CHAPTER II

TRANSITIVITY

2.0 Introduction

If we buy Hopper and Thompson's (1980) Transitivity theory then transitivity is no longer a matter of mechanical counting of participant NPs but is rather a matter of a discourse-derived relationship which is stronger in proportion to the intensity of the event which the clause is reporting. This intensity, which Hopper and Thompson call "the degree of Transitivity" of the event is evaluated as an aggregate of a cluster of properties or parameters, each of which contribute in some fashion to the transitivity relationship.

These discourse parameters, which we will discuss in detail later, function in discourse to distinguish the "more salient, foregrounded, actions" (Hopper, 1983). Earlier, in 1977, Fill—more had proposed the notion of a "salience hierarchy" to pick out the true object, as opposed to the oblique, in connection with pairs like the following:

(1) a. I hit Harry with the stick
    b. I hit the stick against Harry
Fillmore's science hierarchy included properties like humanness, change of location or state, definiteness, and totality. In reworking such a hierarchy in Hopper and Thompson's parameters, it turns out that given two patient NPs in a cause, the one which is higher in "Individuation" or "Affectedness" will be selected as the object of the verb whereas the less individuated or affected one is relegated to the status of bearing oblique Case (Hopper and Thompson '980).

Our interest in this Transitivity theory lies in the fact that a computational measure of transitivity, following Hopper and Thompson, would not be a simple counting of participant NPs but a comparative and relative evaluation of these parameters. We can imagine designing a system whereby the transitivity of a clause can be determined on the basis of a scale where these parameters are arranged in their relative order of contributory potential. But this is getting into too much detail too soon.

2.1 Salience

Although Hopper and Thompson's set of parameters are discourse-oriented, the elaborations that they set forth (also Hopper, 1983) all involve clausal or sentential aspects. This is where, we think, the notion of salience cannot be totally abandoned. In inter-sentential discourse (and semantics) studies,
the notion of salience was discussed, at least as an elementary notion, in connection with the problem of reference of anaphoric pronouns. The problem, originally noticed by Strawson (1952) and Geach (1962), involves the two contradictory faces of anaphoric pronouns, like *it* in (2) below, picking up reference from their antecedents on the one hand, and Russell's (1919) contention that indefinites do not have reference, on the other.

(2) *A dog came in. It* lay down under the table (Heim, 1982)

It was Kripke (1977) who suggested a way out of this puzzle by proposing two types of reference: "speaker's reference" and "semantic reference". While Russell's indefinites can be subsumed under the latter, it is the former which decides the bound variable status of the anaphoric pronoun in (2) above. Speaker's reference depends on pragmatic rather than purely semantic factors. As Heim (1982) points out in her "file-change semantics" model, pronouns are capable of getting their reference by virtue of purely pragmatic factors such as an object's perceptual (or associative) salience. In fact, Lewis (1979) goes one step further in suggesting that a pronoun may refer to whatever object is maximally salient in the situation of the utterance whereby he implies that anaphoric pronouns are only a special case of this, as one method of raising the salience of an object is by producing a suitable utterance (Heim, 1982). This concept of salience
is pore inclusive than Kripke's speaker's reference since it can account for the following utterances:

(3) a. A dog has been rummaging in the garbage can.
   b. It has torn open all the plastic bags.

(Heim, 1982)

As Heim shows in her analysis, (3a) could have been uttered by someone who has not witnessed the event directly, but was merely inferring on the basis of an after-effect. Yet (3b) can be naturally uttered by the same speaker. In (3b) the pronoun it cannot be analyzed as picking up speaker's reference because there was none.

Heim argues that by Lewis' notion of salience however, the utterance of (3a) raises the salience of a particular dog – the dog that did the rummaging. Now in (3b), the anaphoric pronoun can easily refer to this most salient dog in the situation. However, Lewis' salience, Heim notes, fails to correctly interpret minimal pairs like the following:

(4) a. I dropped ten marbles and found all of them, except for one. It is probably under the sofa.
   b. I dropped ten marbles and found only nine of them. It is probably under the sofa.

(Heim, 1982: 21)
By adopting Heim's notion of salience one can imagine that the first sentence of (4b) raises the salience of the tenth. Hissing marble. Still, the utterance does not succeed in raising the salience to such a degree that would allow the pronoun it in the subsequent utterance to refer to it. In contrast, the utterance of the first sentence in (4a) is capable of raising the salience of the object to a degree where the subsequent utterance of the pronoun is felicitous.

It can be concluded, therefore, that the salience-shifting potential of an utterance is a matter of how the utterance is encoded in terms of words. In answering the question: How exactly does wording influence the capacity of an utterance to raise an individual's salience, Heim (1982) proposes the following generalization:

A necessary condition of a sentence S to promote an object X to maximal salience is that S contain either an NP that refers to X or a singular indefinite NP whose predicate is true of X.

This revision can now distinguish between (4a) and (4b). In the former, the first sentence contains the indefinite one — to be read as "one of the marbles" which is true of the tenth Barbie, the referent of the subsequent pronoun. There is nothing in the
first sentence of (4b) which can, by the above generalization, raise the salience of the tenth marble.

2.1.1 Accommodation

In her discussion of novel definites, as in (5) and (6) below, Heim Bakes use of the notion of "accommodation" to render such examples felicitous which are otherwise unaccountable (that is become infelicitous) by her Extended Novelty Familiarity Condition [p369].

(5) Watch out, the dog\textsubscript{i} will bite you.  
(Immediate situation use)

(6) John read a book about Schubert\textsubscript{i} and wrote to the author.  
(Associative anaphoric use)  

(Heim, 1982: 371)

Accommodation, in terms of her kind of semantics, means making adjustments to a file by adding enough information to make a particular utterance felicitous. For instance, file change stops in case of (5) if no accommodation takes place. Accommodation would mean an addition of a new card \textsubscript{i} with an entry like: "is a dog somewhere close by". File change can now proceed.

When a new file card is introduced under accommodation, it has to be linked by cross-references to some already existing file cards. This is particularly relevant for (6), where a card
j is added with an entry like: "is autnor of i". That is, in pairing (book, author), the second member of the pair must have authored the first.

This concept of "cross-reference" (or "bridging" in psychological literature) in analyzing "associative anaphoric" uses as in (6) above, is carried over to other analogous uses (as in (5)) except that the role of "indirect antecedent" ("a book about Schubert" in (6)) is played by a contextually salient referent.

