded clause posited before the matrix verb. This configuration has the following properties pertaining to roles given to the controller NP.

   - Hierarchical role sequence: {[-Ag], [+Ag]}
   - Real time role association sequence: {[+Ag], [-Ag]}
   - Matrix clause role: [-Ag]
   - Embedded clause role: [+Ag]

   I.

   Robi **Amit**-ke$^{[-AG]}$ Shokal Shokal [**PRO**$^{[+AG]}$ *gal-a-gal kor-te*] baddho kor-lo

   Robi Amit-Acc morning-morning [PRO scolding do-inf] compel do-pst

   Robi compelled Amit to swear and scold early morning.

   Shifted Control Clause:

   - Hierarchical role sequence: {[-Ag], [+Ag]}
   - Real time role association sequence: {[+Ag], [-Ag]}
   - Matrix clause role: [-Ag]
   - Embedded clause role: [+Ag]

II.

Robi **Amit**-ke$^{[-AG]}$ Shokal Shokal baddho kor-lo [**PRO**$^{[+AG]}$ *gal-a-gal kor-te*]

Robi Amit-Acc morning-morning compel do-pst [PRO scolding do-inf]

Robi compelled Amit to swear and scold early morning.

(b) **[Obj-Control:CNP$^{[-AG]}$:PRO$^{[-AG]}$]**

Default Word Order:

- Hierarchical role sequence: {[-Ag], [-Ag]}
- Real time role association sequence: {[-Ag], [-Ag]}
- Matrix clause role: [-Ag]
- Embedded clause role: [-Ag]

III.

Robi **Amit**-ke$^{[-AG]}$ Shokal Shokal [**PRO**$^{[-AG]}$ *gal-a-gal k^{h}e-te*] baddho kor-lo

Robi Amit-Acc morning-morning [PRO scolding eat-inf] compel do-pst

Robi compelled Amit to get rebuked/scolded early morning.

Shifted Control Clause:

- Hierarchical role sequence: {[-Ag], [-Ag]}
- Real time role association sequence: {[-Ag], [-Ag]}
- Matrix clause role: [-Ag]
- Embedded clause role: [-Ag]

III.

Robi **Amit**-ke$^{[-AG]}$ Shokal Shokal baddho kor-lo [**PRO**$^{[-AG]}$ *gal-a-gal k^{h}e-te*]

Robi Amit-Acc morning-morning compel do-pst [PRO scolding eat-inf]

Robi compelled Amit to get rebuked/scolded early morning.

Hypothesis:

If the factor of Link Association Increment holds solely for earlier observed processing complexity differences then any significant difference will not show up within subject control at the extraction points for I, II, III and IV. Else if the distribution of the pattern of [+/- Ag] roles mapped onto the controller NP (CNP) is a crucial explanatory factor, then the relevant extraction points should show some significant behavioral differences by indicating it (as

discussed in the predictions below) within the subject control sentence. However if the interaction of both link association complexity and [+/-Ag] pattern are taking place in the processor, then some behavioral correlates of both the explanatory factors should show up in some complex manner. The following are the predictions in detail. There are two major extraction points, one where the embedded clause disambiguates for [+/-Ag] role association with the controller NP and the other where the matrix clause disambiguates for [+/-Ag] role for that NP.

Predictions:

Predictions on outputs from processing load extraction points have been listed as follows:

Extraction point 1

Embedded Verb "k^{h}e-te" Vs "kor-te":

***Hierarchically lower role preferences*:**

In both default as well as shifted control clause sentences, if "*kor-te*" in (I) and (II) shows up to have significantly lesser latency compared to "*k^{h}e-te*" in (III) and (IV) then the preferred embedded role will be inferred to be [+Ag]. If the difference between the two embedded verbs is not significant then the processing will be considered to be independent of [+/-Ag] role differences when the controller is an object and the word order is default.

***Real time initial role preferences*:**

If there is any default initial role preference in real time, then the first verb "*kor-lo*" in (II) and (IV) as well as "*k^{h}e-te*" in (III) should not show any significant difference from each other. But these verbs should show either equally lesser latency than "*kor-te*" in (I), indicating a [-Ag] first preference or equally more latency than "*kor-te*" to indicate a [+Ag] first preference. If however there is no significant difference observed in the comparisons here then the processing will be considered to be independent of the initial role encountered by the processor at least in case of subject control. However, if all possible minimal pairs show an increased latency in case of all the initially occurring verbs in default order in subject controlled clauses when compared with the matrix verb occurring initially in shifted control clause sentences, then the difference in other types of information load before the

embedded verb (as is available in the default order only), shall be considered the causal factor. But if this verb is found to be processed faster than the matrix verb in all such object control cases, then it could provide a hint that when a control verb is encountered before a control clause, the processor detects it instantly and having found this unusual, also engages in a search for the shifted clause instantly. Therefore it could be the process of this detection and search initiation that may be constantly causing the extra delay compared to when it is encountered after the embedded verb and no such phenomenon is possible.

***Embedded role association preferences*:**

If there is any preference for a role association from the embedded clause, then the latency of "*kor-te*" in (I) should not significantly vary from that in (II) and the latency of "*k*^{h}*e-te*" in (III) should not significantly vary from that in (IV). But both (I) and (II) should be similarly different from (III) and (IV). In that case, if a [+Ag] role is preferred for the embedded clause then "*kor-te*" shall show up lesser latency than "*k*^{h}*e-te*", whereas if a [-Ag] role is preferred then "*k*^{h}*e-te*" shall show up lesser latency than "*kor-te*". However if there is no significant difference between latency observed at the matrix verb and the embedded verb at any level, then the processing will be inferred to be independent of the role from embedded event (at least in object control cases for the shifted clause cases).

***Effect of Shifted Clause at last verb*:**

The shifted control clause can provide information about whether an embedded role revealed at the sentence end, may be biased by the previously projected role from the matrix verb which occurs before the shifted clause as compared to the bias upon the role expectation at the sentence end matrix verb caused by the embedded verb occurring earlier in a non shifted default position. According to such an expectation, if there is no such effect, sentence (I) and (II) should not show any difference at "*kor-te*" whereas if there is any bias caused, "*kor-te*" in (I) should have a different latency than that in (II). "*k*^{h}*e-te*" cannot be compared in this context as the sentence containing it has the matrix originating role as similar.

***Inferences on Hierarchical and real-time role bias and their possible interaction*:**

As discussed previously, real-time role bias may be revealed if the last verb appears to behave according to the role that the processor has encountered previously. Hierarchically the

roles are independent of the real time role sequence. It needs to be observed whether an interaction between hierarchical and real-time role may exist and whether a match of the sequences can inherently affect the processing at any of the extraction points in subject control. If this may be the case, then (I) should show some kind of relevant discrepancy which the other sentences will not.

Extraction point 2:

***Matrix Verb "kor-lo"*:**

***Hierarchically higher role preferences*:**

In both default as well as shifted control clause sentences, "*kor-lo*" should not show up to have significantly different latencies at (I), (II), (III) & (IV) as the roles associated to the object controller are identical in all of them. If any difference shows up in any of them, the causes shall be inferred to be other than any hierarchical factors.