Accommodation, which is crucial for accounting for novel indefinites as well as certain pronominal/non-pronominal definites, therefore, to us looks like a matter of salience. For example, the dog in (5) which is visually or perceptually salient, already introduces a card i by the time the sentence is uttered. The utterance of (5) only "triggers" the accommodation whereupon a new card j is introduced that carries a cross-reference to i. On the basis of this we can introduce the following principle which takes care of such definites:

A: Accommodate whatever is salient in the context of the utterance.

Alternatively, by adopting Stalnaker's (1974) construct of speaker's presupposition as a set of possible worlds, we can replace
"context" above with "possible worlds". In fact we will extend Stalnaker's speaker's presupposition to include what we may call speaker's pragmatic presupposition or contextual presupposition. This is, in an extended sense, equivalent to Heim's "file" — the common ground for a context. The following passage from Stalnaker (1979) is relevant in this context:

If a goat walked into the room, it would normally be presupposed, from that point, that there was a goat in the room. And the fact that this was presupposed might be exploited in the conversation, as when someone asks, "how did that thing get in here?" assuming that others will know what he is talking about.

The discussion so far indicates that salience is an indispensable tool both in terms of:

(i) sentential grammar where a concept like Fillmore's (1977) salience hierarchy is reworked within a broader framework of the discourse-parameters of transitivity of Hopper and Thompson (1980),

and,

(ii) intersentential aspects of pronoun reference or definite/indefinite reference as in the frameworks presented by Lewis, Kripke, Heim and others.

It remains to be seen whether salience as a theoretical
construct can be meaningfully involved in a computational investigation of the sort we are engaged in. That this is indeed the case is our next topic of discussion.

2.1.2 Salience in Photographs

A group of computer scientists at the University of Massachusetts have developed an efficient technique for planning the generation of natural language texts that describe photographs of natural scenes as processed by the UMASS VISIONS system. The texts follow the ordering that is imposed on the scene's objects by their visual salience. It is possible to find structural analogues to visual salience in other domains to build simple generation (or parsing) schemes based on them.

Avoiding the super-human fallacy, that is, requiring computers to operate more efficiently than humans themselves can do, McDonald & Conklin (1982) developed an expedient and computationally efficient, if "leaky", planning process which works by monitoring and attending to the user's questions.

The key to the planner's simplicity lies in its making use of the notion of "salience". Objects are introduced into the text according to their relative importance in the conceptual source of the text. The decision regarding which objects to
leave out is taken care of by defining a cut-off salience rating below which objects are ignored. The notion of salience needed for the task of production of short paragraphs describing photographs of houses is widely shared and people interpret what is important about a picture according to such a shared set of conventions involving the size and the centrality of objects shown as well as a knowledge of what is normal or expected in a given domain — a car parked in front of a rural house in India would be highly salient.

The salience ratings with which the objects in the visual representation of McDonald & Conklin's (1982) planner are annotated were derived empirically through extensive psychological testing of human objects, where subjects both rated the photographs on a zero to seven scale, and wrote short paragraphs describing the scenes. Given this data, the planning algorithm runs as follows:

1. The objects in the scene are placed in a list — Unused Salient Object List — in decreasing order of salience.
2. Objects are taken from the list in (1), packaged with selected properties and relations, and are sent to the generator.
3. This process is repeated until the list of objects is exhausted.

The generator uses object-specific rules to construct the text. Paragraphs thus generated on the basis of salience ratings were
shown to be effective in picking out which picture they correspond to from a different camera angle.

2.1.3 Salience and Prepositions

The McDonald & Conklin (1982) planners discussed above show how visual salience simplifies an otherwise complex operation of text generation. A related issue is that of how salience as a construct affects our use of prepositions in natural language. Herskovits (1986) considers salience as one of the fundamental properties (others being relevance, typicality, and tolerance) which influence the systematic behaviour of use of prepositions.

According to her, salience explains the direction of metonymic shifts. It may be obtained visually in connection with a given use of the objects or for some action performed within close association with the objects. This, to our mind, is a most standard description of transitivity. Traditionally, transitivity is understood as a global property of an entire clause such that an activity is carried over or transferred from an agent to a patient. One way, therefore, to measure salience is to look into transitivity in detail — a connection we have earlier pointed out and on which the argumentation in this chapter rests. But before we get into the issue of transitivity — which involves a much broader network of related concepts — let us first see what else Herskovits has to say about salience.
The first 'near principle' that she proposes, which activates certain synecdoches, is the following:

(I) One can use a noun which basically denotes a whole to refer to the region occupied by a part of it that is typically salient.

Consider the following example:

(7) A waiting line at the counter
In (7), a functionally salient part of the line, its head, should be established for the line itself. The phrase is applicable only if the head of the line, not any other part, is very close to the counter. Now consider (8).

(8) The child in the back of the car
Here a salient interior is substituted for the whole reference object.

(9) The cat is under the table
In (9), the cat is probably not under the legs of the table. Table here stands for the table top.

An object is "typically" salient because it abides by the social conventions in use. For example, (10) below is unpragmatic because typically the most salient important part of a cup is
containing part and (10) uses cap to refer to its handle.

(10) * He held the cup by putting two fingers through it

Herskovits has two corollaries for (1) above:

**Corollary 1:** One can use an NP which *basically* denotes a whole object to refer to the region occupied by a part of it that is typically visible.

Consider (11) and (12) in this connection.

(11) The rabbit is under the bush

(12) My house is on top of the hill

(11) does not mean that the rabbit is under the whole bush but under only part of it. Similarly, in (12), *house* refers to the visible part of the house alone.

**Corollary 2:** The geometric description applicable may be in the base of the object (that is, its area in contact with the ground plane).