***Real time final role preferences*:**

If there is any default final role preference in real time, then the last verb "*kor-lo*" in (I) and (III) and "*k*^{h}*e-te*" in (IV) should not show any significant difference from each other but should equally show either a lesser latency than "*kor-te*" in (IV) to indicate a [-Ag] final preference or equally more latency than it to indicate a [+Ag] final preference. If however there is no significant difference observed in the comparisons here then the processing will be considered to be independent of the final role encountered by the processor at least in case of object control. However, if all possible minimal pairs show an increased latency in case of all the finally occurring verbs in default order in object controlled clauses when compared with the matrix verb occurring initially in shifted control clause sentences, then the difference in other types of information load before the final verb (as is available in the default order only), shall be considered the causal factor. But if this verb is found to be processed faster than the embedded verb in all such object control cases, then it could provide a hint that when a control verb is encountered after a control clause, the processor is expecting it after it has encountered the embedded verb, and integrates whatever information is available in the matrix verb. It may also be inferred that after the embedded clause is encountered, there is very little information to integrate between the embedded verb and matrix verb, whereas the chunk of information is bigger before the embedded verb.

***Matrix role association preferences*:**

In this minimal pair, there is no difference between the role associations from the matrix clause and therefore matrix role associations cannot be tested at this point in the experiment. Minimal pairs (2) and (4) however do involve such a comparable variation at the position of the subject of the matrix clause. However, if there is any preference for role association from matrix clause, then the latencies at that verb should not vary at all in (I), (II), (III) and (IV) irrespective of their final or non-final position in the manipulation.

***Effect of Shifted Clause at matrix verb*:**

The shifted control clause can also provide information about whether a matrix clause revealed before the embedded clause, may be processed differently than it is, at the end of the verb. It is significant to check whether a matrix role association (here [-Ag] in all cases) will be processed faster or slower than if it it at the end of the sentence, after the embedded clause has been processed.

***Inferences on Hierarchical and real-time role bias and their possible interaction*:**

If there is an internal comprehension of default structural hierarchy where the nodes of the verbs originate, and the processor is also capable of comparing whether the roles are encountered in a sequence parallel to the role hierarchy, then (I), where there is an in-congruency between structural and real-time role association sequence, show up some behavioral discrepancy detectable at the matrix verb as well. Hierarchically the roles are independent of the real time role sequence. It needs to be observed whether an interaction between hierarchical and real-time role may exist and whether a match of the sequences can inherently affect the processing at any of the extraction points in subject control.

Method:

A self-paced reading experiment, using a moving window paradigm, was conducted in a controlled environment. LINGER experiment software was used for conducting the experiment. The beginning of the experiment consisted of general questions regarding required personal details and also regarding formal reading and writing exposure to Bangla was asked, and they were to enter these details using the keyboard.

Then they were given an introduction to what they should expect in the experiment. They had to press a key to see the next page, instruction, commands and so on. Then they were provided a practice session where they were introduced to self-paced moving window paradigm. This paradigm used the technique of displaying a masked sentence visible on the screen and each word is revealed step by step with its relevant position on the sentence area with each press of "F" key on the keyboard. The subjects were instructed to press "F" immediately after finishing the sentence and then they would be shown a comprehension question. Within the practice session they were also introduced to each type of post-reading comprehension task. After that the experiment would begin.

***Participants*:**

Forty native speakers of Bangla, who were well exposed to formal reading and writing skills in Bangla were chosen for participating in this experiment. These subjects were chosen from University of Hyderabad and their age ranged from 21 to 30 yrs. They were highly proficient in Bangla and were formally exposed to reading and writing the language for at least seven to eight years.

Results and Analysis:

Analysis 25.

Effect of initially encountered role emerging from embedded verb upon matrix verb:

This confirms whether any effect of initially encountered role emerging from the embedded verb is significant upon the processing of the sentence end matrix verb (having a –AG emerging out of it). This effect can check whether a [+AG → –AG] or [–AG → –AG] sequence may be preferred once the initial *embedded* role is encountered in an embedded clause.

25.a Effect on 2nd verb ["kor-lo" (*do-past*) type] of Matrix Complex Predicate.

Roles		Affected RT		Significance	
Role @ EV	Role @ MV	Mean RT @ MV_2		**t value**	**F.value**
+ AG	– AG	1951	337	t value= -3.551	F.value= 12.608
– AG	– AG	2288	msec	Pr(>|t|)= 0.000435 ***	Pr(>F)= 0.000435 ***

Table 16

25.b Effect on 1st verb type ["baddho" (*compel*) type] of Matrix Complex Predicate.

Roles		Affected RT		Significance	
Role @ EV	Role @ MV	Mean RT @ MV_1		**t value**	**F.value**
+ AG	– AG	694.9	96.5	t value= -2.432	F.value= 5.9155
– AG	– AG	791.4	msec	Pr(>|t|)= 0.0155 *	Pr(>F)= 0.01549 *

Table 17

Inferences:

[+AG → –AG] seems to be a significantly preferred sequence here (t value > 2, Pr(>|t|) < 0.05). It is also indicated here that probably a role match might not exactly be a prediction once a type of role is encountered from the embedded event. Also an initial encounter of [-AG] role from an embedded clause seems to be significantly biasing against a [–AG] role from a sentence end matrix event. Considering the previous findings, it seems here that it is more about the initial role and nothing about the sequence or the type of role immediately following a certain type of initially encountered role, that is actually able to affect the behavior, indicating that the ending role is not significant for an over all role sequence as such and that an initial role type is all that matters. How the initial role type is able to influence the ending verb in such a manner, irrespective of the role at that verb, is still unclear.

Analysis 26.

***Effect of initially encountered role upon finally encountered role*.**

This tests whether any role sequence is preferred irrespective of the origin of the role from a

particular embedded or matrix location when the ending role is [-AG].

Effects were found at the 1st matrix predicate word only of the sentence end complex predicate.

Roles		Affected RT		Significance	
Initial Role	Final Role	Mean RT @ W_3		**t value**	**F.value**
+ AG	– AG	694.9	123.1	t value= -2.063	F.value= 4.2554
– AG	– AG	818	msec	Pr(>|t|)= 0.0396 *	Pr(>F)= 0.03958 *

Table 18

Inferences:

This again suggests that, what ever the ending role, it is preferred that the initial role, encountered, be [+AG]. Therefore the processing correlates at the ending event is simply corresponding to the initial role encountered and not in any manner to the ending role itself.

Analysis 27.

***Effect of initially encountered role at the predicate from where it emerges*.**

This tests whether there is any preference towards any initially encountered role regardless of the type of clause that the role is emerging from.

For the first time, the effect seems to have showed up here, in object control case where only the 2nd word of the initially occurring complex predicate showed significant effects.

Effector	Affected RT		Significance	
Initial Roles	Mean RT @ W_2		**t value**	**F.value**
+ AG	582	95.7	t value= -3.226	F.value= 10.41
– AG	678.6	msec	Pr(>|t|)= 0.00131 **	Pr(>F)= 0.0010307 **

Table 19

Inferences:

It seems that the effect of [+AG] preference still exists and has the possibility of a strong effect upon the initial role of the first encountered event as well.

Analysis 28.

***Test for a preferred role from a finally encountered event* (*independent of the origin of the role*).**

This confirms whether or not any particular role is preferred to end with in a role sequence encountered in an event complex.

Effects on both 1st and 2nd verb did not show any significant effects upon the difference of RT at different roles ($Pr(>|t|) > 0.05$, t value < 2).

Inferences:

Final role does not seem to have any effect upon the RTs observed at the final events, which are not sorted for matrix or embedded origin and as such, over all effects of ending role does not seem to exist.

Analysis 29.

***Test for a preferred role emerging from an embedded event at an initial location*.**

This confirms whether or not any type of role is preferred to be comprehended as emerging from an initially occurring embedded clause in a non scrambled sentence.

Effect on 2nd verb only of the embedded clause showed significant effects.