(13) The house is above the apartment building

(13) depicts a situation like this:
Similarly, we have:

(14) The block is on the circle

(14) represents a diagram like the following:

```
  +---+
  |   |
  +---+
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Where *block* refers only to the base of the block, we do not even think of the metonymy involved in such expressions. Metonymy however does not apply in the following sentences because we are talking in terms of two-dimensional objects:

(15) • The rectangle is in the line

for a situation like the following:

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  +---+
  |   |
  +---+
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Two other near principles that Herskovits (1986) proposes are the following:
The geometric description applicable may be the projection of the object on the plane of infinity.

(16)a. The morning star is to the left of the church (16a) will be true only of the appearance of the morning star and the church in the plane of view. This relates to salience since appearance is a salient aspect of one's experience of objects.

(III) The geometric description applicable may be in the projection of the object on the ground plane.

(16)b. The painting is to the right of the chair (16b) may describe a situation like the following;

Although the painting is really higher than the chair, 'to the right' is in fact true of the point approximating the chair and the projection of the painting on the ground. There is nothing unnatural about (16b) because horizontal coordinates stand out in our experience of objects.

Thus we see in Herskovits' interdisciplinary study of prepo-
position in English (and this would appear to hold of other languages such as Hindi and Bangla as well) that salience refers to the kind of foregrounding of objects or object parts that arises in our interaction with and perception of our environment.

Bow does the account of salience presented so far relate to our principle A above where we viewed 'accommodation' necessarily in terms of incorporating salient objects from a contextually presupposed common ground/file? To answer the question we need to ascribe to "accommodation" a broader perspective than hitherto attempted.

2.2 Novelty Condition

In her File Change Semantics, Heim (1982) introduced the concept of file-keeping as a device, and later as a theoretical construct, to understand a dialogue or any piece of discourse. At any given point of conversation, a file contains all that has been conveyed so far. Files in her theory are introduced as an additional level of analysis to intervene between language and the world. Unlike other strictly grammar-internal levels of representation (e.g. logical form), files encode information from non-linguistic sources like perception, permanently stored knowledge, etc., along with information contributed by linguistic structures.
Suppose A is uttering the following text and B is trying to understand, that is B’s task is to construct and update a file:

(17) (a) A woman was bitten by a dog. (b) She hit him with a paddle. (c) It broke in half. (d) The dog ran away (Heim, 1982: 275)

B’s file, to start with, is empty (this concept is later qualified in the theory). After (17a), B takes two new cards and numbers them 1 and 2. On card 1, B writes "is a woman" and "was bitten by 2". On card 2, B writes, "is a dog" and "bit 1".

Next, when A utters (17b), B takes another new card number 3 and writes "is a paddle" and "was used by 1 to hit 2". B also, at this point, updates card 1 by adding "hit 2 with 3". After utterance (17c), B updates card 3 by adding "broke in half". Then (17d) triggers a further addition on card 2: "ran away".

With this view of conversation, Heim points out that B is following the following principle:

B: For every indefinite, start a new card; for every definite, update a suitable old card.

Heim’s is not the first proposal to view communication as somehow analogous to file-keeping. Karttunen’s (1976) “discourse referents” also make use of a file-keeping concept. Around the same time as Heim, Kamp (1981) had proposed the concept of Discourse Representation Structures (DRSs) which together with Heim’s files
came to be identified with Discourse Representation Theory (DRT)

2.3 Discourse Representation Theory

The motivation for DRT comes from the following goals:

(18) a. giving a unified account of indefinite NPs
    b. giving a unified account of definite NPs
       (including pronouns in their different uses)
    c. accounting for the range of anaphora possibilities in discourse.

This, as we can see, matches our computational goals of giving an account of pronominal reference in discourse — a problem that has beset the construction of any satisfactory computational account in natural languages for many years now. It will not be out of place, therefore, to elaborate on DRT further.

The controversy regarding the status of indefinites as quantificational (Russellian view) and as referential that we alluded to earlier, becomes more acute and challenging in the realm of the donkey sentences. These are sentences containing an indefinite NP inside an if-clause or a relative clause and a pronoun outside that clause which refers back to the indefinite. Consider the following example:

(19) Every man who bought a donkey was happy
In Russell's account, since the indefinite descriptions are existentially quantified phrases, the logical fora of (19) may be represented as (in the predicate calculus notation):

\[(19') \ (\forall x)((\text{man } x \land (\exists y)(\text{donkey } y \land x \text{ bought } y)) \land x \text{ was happy})\]

Since \((\exists x 0) x \land (\forall x)(0 \rightarrow x)\) are logically equivalent this makes \((19')\) logically equivalent to \((19'')\):

\[(19'') \ (\forall x)(\forall y)((\text{man } x \land \text{ donkey } y \land x \text{ bought } y) \rightarrow x \text{ was happy})\]

Now consider the following which exhibits the problem associated with donkey sentences:

\[(20) \ Every \ man \ who \ meets \ a \ donkey \ beats \ it.\]

\[(20)\] is standardly assumed to be true only in case every man who meets at least one donkey beats every donkey that he meets. \((20)\) therefore translates into \((20')\).

\[(20') \ (\forall x)(\forall y)((\text{man } x \land \text{ donkey } y \land x \text{ meets } y) \rightarrow x \text{ beats } y)\]

1. The symbol " here denotes the conjunction
The closest equivalent (in the sense of (19’) and (19’’) above) to (20') is (20’’):

(20’’)(∀x)((man x ^ (∃y)(donkey y ^ x meets y))⇨ x beats y)

In (20’’) the final y lies outside the scope of the existential quantifier that is supposed to bind it. We cannot, therefore, represent (20) by means of a formula that treats a donkey existentially. Therefore, in Russellian terms, a uniform analysis is unavailable. Anaphora across a conditional gives rise to the same problem.

(21) If a man meets a donkey, he beats it

In both examples ((20-21)) a donkey cannot be referential. In order to get the right truth condition it cannot be quantificational either. It appears to function as a universal quantifier in these examples. Therefore the right translation of (21) is not (21a) but (21b) since, in the former, in x beats y, the variables are free.

(21)a. ∃x∃y (man(x) ^ donkey(y) ^ x meets y) ⇒ x beats y

(21)b. ∀x∀y ((man(x) ^ donkey(y) * x meets y)=⇒ x beats y)

The problem with (21b) is the familiar one of (20) regarding the scope of the indefinite in addition to the problem of analyzing indefinites sometimes as existentials and sometimes as universals.
In the *Kamp/Heim* system definite and indefinite NPs are translated as variables which serve as discourse referents. In *Kamp's DRT* all the information collected in a discourse is represented *syntactically* by a *DRS* graphically depicted as a box. Statements asserted as facts by participants are entered into the matrix *DRS* which may contain smaller boxes representing denied or doubtful facts, temporary assumptions, etc. This is shown in (22) below where 1 and 2 in the matrix box are asserted facts, 3 is denied, 4 and 5 are possible, 8 is asserted on the assumption 6 and 7, etc.

![Diagram](image)

As can be inferred, there is a hierarchical structure of subdiscourses within subdiscourses, which represents the logical *struc-*
Kamp/Heim proposed that each indefinite implies an introduction of a new variable into the discourse representation (see B above). Let us illustrate this in Kamp's DRT (as we have already seen how it is done in Heim's file). In (23) below, the indefinite a dog is translated as a variable x with a descriptive content predicated of it as in: dog (x).

(23) A dog came in

(23) is reduced to: x came in. The open formulas dog(x) and x came in do not have truth conditions of their own but influence the truth condition of a DRS when entered into it.

A discourse containing (23) alone will be represented as in (24) below.

(24)

The top line of the box represents the 'universe' of the DRS where the new variable x is entered. (24) is taken to be true if
x can be Batched with something in the world or in a model which is in fact a *dog* that cane in. In this system, therefore, the definition of truth induces existential **quantification** over the whole discourse **representation**. DRS is a potential picture of the world or the model, and it is true if *there* is a part of the world/model which is correctly described by it. This is expressed by saying that a DRS is true if it can be 'embedded' into the world/model, formally, a DRS is true iff there is an 'embedding function' which verifies it according to the conditions in the DRS.

The existential **quantification** which is induced over the matrix DRS is, as we can see, **unselective** — it **simultaneously** binds all variables that happen to be in the universe of the DRS. If we were to construct a **computational** system based on this model, note that such unselective binding would simplify the algorithm considerably.

In the **Kamp/Heim** system the indefinite is therefore neither referential nor **quantificational**. Its apparent quantificational force results due to some operator (in this case) in its environment.

**Quantification** in general in DRT is represented in a DRS by a condition which itself is composed of two **DRSs** — an antecedent
DBS which functions as the restrictive clause, and a consequent DBS which functions as the nuclear scope, in the sense of Heim (1982). The DBS of (25) is represented by (26) below.

(25) Every farmer has a donkey.

(26)

Every farmer has a donkey

\[
\begin{array}{c}
\text{farmer (x)} \\
\end{array} \Rightarrow \begin{array}{c}
\text{x has a donkey} \\
\text{donkey (y)} \\
\text{x has y}
\end{array}
\]

The verification part of this DRS would consist of induction of a combination of universal quantification (over the matrix DRS) and existential quantification (over the consequent sub-DRS). (26) is true if for every way of matching x with a farmer in the model, there is a way of finding a donkey that the farmer has.

The Lamp/Heim system therefore distinguishes two kinds of NPs: (i) definite and indefinite NPs which are not quantificational, and which are translated as variables, (ii) quantificational NPs all of which induce unselective restricted quantification — in DRT they trigger the introduction of a conditional into the DRS.

Anaphoric definite NPs in the Kamp/Heim system, as we have
pointed out earlier, are translated as one of the variables which are already present in the representation. The DRS of (27) is (28).

(27) A dog cane in. It lay down.

(28) The antecedent of the pronoun it is the DRS variable x. In DRT the antecedent of an anaphora must also be "accessible" to the pronoun.

Accessibility is a part of "nodal base" in the sense of Kratzer (1981) where a modal base defines an accessibility relation on the set of possible worlds. Heim (1982) denotes it as $R_B$ for the accessibility relation defined by the modal base B; "V $R_B$ V" is to be read as: "V is accessible fron V". In DRT of Kamp accessibility is syntactically defined as:

(29) The variables accessible from a position in DRS $K$ are those which appear in the universe of

(i) $K$ itself
(ii) all the DRSs that graphically contain $K$, and
(iii) in case $K$ is a consequent DRS of a conditional,
In (28), the dog variable x is accessible to the pronoun from the position of the pronoun because they are in the state box. According to the criteria in (29) above, the pronoun it in (30) cannot access the cog variable x, as shown in (3D.

(30) Every dog came in. It lay down.

Pronouns, therefore, function in the Kamp/Heim system like bound variables (x elements) by (i) picking up the variable of the indefinite, and (ii) getting bound by the same quantifier that binds the indefinite. The variables, or discourse referents, enable the speaker to keep track of the content of a conversation, without being tied down to any particular referent in the model.

Given this model, donkey sentences are no longer a problem. For instance (19), repeated here as (32), is treated like any
other conditional, with an implicit universal quantifier and is represented as (33).

(32) If a man meets a donkey, he beats it.

(33)

![Diagram of (33)]

There are a few things to be noted in connection with (33):

(i) indefinites, as usual, are variables
(ii) their universal force is due to some quantifier that binds them
(iii) the pronoun can refer back to variables X and Y because these are in the antecedent box and therefore accessible
(iv) pronouns are in the scope of the same universal quantifier which binds the variable
(v) there is no problem with the scope of the indefinite extending beyond the clause boundary because the indefinite is not a quantifier and does not bind the pronoun

As evident from (i) to (v) above, DRT then solves the donkey sentence problem.
2.4 An Algorithm

Our interest in DRT lies in the fact that all the essential steps for picking out the reference of a pronoun are already worked out in terms of the DRS construct. Designing an appropriate algorithm on the basis of such a model can now be trivially derived. At this stage we conjecture it as follows:

(34)a. construct a 'universe' where the variables declared follow the Novelty Condition (B of section 2.4)

b. construct open formulas for the indefinites by predicating them of the variables declared in a. and by replacing the indefinite with the appropriate variable

c. translate anaphoric definite NPs, if any, in terms of variables already declared in a. (A sub-routine creates suitable pairs to decide which variables from the 'universe' to be used in such a translation)

d. check if any anaphoric variable in c. is accessible or not according to the accessibility condition ((29) above)

e. if yes, declare the discourse component as felicitous; infelicitous otherwise

f. any Q-adverb (Lewis 1975), if found, triggers an introduction of a condition in the DRS and steps a to e are repeated

This is, of course, a very rough procedure awaiting a detailed working out of the finer computational points. Nevertheless, (34) indicates the extent to which DRT can be successfully applied to solve the computational problem of reference tracking
in a discourse.

2.5 Accommodation Revisited