Effector	Affected RT	Significance	
Roles	Mean RT @ EV_2	**t value**	**F.value**

+ AG	582.9	53.5	t value= -2.403	F.value= 5.7764
– AG	636.4	msec	Pr(>|t|)= 0.0167 *	Pr(>F)= 0.01674 *

Table 20

Inferences:

The preference for an initial embedded role is shown only at the 2nd verb of the matrix complex verb and [+AG] seems to be the preferred role. Therefore, it seems that roles emerging from an embedded event in a control clause needs to be able to engage the controller into an active participant status in the initial occurrence and also in conformity with other findings, it also seems this could also be an effect of the initial role preference as observed till now.

Analysis 30.

Test for a preferred role emerging from an embedded event at a final location.

This confirms whether or not any type of role is preferred to be comprehended as emerging from an initially occurring embedded clause in a sentence having the embedded clause in its normal position.

Effects on both 1st and 2nd verb of the embedded clause did not show any significant effect upon the RT (Pr(>|t|) > 0.05, t value < 2).

Analysis:

Here in object control case, the embedded clause did not show any preference for emerging role type when it was put at the end of the sentence unlike the findings in initial occurrence in a*nalysis 29.*

8. MP (d)
   Pair (24) = (2.a.i) (2.b.i)
   (*2.a*) *problematic*

4.3.3.3 *Sub Vs Obj* Control for each Feature

9. Feature (1)

   Pair (4) = (1.a.i) (2.a.i)

   (*2.a*) *problematic*

10. Feature (2)

    Pair (11) = (1.a.ii) (2.a.ii)

    (*2.a*) *problematic*

11. Feature (3)

    Pair (22) = (1.b.ii) (2.b.ii)

    This minimal pair has been prepared to test the relevance of processing difference of control types in presence of [-Ag] roles associated to the controller from both matrix as well as embedded event. Here all the roles have been kept similar but only the control type has been carefully manipulated in order to minimize the difference to the control type. This has been possible as subject control is possible in Bangla with a non-agentive role from the matrix verb, "*baddho ho-lo*" where as the object of any matrix clause in most configurations is by default in receipt of a [-Ag].

    (a) **[Subj-Control:CNP$^{[-AG]}$:PRO$^{[-AG]}$]**

    This property has been tested for the default word order and also for shifted control clause.

    Default Word Order:

    The default word order in a complex sentence in Bangla has the embedded clause posited before the matrix verb. This configuration has the following properties pertaining to roles given to the controller NP.

    - Hierarchical role sequence: {[-Ag], [-Ag]}
    - Real time role association sequence: {[-Ag], [-Ag]}
    - Matrix clause role: [-Ag]
    - Embedded clause role: [-Ag]

I.

Robi$^{[-AG]}$ [Amit-ke shokal shokal dekh-e-i] [**PRO**$^{[-AG]}$ *gaali k^{h}e-te*] baddho ho-lo

Robi Amit-Dat/Acc morning-morning see-pft-emph [PRO scolding eat-inf] compel be-pst

Having met Amit early in the morning, Robi had to get a scolding.

Shifted Control Clause:

- Hierarchical role sequence: {[-Ag], [-Ag]}
- Real time role association sequence: {[-Ag], [-Ag]}
- Matrix clause role: [-Ag]
- Embedded clause role: [-Ag]

II.

Robi$^{[-\text{AG}]}$ [Amit-ke shokal shokal dekh-e-i] baddho ho-lo [**PRO**$^{[-\text{AG}]}$ *gaali k^{h}e-te*]

Robi Amit-Dat/Acc morning-morning see-pft-emph compel be-pst [PRO scolding eat-inf]

Having met Amit early in the morning, Robi had to get a scolding.

Default Word Order:

- Hierarchical role sequence: {[-Ag], [-Ag]}
- Real time role association sequence: {[-Ag], [-Ag]}
- Matrix clause role: [-Ag]
- Embedded clause role: [-Ag]

III.

Robi **Amit**-ke$^{[-\text{AG}]}$ [shokal shokal dekhe-i] [**PRO**$^{[-\text{AG}]}$ *gaali k^{h}e-te*] baddho kor-lo

Robi Amit-Dat/Acc morning-morning [PRO scolding eat-inf] compel do-pst

Robi compelled Amit to get scolded early morning.

Shifted Control Clause:

- Hierarchical role sequence: {[-Ag], [-Ag]}
- Real time role association sequence: {[-Ag], [-Ag]}
- Matrix clause role: [-Ag]
- Embedded clause role: [-Ag]

IV.

Robi **Amit**-ke$^{[-\text{AG}]}$ [shokal shokal dekhe-i] baddho kor-lo [**PRO**$^{[-\text{AG}]}$ *gaali k^{h}e-te*]

Robi Amit-Dat/Acc morning-morning compel do-pst [PRO scolding eat-inf]

Robi compelled Amit to get scolded early morning.

Hypothesis:

If the factor of Link Association Increment holds solely for earlier observed processing complexity differences then significant difference will show up across control types at the extraction points for I, II, III and IV. Else if the distribution of the pattern of [+/- Ag] roles mapped onto the controller NP (CNP) is a crucial explanatory factor, then the relevant extraction points should not show any significant difference below. However if the interaction of both link association complexity and [+/-Ag] pattern are taking place in the processor, then some behavioral correlates of both the explanatory factors should show up in some complex manner. The following are the predictions in detail. There are two major extraction points, one where the embedded clause disambiguates for [+/-Ag] role association with the controller NP and the other where the matrix clause disambiguates for [+/-Ag] role for that NP.

Extraction point 1

Embedded Verb "k^he-te"

***Hierarchically lower role preferences*:**

It will be crucial to compare the embedded verb across the control types to see whether a kind of control can actually bias any role, originating from the embedded clause. In shifted control clause sentences, if "*k^he-te*" in (II) shows up to have significantly different latency compared to "*k^he-te*" in (IV) then, if the verb in (II) has lesser latency than in (IV), it can be inferred that a [-Ag] embedded role is more preferred in subject control than in object control, independent of the role association from the matrix clause (which is [-Ag] in all the cases here). In case the difference in latency is opposite to the previous possibility, [-Ag] embedded role would be inferred to be less preferred in subject control than in object control. If the difference between the two embedded verbs is not significant then the processing will be considered to be independent of control type differences when the controller varies for subject and object and there is a shifted control clause.

***Real time initial role preferences*:**

If there is any default initial role preference in real time, then all the first verbs in (I), (II), (III) and (IV) should not show any significant difference from each other. If however

there is significant difference observed in any of the comparisons here then the processing will be considered to be dependent on factors other than those controlled which has the least chance here. However, if all possible minimal pairs show an increased latency in case of all the initially occurring verbs in default order in both subject and controlled clauses when compared with the matrix verb occurring initially in shifted control clause sentences, then the difference in other types of information load before the embedded verb (as is available in the default order only), shall be considered the causal factor. But if this verb is found to be processed faster than the matrix verb in all such object control cases, then it could provide a hint that when a control verb is encountered before a control clause, the processor detects it instantly and having found this unusual, has also engaged in a search for the shifted clause instantly. Therefore it could be the process of this detection and search initiation that may be constantly causing the extra delay compared to when it is encountered after the embedded verb and no such phenomenon is possible.

***Embedded role association preferences*:**

If there is any preference for a role association from the embedded clause, then the latency of "*kʰe-te*" in (I) should not significantly vary from that in (II), (III) and (IV). But if there is a weak or no preference for the role association, and a strong preference for control type information upon the embedded clause by any chance then the following difference may be expected. "*kʰe-te*" shall be processed differently in presence of a previously encountered subject control verb "*baddʰo ho-lo*" in (II) than in presence of a previously encountered object control verb "*baddʰo kor-lo*" in (IV). If a [-Ag] role from embedded clause is preferred more in a subject control situation than an object control, then "*kʰe-te*" in (II) should show lesser latency than that in (IV). But if the preference is more for a [+Ag] in subject control then "*kʰe-te*" in (IV) should show lesser latency. However if there is no significant difference between latency observed at the embedded verb at any level, then the processing of role associations from embedded event will be inferred to be independent of the control type.

***Effect of Shifted Clause at last verb*:**

The shifted control clause can provide information about whether an embedded role revealed at the sentence end, may be biased by the previously projected role from the matrix verb which occurs before the shifted clause as compared to the bias upon the role expectation

at the sentence end matrix verb caused by the embedded verb occurring earlier in a non shifted default position. According to such an expectation, if there is such an effect, sentence (I) and (II), (III) and (IV) should not show any difference at "*k^{h}e-te*".

***Inferences on Hierarchical and real-time role bias and their possible interaction*:**

As discussed previously, real-time role bias may be revealed if the last verb appears to behave according to the role that the processor has encountered previously. Hierarchically the roles are independent of the real time role sequence. It needs to be observed whether an interaction between hierarchical and real-time role may exist and whether a match of the sequences can inherently affect the processing at any of the extraction points in subject control. If this may be the case, then there should not be any discrepancy related to this factor as no role sequence is such that any such discrepancy can be located.

Extraction point 2:

Matrix Verb "ho-lo" and "kor-lo":

***Hierarchically higher role preferences*:**

In both default as well as shifted control clause sentences, "*ho-lo*" should not show up to have significantly different latencies at (I), (II), (III) & (IV) as the roles associated to the controller are identical in all of them. But, if any difference shows up relevant to control type variation then the following latency differences may be expected. If subject control is preferred then "*ho-lo*" should show significantly lesser latency than "*kor-lo*" in all cases. But if object control is preferred then "*ho-lo*" should show significantly more latency than "*kor-lo*" in all cases.

***Real time final role preferences*:**

If there is any default final role preference in real time, then the last verb "*ho-lo*" in (I) and "*kor-lo*" in (III) should not show any significant difference from each other. This will indicate that control type has played no role in any kind of processing discrepancy. But if control type has a strong role to play, then subject control preference will render the latency of "*ho-lo*" to be less than "*kor-lo*" where as an object control preference will render the latency of "*ho-lo*" to be more than "*kor-lo*". However, if all possible minimal pairs show an increased latency in case of all the finally occurring verbs in default order in object controlled

clauses when compared with the matrix verb occurring initially in shifted control clause sentences, then the difference in other types of information load before the final verb (as is available in the default order only), shall be considered the causal factor. But if this verb is found to be processed faster than the embedded verb in all such object control cases, then it could provide a hint that when a control verb is encountered after a control clause, the processor is expecting it after it has encountered the embedded verb, and integrates whatever information is available in the matrix verb. It may also be inferred that after the embedded clause is encountered, there is very little information to integrate between the embedded verb and matrix verb, whereas the chunk of information is bigger before the embedded verb.

***Matrix role association preferences*:**

In this minimal pair, there is no difference between the role associations from the matrix clause and therefore matrix role associations cannot be tested at this point in the experiment. Minimal pairs (2) and (4) however do involve such a comparable variation at the position of the subject of the matrix clause. However, if there is any preference for role association from matrix clause, then the latencies at that verb should not vary at all in (I), (II), (III) and (IV) irrespective of their final or non-final position in the manipulation.

***Effect of Shifted Clause at matrix verb*:**

The shifted control clause can also provide information about whether a matrix clause revealed before the embedded clause, may be processed differently than it is, at the end of the verb. It is significant to check whether a matrix role association (here [-Ag] in all cases) will be processed faster or slower than if it it at the end of the sentence, after the embedded clause has been processed. Where as if there is an initial detection of control type, then the initial verb encountered shall show up differences accordingly where the subject control verb shall be processed faster than the object control verb in case of a subject control preference and in case of an object control preference, the object control verb shall be processed faster than the subject control verb.

***Inferences on Hierarchical and real-time role bias and their possible interaction*:**

If there is an internal comprehension of default structural hierarchy where the nodes of the verbs originate, and the processor is also capable of comparing whether the roles are

encountered in a sequence parallel to the role hierarchy, then (I), where there is an in-congruency between structural and real-time role association sequence, show up some behavioral discrepancy detectable at the matrix verb as well. Hierarchically the roles are independent of the real time role sequence. It needs to be observed whether an interaction between hierarchical and real-time role may exist and whether a match of the sequences can inherently affect the processing at any of the extraction points in subject control.

Method:

A self-paced reading experiment, using a moving window paradigm, was conducted in a controlled environment. LINGER experiment software was used for conducting the experiment. The beginning of the experiment consisted of general questions regarding required personal details and also regarding formal reading and writing exposure to Bangla was asked, and they were to enter these details using the keyboard.

Then they were given an introduction to what they should expect in the experiment. They had to press a key to see the next page, instruction, commands and so on. Then they were provided a practice session where they were introduced to self-paced moving window paradigm. This paradigm used the technique of displaying a masked sentence visible on the screen and each word is revealed step by step with its relevant position on the sentence area with each press of "F" key on the keyboard. The subjects were instructed to press "F" immediately after finishing the sentence and then they would be shown a comprehension question. Within the practice session they were also introduced to each type of post-reading comprehension task. After that the experiment would begin.

***Participants*:**

Forty native speakers of Bangla, who were well exposed to formal reading and writing skills in Bangla were chosen for participating in this experiment. These subjects were chosen from University of Hyderabad and their age ranged from 21 to 30 yrs. They were highly proficient in Bangla and were formally exposed to reading and writing the language for at least seven to eight years.

Results and Analysis:

Analysis 31.

Preferences in Control type observed in the sentence final control verb in a non shifted sentence.

This measures whether there are significant effects of control type upon the role emerging form the matrix verb at the sentence final position. It ascertains whether certain type of interaction of emerging role type and control type may be existing in the behavior, as consistent effects of role type as well as control type have been observed already in various experiments here and in other studies.

Effect of interaction between final role type and control type upon sentence final matrix verb (which is the disambiguation point for the control information) showed up only in the 2nd word of the matrix complex predicate.

Roles * Control Type		Affected RT		Significance	
Control Type	Final Role	Mean RT @ MV_2		**t value**	**F.value**
Subject	– AG	1235	611	t value= -5.781	F.value= 33.416
Object	– AG	1846	msec	Pr(>|t|)= 1.61e-08 ***	Pr(>F)= 1.611e-08 ***

Table 21

Inferences:

Here matrix verbs disambiguating for subject control information show 611 msec lesser RT than those disambiguating for an object control information. The above effects seem to suggest that when the matrix control verb has the control information disambiguating for an object control, it may not go well with a [–AG] role than in case of a subject control and perhaps [–AG] roles are processed with lesser complexity (of some kind) when they go with a subject control information. To make a very strong inference, subject control seems to go well with [–AG] in **analysis 24** as well**.** Also in the sentences, the object of the sentence were dropped, so as to be able to make good comparable minimal pairs, varying only for the control type and not the object location in the sentences. Therefore, it seems that in absence

of an overt object (which is not the case in the 2nd experiment where subject control had taken significantly more time than object control) the processor faces an added task of positing a controller matrix object identity as the controller of the embedded subject performer concept when faced with an object control information. This is expected of the processor. But the important observation to notice here is that subject control information went well with [–AG] role again, thus ascertaining again that the initially observed difference between the preferred object control and the non preferred subject control was not due to a particular difference of roles upon the Subject entity in the Bangla sentences, but due to the phenomenon of the control preference itself.

Analysis 32.