Files are common grounds and therefore contain discourse referents which do not correspond to any KP occurring in the discourse, but are introduced on the basis of world knowledge. The objects to be included in a file are selected on the basis of their saliency. This is how a saliency rating of objects in the surrounding would feed into the process of discourse referent introduction in a file. Such a procedure will also necessarily subsume the concept of accommodation. In accommodation, as we recall from section 2.1, listeners adjust their assumptions by adding "just enough" information to remedy the Novelty Condition violation. For example, an expression like my dog can be assumed to be felicitous only in a situation where it is accepted that I have a dog. However, if I utter (35), even without such an assumption the listener immediately accommodates the assumption that I have one.

(35) My dog is at the door

This is analogous to the immediate situation case we presented earlier in (5), repeated here as (36), which is uttered, suppose, if I see a dog around someone.

(36) Watch out! The dog will bite you
The fact that accommodation is a real factor in natural languages cannot be challenged but as a theoretical tool it seems to be too powerful. It might conceivably allow too many cases of anaphora to an accommodated antecedent. An attempt, therefore, was Bade (in Heim, 1982) to constrain accommodation. We have already pointed this out in our discussion of Heim's notion of accommodation. The restriction proposed in Heim concerned the concept of cross-referring, as can be noticed in (6), repeated here as (37).

(37) John read [a book about Schubert], and wrote to the author.

As in a file, we will assume that accommodated material is also included in DRSs as and when they arise. We will further assume that such accommodated material is given an identity index, distinguishing it from material which directly refers to the text. This can be included (similar to the algorithm in (34)) as another step in an algorithm. Heim also talks about temporarily introduced accommodation or local accommodation as distinct from global or permanently accommodated material. She also suggests that the latter is preferable. According to her, local accommodation is needed while analyzing expressions with operators. In an analogous computational procedure, this can easily be achieved by tagging different types of accommodated
Another way to constrain accommodation is by way of making it minimal — adding just enough information to avoid a felicity condition violation. It is most readily executed if it is very minimal. This criterion actually clashes with what we are going to propose next and needs to be modified in the context of our proposal.

2.6 The Camera Angle View

We propose that the best way to capture all the contextual underpinnings of an utterance like (3f) above (and others, as we shall point out below) is to imagine discourse being presented in terms of photographs. That is, imagine that at each stage of a conversation, the listener is being presented with photographs of the situation in question. In short, language understanding takes place through the camera lens. Throughout the duration of the conversation, a camera placed at the site records all the events as and when they occur. We emphasize that this is not just a metaphor. In fact, such a view of language understanding, especially in terms of a computational version of the system, is not impossible to imagine in the light of what we have presented earlier regarding the designing of a planner whose task is to generate texts based on photographs of houses on the basis of a
We suggest that the exact theoretical construct in a camera-angle view of discourse understanding be what we Bay call a field. We further suggest that a field has certain advantages over a file or a DRS in Kamp/Hein in DRT. Introduction of a file card is achieved in this model through a new photograph each time a new object enters the field of vision. Imagine the camera to be sensitive to such new objects (or even substantial modification of new objects — a fact which neither Kamp or Hein considers) and takes a snap each time such a major change of state occurs. A field is never blank. Even before the utterance of (36) above, the field consists of, let us say, a flight of steps, you — the addressee — coming down the steps, and there is a dog lurking behind. By the time I utter (36), there is already a field consisting of a dog. By this we mean that a listener is not surprised by a definite novel-NP the dog precisely because s/he has popped up a field pertaining to the conversation under progress from a set of universal fields which are part of the human language processing faculty, where the utterance of a definite dog is not unexpected, given our language experience contained within this universal set.

In connection with accommodation, fields have an advantage over files in terms of the question: at what stage of a dis-
course-construction can one accommodate Material for the purpose of satisfying the felicity condition? In Heim's model, the felicity condition must be satisfied by a file prior to the processing of the definite. That is, whenever a listener encounters a novel definite a/he will have to first accommodate an antecedent; only then can the definite be added to the file. However, in Kadmon's (1987) theory of uniqueness, where she makes use of DRSs rather than files, accommodation follows the entry of the definite into the DRS. Kadmon also suggests that because of uniqueness, the accommodated antecedent is entered into a DRS permanently whereas Heim allows for temporary accommodation to take place, as we have seen earlier. This tension between the two theories regarding the level and the local/global nature of accommodation can be eased out with our concept of a field, which is a deeper (and more universal) level of representation, in tandem with a file.

What we are now suggesting is that, theoretically and computationally, it makes better sense to allow field and file to work together albeit at different levels of representation. Accommodation would now proceed as follows: Accommodation takes place in the field at some level prior to the processing of the utterance — in the speaker's intention, for example, — but it is available at the file-level only when the utterance is actual-
ly made. This weeds out the und *sirable* lag between the *encoun-
tering of the* utterance by the listener and its subsequent accommod-
ation in the *file* in Heim's system. Secondly, an *accommodated*
entry remains in the field memory (or, if you prefer, in the
*"album") once it is entered, but has a local character only in
connection with its appearance at the *file-level*. *Kadmon's* DRS,
therefore, is our file and Heim's file is somewhere between our
field and the file-level. Although this theory is forced to
propose an additional level of representation, it *nevertheless*
attains conceptual simplicity.

In this model, *accommodation* is not minimal at the *field-
level but is *minimal* at the *file-level*, not according to Heim's
(1982) criteria, but according to a salience grading of the
objects in the file where a cut-off point determines the extent
of *minimality of accommodation*. Translating a field into a file
will proceed accordingly. Notice that the principle A that we
proposed earlier can now be seen to be applying at the file
level. Extending the metaphor of a *camera's* field of vision,
salience could be seen as a device for focusing and zooming.

It remains to be seen how a field can be constructed. Given