***Preferences in Control type observed in the pre infinite clause control verb in a shifted sentence*.**

This measures whether there are significant effects of control type upon the role emerging form the matrix verb at the pre non-finite clause position. It ascertains whether certain type of interaction of emerging role type and control type may be existing in the behavior, as consistent effects of role type as well as control type have been observed already in various experiments here and in other studies.

Effect of interaction between initial role type and control type upon sentence final matrix verb (which is the disambiguation point for the control information) showed up only in the 2nd word of the matrix complex predicate in a sentence having a shifted embedded clause.

Roles * Control Type		Affected RT		Significance	
Control Type	Initial Role	Mean RT @ MV_2		**t value**	**F.value**
Subject	– AG	670.8	110.3	t value= -2.659	F.value= 7.0713
Object	– AG	781.1	msec	Pr(>|t|)= 0.00818 **	Pr(>F)= 0.008181 **

Table 22

Inferences:

Here too the results indicated an effect of interaction of role type and control disambiguation

phenomenon similar to findings in analysis 32. Therefore the consistency of the subject control phenomenon going well with a [–AG] association for the controller subject NP.

Analysis 33.

Effect of initially occurring control information upon finally occurring embedded clause event when ending role is [–AG].

Both the words of the embedded predicate showed no significant difference as an effect of the initial control information. (t value < 2, Pr(>|t|) > 0.05).

Inferences:

This seems to indicate that the initial processing of the interaction of the role type with the control information within the control verb is initially sorted out and any later processing of verbs does not get affected in any manner from any previously observed anomalies. Also it may be some how suggestive that there is a possibility that the initial resolution of the interaction of control information and the role type information may render the control information unable to bring about any effects upon the ending embedded clause event processing.

12. Feature (4)

    Pair (17) = (1.b.i) (2.b.i)

    This minimal pair has been prepared to test the relevance of processing difference of control types in presence of [-Ag] roles associated to the controller from both matrix as well as embedded event. Here all the roles have been kept similar but only the control type has been carefully manipulated in order to minimize the difference to the control type. This has been possible as subject control is possible in Bangla with a non-agentive role from the matrix verb, "*baddho ho-lo*" where as the object of any matrix clause in most configurations is by default in receipt of a [-Ag].

    (a) **[Subj-Control:CNP$^{[-AG]}$:PRO$^{[+AG]}$]**

    This property has been tested for the default word order and also for shifted control clause.

Default Word Order:

The default word order in a complex sentence in Bangla has the embedded clause posited before the matrix verb. This configuration has the following properties pertaining to roles given to the controller NP.

- Hierarchical role sequence: {[-Ag], [+Ag]}
- Real time role association sequence: {[+Ag], [-Ag]}
- Matrix clause role: [-Ag]
- Embedded clause role: [+Ag]

I.

Robi$^{[-\,AG]}$ [Amit-ke shokal shokal dekhe-i] [**PRO**$^{[+\,AG]}$ *gal-a-gal kor-te*] baddho ho-lo

Robi Amit-Dat/Acc morning-morning see-pft-emph [PRO scolding do-inf] compel be-pst

Having met Amit early in the morning, Robi had to scold (/swear at) him.

Shifted Control Clause:

- Hierarchical role sequence: {[-Ag], [+Ag]}
- Real time role association sequence: {[+Ag], [-Ag]}
- Matrix clause role: [-Ag]
- Embedded clause role: [+Ag]

II.

Robi$^{[-\,AG]}$ [Amit-ke shokal shokal dekh-e-i] baddho ho-lo [**PRO**$^{[+\,AG]}$ *gal-a-gal kor-te*]

Robi Amit-Dat/Acc morning-morning see-pft-emph compel be-pst [PRO scolding *do*-inf]

Having met Amit early in the morning, Robi had to get a scolding.

Default Word Order:

- Hierarchical role sequence: {[-Ag], [+Ag]}
- Real time role association sequence: {[+Ag], [-Ag]}
- Matrix clause role: [-Ag]
- Embedded clause role: [+Ag]

III.

Robi [shokal shokal **Amit**-ke[– AG] dekhe-i] [**PRO**[+ AG] *gal-a-gal kor-te*] baddho kor-lo

Robi Amit-Dat/Acc morning-morning [PRO scolding do-inf] compel do-pst

Robi compelled Amit to scold and swear early morning.

Shifted Control Clause:

- Hierarchical role sequence: {[-Ag], [-Ag]}
- Real time role association sequence: {[-Ag], [-Ag]}
- Matrix clause role: [-Ag]
- Embedded clause role: [-Ag]

IV.

Robi [shokal shokal **Amit**-ke[– AG] dekhe-i] baddho kor-lo [**PRO**[+ AG] *gal-a-gal kor-te*]

Robi Amit-Dat/Acc morning-morning compel do-pst [PRO scolding do-inf]

Robi compelled Amit to scold and swear early morning.

Hypothesis:

If the factor of Link Association Increment holds solely for earlier observed processing complexity differences then significant difference will show up across control types at the extraction points for I, II, III and IV. Else if the distribution of the pattern of [+/- Ag] roles mapped onto the controller NP (CNP) is a crucial explanatory factor, then the relevant extraction points show appropriate significant difference below only according to the distribution of the roles, independent of the control type properties. However if the interaction of both link association complexity and [+/-Ag] pattern are taking place in the processor, then some behavioral correlates of both the explanatory factors should show up in some complex manner. The following are the predictions in detail. There are two major extraction points, one where the embedded clause disambiguates for [+/-Ag] role association with the controller NP and the other where the matrix clause disambiguates for [+/-Ag] role for that NP.

Extraction point 1

Embedded Verb "kor-te"

***Hierarchically lower role preferences*:**

It will be crucial to compare the embedded verb across the control types to see whether a kind of control can actually bias any role, originating from the embedded clause. In shifted control clause sentences, if "*kor-te*" in (II) shows up to have significantly different latency compared to "*kor-te*" in (IV) then, if the verb in (II) has lesser latency than in (IV), it can be inferred that a [+Ag] embedded role is more preferred in subject control than in object control, independent of the role association that the controller receives from the matrix clause (which is [-Ag] in all the cases here). In case the difference in latency is opposite to the previous possibility, [+Ag] embedded role would be inferred to be less preferred in subject control than in object control. If the difference between the two embedded verbs is not significant then the processing will be considered to be independent of control type differences when the controller varies for subject and object and there is a shifted control clause.

***Real time initial role preferences*:**

If there is any default initial role preference in real time, then all the first verbs in (I), (II), (III) and (IV) should not show any significant difference from each other. If however there is significant difference observed in any of the comparisons here then the processing will be considered to be dependent on factors other than those controlled which has the least chance here. However, if all possible minimal pairs show an increased latency in case of all the initially occurring verbs in default order in both subject and controlled clauses when compared with the matrix verb occurring initially in shifted control clause sentences, then the difference in other types of information load before the embedded verb (as is available in the default order only), shall be considered the causal factor. But if this verb is found to be processed faster than the matrix verb in all such object control cases, then it could provide a hint that when a control verb is encountered before a control clause, the processor detects it instantly and having found this unusual, has also engaged in a search for the shifted clause instantly. Therefore it could be the process of this detection and search initiation that may be constantly causing the extra delay compared to when it is encountered after the embedded

verb and no such phenomenon is possible.

***Embedded role association preferences*:**

If there is any preference for a role association from the embedded clause, then the latency of "*kor-te*" in (I) should not significantly vary from that in (II), (III) and (IV). But if there is a weak or no preference for the role association, and a strong preference for control type information upon the embedded clause by any chance then the following difference may be expected. "*kor-te*" shall be processed differently in presence of a previously encountered subject control verb "*badd*^{h}*o ho-lo*" in (II) than in presence of a previously encountered object control verb "*badd*^{h}*o kor-lo*" in (IV). If a [+Ag] role from embedded clause is preferred more in a subject control situation than an object control, then "*kor-te*" should show lesser latency in (II) than in (IV). But if the preference is more for a [-Ag] in subject control then "*kor-te*" in (IV) should show the lesser latency. However if there is no significant difference between latency observed at the embedded verb at any level, then the processing of role associations from embedded event will be inferred to be independent of the control type.

***Effect of Shifted Clause at last verb*:**

The shifted control clause can provide information about whether an embedded role revealed at the sentence end, may be biased by the previously projected role from the matrix verb which occurs before the shifted clause as compared to the bias upon the role expectation at the sentence end matrix verb caused by the embedded verb occurring earlier in a non shifted default position. According to such an expectation, if there is such an effect, sentence (I) and (II), (III) and (IV) should not show any difference at "*kor-te*".

***Inferences on Hierarchical and real-time role bias and their possible interaction*:**

As discussed previously, real-time role bias may be revealed if the last verb appears to behave according to the role that the processor has encountered previously. Hierarchically the roles are independent of the real time role sequence. It needs to be observed whether an interaction between hierarchical and real-time role may exist and whether a match of the sequences can inherently affect the processing at any of the extraction points in subject control. If this may be the case, then there should not be any discrepancy related to this factor as no role sequence is such that any such discrepancy can be located.

Extraction point 2:

Matrix Verb "ho-lo" and "kor-lo":

Hierarchically higher role preferences:

In both default as well as shifted control clause sentences, "*ho-lo*" in (I) and (II) should not show up to have significantly different latency from each other, also compared to "*kor-lo*" in (III) & (IV) which should be similar to each other too, as the roles associated to the controller are identical in all of them. But, if any difference shows up relevant to control type variation then the following latency differences may be expected. If subject control is preferred then "*ho-lo*" should show significantly lesser latency than "*kor-lo*" in all cases. But if object control is preferred then "*ho-lo*" should show significantly more latency than "*kor-lo*" in all cases.

Real time final role preferences:

If there is any default final role preference in real time, then the last verb "*ho-lo*" in (I) and "*kor-lo*" in (III) should not show any significant difference from each other. This will indicate that control type has played no role in any kind of processing discrepancy. But if control type has a strong role to play, then subject control preference will render the latency of "*ho-lo*" to be less than "*kor-lo*" where as an object control preference will render the latency of "*ho-lo*" to be more than "*kor-lo*". However, if all possible minimal pairs show an increased latency in case of all the finally occurring verbs in default order in object controlled clauses when compared with the matrix verb occurring initially in shifted control clause sentences, then the difference in other types of information load before the final verb (as is available in the default order only), shall be considered the causal factor. But if this verb is found to be processed faster than the embedded verb in all such object control cases, then it could provide a hint that when a control verb is encountered after a control clause, the processor is expecting it after it has encountered the embedded verb, and integrates whatever information is available in the matrix verb. It may also be inferred that after the embedded clause is encountered, there is very little information to integrate between the embedded verb and matrix verb, whereas the chunk of information is bigger before the embedded verb.

***Matrix role association preferences*:**

In this minimal pair, there is no difference between the role associations from the matrix clause and therefore matrix role associations cannot be tested at this point in the experiment. Minimal pairs (2) and (4) however do involve such a comparable variation at the position of the subject of the matrix clause. However, if there is any preference for role association from matrix clause, then the latencies at that verb should not vary at all in (I), (II), (III) and (IV) irrespective of their final or non-final position in the manipulation.

***Effect of Shifted Clause at matrix verb*:**

The shifted control clause can also provide information about whether a matrix clause revealed before the embedded clause, may be processed differently than it is, at the end of the verb. It is significant to check whether a matrix role association (here [-Ag] in all cases) will be processed faster or slower than if it it at the end of the sentence, after the embedded clause has been processed. Where as if there is an initial detection of control type, then the initial verb encountered shall show up differences accordingly where the subject control verb shall be processed faster than the object control verb in case of a subject control preference and in case of an object control preference, the object control verb shall be processed faster than the subject control verb.

***Inferences on Hierarchical and real-time role bias and their possible interaction*:**

If there is an internal comprehension of default structural hierarchy where the nodes of the verbs originate, and the processor is also capable of comparing whether the roles are encountered in a sequence parallel to the role hierarchy, then (I), where there is an in-congruency between structural and real-time role association sequence, show up some behavioral discrepancy detectable at the matrix verb as well. Hierarchically the roles are independent of the real time role sequence. It needs to be observed whether an interaction between hierarchical and real-time role may exist and whether a match of the sequences can inherently affect the processing at any of the extraction points in subject control.

Method:

A self-paced reading experiment, using a moving window paradigm, was conducted in a controlled environment. LINGER experiment software was used for conducting the

experiment. The beginning of the experiment consisted of general questions regarding required personal details and also regarding formal reading and writing exposure to Bangla was asked, and they were to enter these details using the keyboard.

Then they were given an introduction to what they should expect in the experiment. They had to press a key to see the next page, instruction, commands and so on. Then they were provided a practice session where they were introduced to self-paced moving window paradigm. This paradigm used the technique of displaying a masked sentence visible on the screen and each word is revealed step by step with its relevant position on the sentence area with each press of "F" key on the keyboard. The subjects were instructed to press "F" immediately after finishing the sentence and then they would be shown a comprehension question. Within the practice session they were also introduced to each type of post-reading comprehension task. After that the experiment would begin.

***Participants*:**

Forty native speakers of Bangla, who were well exposed to formal reading and writing skills in Bangla were chosen for participating in this experiment. These subjects were chosen from University of Hyderabad and their age ranged from 21 to 30 yrs. They were highly proficient in Bangla and were formally exposed to reading and writing the language for at least seven to eight years.

Results and Analysis:

Analysis 34.

***Effect of initial role comprehended as emerging from the initially encountered predicate, upon the predicate itself*.**

This test can tell us about whether an initial role type is preferred for the initially occurring event. Here the test has been separately conducted according to type of control as otherwise the control type difference may also have its merged effect which shall be hidden in the analysis and may be falsely reported as the effect of role type otherwise.

This test did not show any significant effects in the subject control cases but in case of object control cases it showed significant effects only in the 2nd word of the predicate.

Effector	Affected RT		Significance	
Initial Roles	Mean RT @ W_2		**t value**	**F.value**
+ AG	616.8	107.3	t value= -2.963	F.value= 8.7786
– AG	724.1	msec	Pr(>|t|)= 0.00325 **	Pr(>F)= 0.00325 **

Table 23

Inferences:

This indicates that in case of object control sentences, there is a preference of initial role and [+AG] roles are most preferred and shows lesser latency.

Analysis 35.

***Effect of final role type upon final predicate*.**

This tests whether there may be any sentence final role type preferences as indicators of role type in the end of the sequence.

Both subject control as well as object control sentences showed final role preferences as tabulated below except for the 2nd word of the complex predicate in object control sentence.

35.a.i

Effect of final role type upon 1st word of sentence-final events in subject control sentences.

Effector	Affected RT		Significance	
Final Roles	Mean RT @ W_1		**t value**	**F.value**
+ AG	667.7	30.7	t value= -2.386	F.value= 5.6952
– AG	698.4	msec	Pr(>|t|)= 0.0175 *	Pr(>F)= 0.01753 *

Table 24

35.a.ii

Effect of final role type upon 2nd word of sentence-final events in subject control sentences.

Effector	Affected RT		Significance	
Final Roles	Mean RT @ W_1		**t value**	**F.value**
+ AG	1251	76	t value= -2.163	F.value= 4.6805
– AG	1175	msec	Pr(>|t|)= 0.0312 *	Pr(>F)= 0.03117 *

Table 25

35.b.i

Effect of final role type upon 1st word of sentence-final events in object control sentences.