the universal character of *fields* in general, we suggest that a
conceptual dependency network like Schank (1972) or a modified
version of it (or even a modified conceptual semantics of Jack—
endoff (1992) can be used to construct a model of a field. Scripts designed on the basis of actual language experience can be profitably used in this connection, as far as a computational model of a field is concerned. A simple functional semantics can do the job of then translating a field into a file in accordance with the "zoom potential" of various objects in the field.

2.7 Transitivity

One way in which this zoom potential or salience rating as we mentioned earlier can be worked out is through transitivity. This is crucial for our implementation to work because unless we evaluate the salience potential of different objects in a particular setting, we cannot construct the file — and, therefore, computation cannot proceed. This requirement, therefore, merits a detailed discussion of transitivity which we offer as a justification of the title of this dissertation.

Transitivity, as we mentioned at the beginning of this chapter, is some sort of transfer of energy from the agent to the patient. The big question that arises at this point is: is transitivity to be seen as a universal prime or is it to be merely viewed as a theoretical construct? We will produce evidence from (mainly) Hopper and Thompson (1980) and others to prove that it is the former. We will also say, however, that a
syntactic notion of Transitivity is essential for a model-driven computation of the kind we propose to proceed. Therefore, we will distinguish between a semantic/pragmatic notion of transitivity and a syntactic notion of transitivity in the course of our discussion.

2.7.1 Semantic/Pragmatic Transitivity

Hopper and Thompson (henceforth HT) (1980) identified the following parameters according to which a transitivity rating of a particular clause can be measured.

(37)

<table>
<thead>
<tr>
<th>PARAMETERS</th>
<th>TRANSITIVITY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HIGH</td>
</tr>
<tr>
<td>A. PARTICIPANTS i</td>
<td>2 or more participants, A and 0</td>
</tr>
<tr>
<td>B. KINESIS</td>
<td>action</td>
</tr>
<tr>
<td>C. ASPECT</td>
<td>telic</td>
</tr>
<tr>
<td>D. PUNCTUALITY</td>
<td>punctual</td>
</tr>
<tr>
<td>E. VOLITIONALITY</td>
<td>volitional</td>
</tr>
<tr>
<td>F. AFFIRMATION</td>
<td>affirmative</td>
</tr>
<tr>
<td>G. MODE</td>
<td>realis</td>
</tr>
<tr>
<td>H. AGENCY</td>
<td>A high in potency</td>
</tr>
<tr>
<td>I. AFFECTEDNESS OF 0</td>
<td>8 totally affected</td>
</tr>
<tr>
<td>J. INDIVIDUATION OF 0</td>
<td>0 highly individuated</td>
</tr>
</tbody>
</table>
(A) PARTICIPANTS: No transfer at all can take place unless at least 2 participants are present.

(B) KINESIS: Actions can be transferred from one participant to another — crucial for the core definition of transitivity. States cannot be so transferred. Thus something happens in *I kicked the ball* but not in *I like football*.

(C) ASPECT: Telic action is an action viewed from its endpoint and is more effectively transferred to a patient in comparison to an atelic action. In (38a) the activity is viewed as completed but in the atelic (38b) transference is only partial.

(38)a. *memne caawal kheayaa*
   I- **G rice** ate
   'I ate rice'

   b. *mem cawal khaa rahaa huM*
   I rice eat PROG be-3PS
   'I am eating rice'

HT also distinguish aspect in the sense of telicity from 'Aktion-sart' or lexical aspect which involves those ways of looking at an action which are predictable from the lexical meaning of the verb.

HT show that if other things are equal an interpretation where the aspect is perfective will make the clause more transi-
tive than a clause where the action is interpreted as imperfect. For example, in the Finnish example (39a), the object which is marked by Accusative, is interpreted as perfective and is therefore considered to be more transitive than the object in (39b), which is marked with a partitive Case and is interpreted as imperfective.

(3E)a. liikemies kirjoitti kirjeen valiokunnalle businessman wrote letter-ACC committee-to 'The businessman wrote a letter to the committee'

b. liikemies kirjoitti kirjetta valiokunnalle businessman wrote letter-PART committee-to 'The businessman was writing a letter to the committee'

The ergative construction in Hindi is limited to perfective environments, while a non-ergative is used in the imperfective:

(40)a. mEMne ciTThii likhii I-ERG letter wrote-I-sg-fem "I wrote a letter"

b. mEM ciTThii likhungaa I letter write-will-I-sg-masc "I will write a letter"

The ergative in Hindi therefore can be considered to be more transitive since it involves telicity. Hopper (1983) reaches a similar conclusion regarding the comparison of Ergative, Passive and Active in Malay and finds the ergative to be most transitive. As far as Bangla aspect is concerned, we will discuss this in greater detail when we talk about syntactic transitivity.
D. **Punctuality**: actions carried out with no obvious transitional phase between inception and completion have a greater effect on their patients than actions which are inherently on-going. For example, *hit* is punctual whereas *carry* is non-punctual. In Samoan, the contrast between the more punctual and the less punctual action is encoded in the ergative/antipassive contrast:

(41)a. saa manatu le tama i le tiene  
TNS think the boy OBL the girl  
'The boy thought about the girl'

b. saa manatu-a le tiene e le tana  
TNS think-TRANS the girl ERG the boy  
'The boy remembered the girl'

(HT. 1980)

In a. *le tama* 'the boy' is in the absolutive with no Case-marker, while the object, *le tiene* 'the girl', is Barked OBL. The action is understood to be durative. In b. the position of the object is changed and is marked by the transitive suffix -a, the action being interpreted as punctual.

The Samoan example as well as the Chukchee example (42) below (Comrie, 1973 cited in HT) show an important point in support of the hypothesis that transitivity should indeed be considered as a fundamental property of natural languages. Both these languages, and many others, show a distinct morphosyntactic marker of transitivity and intransitivity (also marked in some languages such as Eskimo).
This point will be considered while providing a morphological validity of a syntactic notion of transitivity as proposed in Murasugi (1992) where TrP is a mere place holder for a "feature" of Transitivity which the NPs check against in a transitive clause.

E. VOLITIONALITY: When the agent acts volitionally the effect on the patient is more apparent than when it is not. For example, in Culeño (Hill 1969, cited in HT) volitional and non-volitional verbs are distinctly marked with suffixes -ine and -yaxe respectively. Morphosyntactic realizations of volitionality are marked on the object in Estonian: Nominative on O when no overt agent is present; partitive in case of absence of voluntary participation as in (43).

(43) ta kuulis nende komnet
    he heard their talk (PART)
    'He heard their talk'

F. AFFIRMATION: In many languages the object of a negated clause appears in forms which show that the action of the verb is deflected or less direct. In French, indefinite Os in the partitive must drop the definite article normally present:

(42)a. tug-e  n:ntawat-an k>pre-n
    friends-ERG set-TRANS net-APS
    'The friends set the net'

b. tug-at  kopra-ntawat-Gzat
    friends-NOM net-set-INTR
    'The friends set nets'
(44) a. Nous **avons du** pain
    \[ \text{we have the-PART bread} \]
    'We have some bread'

    b. Nous n'avons plus de pain