Effector	Affected RT		Significance	
Final Roles	Mean RT @ W_1		**t value**	**F.value**
+ AG	718.9	77	t value= -3.037	F.value= 9.2231
– AG	795.9	msec	Pr(>|t|)= 0.00256 **	Pr(>F)= 0.002563 **

Table 26

Inferences:

The general trend seemed to persist here with a preference toward the [+AG] except for the second word in subject control sentences where [–AG] role seemed to have been preferred. It also seems to be the case that atleast in case of object control cases too, the [+AG] role is most preferred as the ending role.

Analysis 36.

***Preferences in Control type observed in the sentence final control verb in a non shifted sentence*.**

This measures whether there are significant effects of control type upon the matrix verb at the sentence final position.

Effect of control type upon sentence final matrix verb (which is the disambiguation point for the control information) showed up only in the 2nd word of the matrix complex predicate.

Control Type	Affected RT		Significance	
	Mean RT @ MV_2		**t value**	**F.value**
Subject	1175	418	t value= -5.122	F.value= 26.233
Object	1593	msec	Pr(>|t|)= 4.93e-07 ***	Pr(>F)= 4.935e-087 ***

Table 27

Inferences:

Independent of the role type differences, the control type seems to have made a significant difference of 418 msec where subject control seems to have taken least amount of time at the matrix verb. This is expected from a sentence where the object is not overtly present and the processor has to posit the notion of a hidden or dropped *pro* at the object position of the matrix object after the matrix verb has been encountered.

Analysis 37.

***Preferences in Control type observed in the pre non-finite clause control verb in a shifted sentence*.**

This measures whether there are significant effects of control type upon the matrix verb at the sentence medial position.

Effect of control type upon sentence medial matrix verb (which is the disambiguation point for the control information) showed up only in the 2nd word of the matrix complex predicate.

Control Type	Affected RT		Significance	
	Mean RT @ MV_2		**t value**	**F.value**
Subject	659.9	64.2	t value= -3.365	F.value= 11.324
Object	724.1	msec	Pr(>|t|)= 000847 ***	Pr(>F)= 0.0008468 ***

Table 28

Inferences:

The results of analysis 37 persists here again and for similar reasons, subject control seems to have been preferred here.

Analysis 38.

***Preferences in Control type observed in the sentence final embedded verb in a shifted sentence*.**

This measures whether there are significant effects of control type upon the matrix verb at the sentence final position.

Effect of control type upon sentence final embedded verb showed up only in the 2nd word of the matrix complex predicate which is also the last word of the sentence.

Control Type	Affected RT		Significance	
	Mean RT @ EV_2		**t value**	**F.value**
Subject	1175	418	t value= -2.091	F.value= 4.3708
Object	1593	msec	Pr(>|t|)= 0.0373 *	Pr(>F)= 0.03726 *

Table 29

For currently unknown reasons, the ending word of the sentence directly corresponds to the control type preference observed in analysis 36 and 37. Even if the control type has been processed earlier beside the delay in the non-preferred control type in given circumstances, at the end of the sentence, the processor may be going through the total comprehension of the linkage from all the events required. At this point, the earlier observed discrepancy seems to arise again when the embedded event needs to be associated with the appropriate controller identity.

The findings of this chapter has been discussed with details in comparison with the results of the previous experiments in chapter 5 with reference to appropriate and adequate comparison of the findings in general control processing.

Chapter 5

Conclusion

To start with, the main thrust of this study has been to look at the processing of control clauses from the perspective of how agents are integrated with a number of events and the deeper strategies and processes probably involved in the processor while doing so. This asserts the understanding of the situations in an environment where the processor is given an option to choose for itself, what kind of and which agent it would prefer to integrate with a single or more events. Studies in control have not yet been able to verify fully how such a phenomenon operates when there is no compulsion upon the processor to choose any of the given agents in the matrix clause in cases of Arbitrary control. As reported here, the linkage in object control seems to be offering a complexity similar to arbitrary control, and both seem to be consistently and significantly less than subject control. In Bangla, the subject control is generally induced into the sentence by verbs which do not give a [+AG] role to the subject of the matrix clause. Such a situation situates a condition where the variation for subject and object control (as discussed in Experiment 2) creates a variation in another factor, i.e. the matrix subject has a [+AG] role from the matrix verb in case of Object control and has a [–AG] role from the matrix verb in case of Subject control. As such it was necessary to also check whether this kind of variation could possibly be a confounding factor that is giving rise to such a difference in preference in the control type where the object control (having a [+AG] role for the matrix subject) is being preferred. Though the multiple types of variation in [+/–AG] role showed that there is a preference for a [+AG] role in most cases (as discussed in chapter 7), the first word of the matrix verb showing a possible ambiguity (resolved by the second word of the complex predicate) for both subject and object control and had a [–AG] role was significantly preferred to its counter part whose first word provided unambiguously a subject control situation and also had a [+AG] role. Therefore it has been ascertained for the first time that there is a preference for types of roles emerging from the verb that the processor has to process as being associated to the arguments of the verb as well as the fact that control information may be able to strongly over ride that preference due to the load of numerosity in the types of links. It is therefore understandable that when the information of the control linkages are being processed, actually the underlying associations from the verbs as well as the properties of associations are being counted, measured, comprehended and

predicted by the processor, parallel to the introduction of appropriate cues that enable an efficient over all linguistic cognition.

This finding may ask us to keep aside the issue of preference for some time and reflect upon the possibility of how information pieces are actually being counted and measured in the processor and how concrete can the measurements be that should be entitled to account for these valid mechanisms. It also seems from the present finding that the mechanism may also be at some point equatable with the amount of neural activity load (verifiable through EEG measures) which may be established as a direct correlation to the processing of linkage load between the agents and the events in control clauses. The exposure to [+/–AG] role types also may be verified through suitable designs as to whether a significant measure, either in eye-movements or in EEG measures, may disclose some information related to what type of agency is preferred and why that consistency is visible.

The current study also however provides an intuitive question regarding the findings in the processing of wh-trace, dropped *pro*,

The reported finding throws a significantly new piece of information regarding the probable inbuilt strategies that may be capable of governing certain grammatical restrictions observed in a language. This in turn raises the following questions.

- How does the processor come to have the capacity of measuring certain amount of link numbers?
- How does the processor come to have any preference for [+/–AG] role types that emerge from the event and also link up with the NPs associated with them as their participants?
- How does the processor come to have an understanding of what kind of link numerosity should be expected in the upcoming information at a later part of the sentence?
- Why does the processor have any initially detectable, internal preference for a kind of agent-event linkage pattern?
- Why should there be any preference pertaining to any type of role for the participants

and whether certain world knowledge is capable of guiding this information or is it just some kind of a probable strategy of maintaining load economy that is justifiable in terms of an efficient prediction that may be capable of speeding up the over all processing latency.

Several findings in the previous experiments pertaining to trace reactivation, active filler search, active gap location and processing of garden path conditions in sentences may need to be reanalyzed in this light. The existing understanding of control processing tries to implement a justification of the findings in terms of structural explanations (Betancort, 2006; Sakamoto, 2000; Featherston 2001) but a link load explanation may be better suited for any such detected preference which needs an explanation equatable with internal set up of the brain and mind.