    \[ \text{we \textit{N}G\textit{-have} more PART bread} \]
    'We have no more bread'

HT suggest that the object of a clause which is **imperfective**, negated, \textit{inactive}, or irrealis is somehow less of an object and is marked as such in the \textit{morphosyntax}.

This and the next parameter, \textit{Mode}, are less convincing in the HT system and we contest these two \textit{separately} in a later section in connection with syntactic \textit{transitivity}. Also, the psycholinguistics literature that we present does not support at least the affirmative parameter.

G. **MODE**: This parameter \textit{distinguishes} between the \textit{realis} and the \textit{irrealis} encoding of events. An action which did not take place or is supposed to be occurring in a non-real world, is less effective than one whose occurrence is asserted in the real world. This is an opposition between the indicative and other non-assertive forms such as subjunctive, optative, hypothetical, imaginary, conditional, etc. In Yakulta, irrealis non-past clauses elicit antipassive rather than the \textit{ergative} construction.

H. **AGENCY**: Participants high in agency can cause an action \textit{more
effectively than those without. The interpretation of (45a) would be that of a perceptible event with a perceptible consequence but b. is a Matter of internal state.

(45)a. John startled me
   b. The picture startled me

In Cupeño (Bill (1969) cited in HT) volitional and non-volitional verbs are marked with suffixes -ine and -yaxe respectively. Morphological realization of higher vs. lower Agency can be displayed in clauses with only one argument. Thus, depending on the degree of control exercised by this argument over the action, it is marked morphologically as either A or 0. Lakhota functions in this manner. Therefore, structures traditionally called 'intransitives' can be either more or less transitive depending on some discourse parameter.

I. AFFECTEDNESS OF O: The degree to which an action is transferred to a patient is a function of how completely that patient is affected. For example, in (46a) it is more effective than in (46)b.

(46)a. MEM-ne kitaabeM paRhiim
   I-ERG books read-past-took-sg-fem
   'I read the books (up)'

   b. MEM-ne kuch kitaabeM paRhiim
      I-ERG some books read-sg-fem
      'I read some of the books'

In Indonesian two rival suffixes -kan and -i are used as follows:
With \(-i\) in a. it is implied that the heating is gentler and more controlled. With \(-kan\) the act of heating is more drastic, for example, boiling water for cooking making (47b) more intense. The suffix \(-kan\) is also the suffix used to make causatives and to transitivize dative verbs and is correlated with a sense of total effect on the object. In the Finnish example that we saw earlier ((39)), the Transitivity Hypothesis of HT predicts that the Accusative, which induces totally affected Os, gives the clause a perfective or telic value, while the partitive gives it an imperfective or atelic value.

J. **INDIVIDUATION** OF 0: Individuation refers both to the distinctness between 0 and A and to the distinctness from its own background. HT lists the properties of individuation as follows:

(48)

<table>
<thead>
<tr>
<th>INDIVIDUATED</th>
<th>NON-INDIVIDUATED</th>
</tr>
</thead>
<tbody>
<tr>
<td>proper</td>
<td>common</td>
</tr>
<tr>
<td>human, animate</td>
<td>inanimate</td>
</tr>
<tr>
<td>concrete</td>
<td>abstract</td>
</tr>
<tr>
<td>singular</td>
<td>plural</td>
</tr>
<tr>
<td>count</td>
<td>mass</td>
</tr>
<tr>
<td>referential, definite</td>
<td>non-referential</td>
</tr>
</tbody>
</table>
An action which is sore individuated, that is, has more of the left-hand side properties can be more easily transferred to a patient than those with more of the right-hand sided properties. The definite in (49a) implies that probably John finished the available beer in contrast with (49b).

(49)a. John drank the beer  
b. John drank some beer

In Hindi the ko marker on objects requires them to be animate and human, and also definite:

(50)a. mEM-ne laRkaa dekhaa  
'I saw a boy'

b. mEM-ne laRke-ko dekhaa  
'I saw the boy'

In other languages, the verb and object tend to merge in case of an indefinite object — they tend to form a single unit. In an extreme case an indefinite object is not really an object but is a sub-part of a compound of which the verb stem is the head, that is, the object is incorporated into the verb. This takes place even in Bangla to some extent.

(51)a. ami kapoR dhulan  
'I finished washing clothes'

b. amar kapoR-dhoVa SeS holo  
'I finished washing clothes'

In (51)b the object incorporates into the verb which creates an
Transitivity, then, in the HT system, is a matter of carrying over an action from one participant to another which can be broken down into component parts, each highlighting a different aspect in this transferring of action in different parts of the clause (agents, verbs, objects).

2.7.2 Reduction of Transitivity

Givón (1985) in his discussion of ergativity in Newari showed that ergative morphology, especially split ergativity, is sensitive to the transitivity properties of a clause whereas nominative typology is sensitive to the discourse/pragmatic role of NPs in the clause in terms of whether they are or not the subject/topic. He reduces the transitivity properties of a clause in terms of three core properties of Agent, Patient and the Verb and the rest can be predicted through semantic/pragmatic general principles. These three components are:

(52)a. **Agent-related**: The prototypical transitive clause has a visible, salient, volitional, controlling agent-cause which imitates the event.

b. **Patient-related**: The prototypical transitive clause has visible, salient, non-volitional, non-controlling patient-effect which registers the bulk of the change associated with the event.
c. **Verb-related**: The prototypical transitive clause has a compact, perfective, real is verb or verbal tense-aspect modality.

As we can see, both A and 0 are salient in a prototypical transitive clause which further consolidates our motivation for studying one in terms of the other. The other crucial point to note at this juncture is that both a. and b. above are related to the predicational properties of a clause, i.e. by looking at the clause type, something about the agent and the patient can be inferred. Whereas, as Hopper (1983) has shown, verb-initial ergatives in Malay are non-predicational events. By looking at the centrality of the verb in agreement patterns of a language, again, we can say something about the Agent and Patient if a transitive clause.

By reducing HT's discourse parameters to three core notions, as in Giv6n, we have in fact reduced transitivity to Predication and Agreement — central to the discussion in the next chapter. WE motivate the last chapter (on **Classification**) on the basis of the discourse model that we have proposed in this chapter which picks out the reference of definites and indefinites in intersen-tential discourse according to a salience gradient.

The discussion of transitivity so far might give the false
impression that HT's transitivity parameters are calculable only for a simple clause. Givdn, in his discussion of Newari, shows that the interaction of complement verbs and ergative/non-ergative subject marking in the main clause in case of sodality verbs (verbs requiring a co-referential subject in their complements) like 'want', 'need', 'kill', 'break', 'work', 'can', etc. induce an upward filtering of transitivity. He shows that WANT/NEED are of low transitivity, KILL/BREAK are of high transitivity, WORK (like EAT) is syntactically high in transitivity but semantically low on the transitivity scale, and CAN is of low transitivity but at a higher position on the scale than WANT. This again shows that transitivity is a fundamental relation in natural languages.