Limitations:

The study here is focused in the direction of exploring the issue of control processing and the issues in roles for the controller and other NPs in the matrix clause in Bangla. Bangla however is restricted to the type of roles that it plausibly allows in certain cases. The counter examples for object controller having [–AG] role from the matrix verb has not been tested here, as Bangla at least, (like several other Indian languages) does not allow a [+AG] role for the object of the matrix verb from the matrix verb in a plausibly sound sentence. As such this design needs to be tested in other languages that may allow that flexibility and add to the variation in the manipulations allowed for the same.

However this study can be extended in to a comparable analysis of the processing of wh-traces, dropped *pro*, clefts and pseudo clefts as well as various instances of shifted clauses that call for a postulation of some kind of an EC. This can throw sufficient light in the direction of how such a concept of a single performer is getting related and associated with more than one event and whether the differences in [+/–AG] roles can be effective in influencing their processing in any comparable and consistent manner. Thus the discussion can be extended in the direction of a universal understanding of how, in reality, the actual semantic associations, that the processor needs to extend to the participant and event concept may emerge into a valid incremental load and whether that load can have a consistent

influence upon detectable behavioral correlates in some manner.

The current study however gives an outline regarding how a concrete and measurable account of incremental complexity may be preferred to other available accounts of preference patterns and complexities observed in configuration. Such an incremental link load account may form a clearer understanding regarding how a probable decomposition of information in the environment, is carried out, to meet the demands of an internal representation which is not in real terms, comparable to any of the units, felt and tangible to the conscious senses. Thus if an attempt is made to understand the internal set up, or configuration, that is unifiable with all kinds of stimulus perception and the integration of its various segments, measures that can indicate countable methods and intuitions may be given a significant consideration. The study of control clauses provided a significant improvement in demonstrating a capable method which can tap deeper into the vein of processing and expose the details of the mechanisms of comprehension lurking in the strategies thereof.

Ending Statement:

This study has in fact been able to clearly identify the different requirements in order to find out whether or not the role type effect does actually influence the processing mechanisms. The third experiment entailing for the first time, an Arbitrary control, has clarified that the different linkage patterns from the agent to the predicate and not that from the predicate to the controller NPs. Seem to be actually responsible for the difference observed across object and subject control types. This seemed to be the case as the differences existed only the pair of sentence types compared contained the difference in linkage. When this was missing in the pair involving object Vs arbitrary control, the difference ceased to exist. The new parameter of [+/-Ag] roles have been tested here for the first time. In order to find out more about the features, when probable shifted control clauses may exist, in-terms of real-time role differences, the other parameters of shifted clauses have also been considered. In the final interaction of results, the following interaction of overall processing strategies in the human mind seem to exist in the language processor.

Linkage Complexity Vs Gramatical identity:

Linkage complexity seems to be a better explanation than the grammatical roles and subject

or object properties of the controller NP, in terms of explaining the processing preference towards any type of control. This is so because, preference any how needs to be explained in-terms of some concrete incremental model so that the difficulty or lack of preference can be rendered countable through available statistical as well as other complex mathematical functions, considered capable of accounting for such a complex phenomenon. In this situation it may be also asserted that any hint towards preference is actually an unsolved complexity scenario that needs adequate explanation in terms of *linkage and load increment* models.

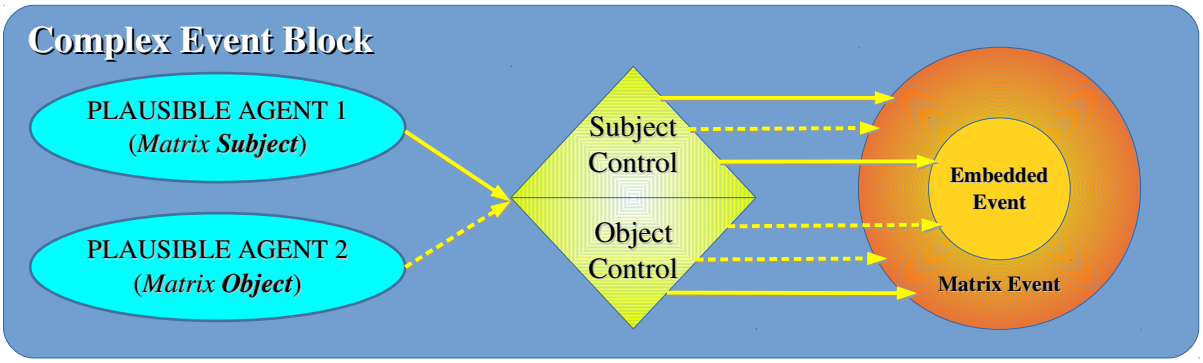

Figure 3

From the above figure, representing a spectrum of links that the variation in control type projects, it seems that load increment is most likely to increment if the number of links from subject (continuous lines) participant increases and gets associated with both the matrix as well as the embedded event. This is different for the object control as the matrix subject only remains associated to the matrix event. It may seem plausible to infer that the default linkage is perhaps more preferred for a subject as a sentence can also occur with out an object. As such, the object linkages (dashed lines) to more than one event seems not to be actually as strongly marked as the subject linkages to more than one event.

The relevant explanations in the literature can have clearer understanding if the increment model approach may be considered inevitable and thus the issue of "*preferences*" can therefore be done away with in the long run. The applications of this approach could be to be able to provide more concrete mathematical models and equations of internal processing strategies that need to be unifiable with probable correlative neural information processing models such that a balance can be struck in the long run, being also able to propose stronger and more robust models of computation of complex syntactic information. Such an initiative

however needs to be carried out by testing all languages and the phenomenon related to agent event linkage and association along with the yet unexplained complexity in the processing of [+/–AG] preferences in a processor, that could have otherwise overlooked it without forming any such internal and initial preferences in the whole process after all.

Furture directions:

The model of linkage complexity is to be tested in different types of control environments discussed in Stiebels (2007) and it seems quite feasible that all kinds of control may actually reveal such a processing restriction at the core of the information comprehension mechanism across several languages. More substantially, relevant ungrammatical and implausible sentential constructions can also be used as evidence to show how Agent-Event Association load may be capable of determining grammaticality in any given language, clearly indicating that actual, measurable processing constraints have originally shaped certain grammatical restrictions of human language. Considering the role of link processing restrictions upon grammar in human language the following issue may shed some light in identifying the relevance of the proposed model.

If a double embedding of infinite clause is done, the 2nd level (or the lowest) embedded clause seems to have an obligatory object control and the 1st level (or next higher) embedded clause must have subject control when the matrix verb implies subject control.

(1) robi$_i$ [PRO$_i$ shyam-ke$_j$ [PRO$_{*i/j/*k}$ boi-ta dekh-te] di-te] baddho **ho**-l-o
Robi [PRO Shyam-Dat/Acc [PRO book-cl see-inf] allow-inf] compel be-pst-3rd
Robi had to allow Shyam to see the book.

But when the matrix verb implies an object control, as in (IV.2), both the 1st level as well as 2nd level embedded clauses must have object control.

(2) robi$_i$ shyam-ke$_j$ [PRO$_{*i/j}$ Sita-ke$_k$/*pro*$_{i/*j/k}$ [PRO$_{*j/k/\text{identity-of-}pro}$ boi-ta dekh-te] di-te] baddho **kor**-l-o
Robi Shyam-Dat/Acc [PRO Sita-[Dat/Acc]/*pro* [PRO book-cl see-inf] allow-inf] compel do-pst-3rd
Robi compelled Shyam [PRO to allow Sita/*s-one* [PRO to see the book]].

However, a very interesting phenomenon can be observed here. The identity of the participant associated with the 2nd level embedded event can in no instance be interpreted as identical with a subject controller from the matrix clause and the type of control which seems to be obligatory in this level is Object control. Such tests will help verify the relevance of mathematically verifiable models to account for several such syntactic phenomena that may be governing our linguistic faculty in the realm of both plausibility and grammaticality.

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