2.7.3 Transitivity as an Inherent Feature

Amritavalli (1979) shows that in Hindi sain verbs as well as members of compound verbs carry the intrinsic feature of transitivity, independent of their context of occurrence. In the standard theory transitivity is a contextual feature like [+NP], it is not a theoretical prime. We have been arguing against that and so does Amritavalli. She shows that the transitivity of a verb in Hindi is relevant for the operation of two rules in the language: the rule of ergative Case-marking and the rule of passive. Both rules apply if the verb is transitive and neither rule applies if the verb is intransitive. Transitive
verbs occur in the context of NP # and intransitive verbs in #. For Hindi, there is a third possibility, where the verb is a member of a compound verb. It is in the third context that the above two rules apply consistently provided transitivity is treated as an intrinsic feature of the verb.

In sentences with compound verbs, the transitivity of V2 which determine the ergative Case marking. Consider the following:

(53)a. khargoS gaajar khaa-gayaa
    rabbit carrot eat-go-perf-masc-sg
    'The rabbit ate up the carrots'

b. khargoS gaajar khaa-gayaa hE
    be-PRS-sg
    'The rabbit has eaten up the carrots'

c. khargoS gaajar khaa-gayaa thaa
    be-PST-M-Sg
    'The rabbit had eaten up the carrots'

The intransitive V2 gayaa here cannot induce ergative Case marking on the subject. Consider the following now:

(54)a. khargoS ne gaajar khaa-Daale
    ERG put-PRF-M-Pl
    'The ate up carrots'

b. khargoS ne gaajar khaa-Daale hEM
    be-PRS-Pl
    'The rabbit has eaten up carrots'

c. khargoS ne gaajar khaa-Daale the
    be-PST-M-Pl
    'The rabbit had eaten up the carrots'

The transitive V2 Daale in (54) triggers ergative Case marking on
Now let us see how passivization is affected by different types of compounds. For a V1V2 compound where V2 is transitive, passivization correctly applies as in (55) but not when V2 is intransitive as in (56).

(55)a. kisaan ne mazduuroM ke vetan de-diye farmer HG labourers to wage give-give-PRF 'The farmer gave wages to the labourers'
   b. mazduuroM ko vetan de-diye gaye go-PRF (pass AUX) 'The labourers were given wages'

(56)a. kisaan mazduuroM ko vetan de-gayaa go-PRF
   b. * mazduuroM ko vetan de-gaya gaye

Amritavalli (1979) points out that the ungrammaticality of (56b) is not due to any surface constraint of co-occurrence on the two identical forms of jaanaa since similar ungrammatical results obtain for the following:

(57)a. wo muurkh kaam kar-bEThaa he foolish work do-sit-PRF 'He did something foolish'
   b. * muurkh kaam kar-bEThaa gayaa go-PASS

She concludes from this set of data that it is the transitivity of V2 that is relevant for the application of the passive to take
place. Accordingly, she justifies a system of designing the lexical entry of verbs in Hindi where the feature [\textit{\textbf{\textast}} Transitive] is an integral part of the entry.

2.7.4 \textbf{Psycholinguistic} Basis of \textit{Transitivity}

Having justified \textit{transitivity}, so far, as a natural theoretical principle, we now present convincing evidence from the psycholinguistic material to further strengthen our proposal. Chomsky (1980) makes a distinction between \textit{computational} and conceptual aspects of language and suggests that children at a very early stage may use a conceptual system to \textit{comprehend} language when \textit{language-specific knowledge} is not available. Researchers in learnability, like Wexler (1976), hypothesize that children construct meaning based on context. Wexler and Culicover (1980) show that \textit{syntax} would be unlearnable unless children were able to make use of \textit{information} from the underlying structure of sentences.

What the Semantic \textit{Bootstrapping} Hypothesis (of Pinker, 1982, 1984) has in common with learnability theories is the idea that children's early \textit{grammar} is characterized by a one-to-one form/meaning relationship between the events children witness and the linguistic input used to describe them. This is present only in the initial stages as the \textit{relationships} do not apply in adult grammar. Syntactic categories are not reducible to \textit{meaning}
despite the fact that early grammar makes use of this correspondence. These are two separate, interacting systems of representation.

Slobin (1981) showed how children begin the process of grammaticalization, that is, how they first crack the syntactic codes. Slobin shows that only certain conceptual relations are expressed and transitive events are likely to be among the basic ones. He hypothesizes that in the early stages only prototypical transitive events — the most salient events for the child — will be encoded in canonical form and later extended to other less typically transitive events. What is interesting for us is that Slobin bases his notion of prototypical transitive event on HT's discourse parameters.

Balcom (1990) extends this to mean that children are predisposed to attend to events that are of cardinal transitivity and therefore allow them to infer grammatical relations expressed therein. A distinction is made in the literature (Newport, et al. 1977; White 1980) between the language children are exposed to ("input") and the one they actually use in constructing their grammar ("intake"). Children are "tuned in" to cardinal transitive events — it provides a means for children to structure their experience.
Although HT's parameters are universal, individual languages select from those parameters rather than using them all. For example, Sheyne (1982) found that only four of HT's parameters were used in San Carlos Apache.

**Bruner (1972)** has found that from the first few weeks after birth, infants distinguish the category of people from the category of things. Other studies have similarly found that by twelve months participants (HT's A) are distinguished by infants and are endowed with permanence. Particular attention is paid to the Agent and Balcom (1990) proposes that children can distinguish agents from other participants. However, most studies report experiments which suggest agents as initiators of actions — that is, they appear in a given context prior to other participants. This could be the reason why children pay more attention to agents. In fact Golinkoff (1981) reports that both agents and patients are salient for children. According to Bloom (1973), these notions come from the child's conceptual relations: persons perform actions and things are affected by actions. This for us means that transitivity is a more basic and primary concept than, let us say, agreement which is more like a syntactic surface phenomenon. This is, therefore, another justification for study-
At the Multi-word stage, Greenfield and Smith (1976) report that the object is more salient\(^2\) and Lebeaux (1987) attributes the lack of subjects at this stage to the difficulty in Case assignment to an external argument.

Movement is a powerful visual stimulus which, according to some researchers, even neonates attend to. Movement makes objects more perceptible against their background. Bower (1982) has found that children detect motion as early as two weeks. All this research supports Nelson and Horowitz’s (1987) hypothesis that the mammalian brain is "prewired" to attend to motion.

No clear distinction is made by children at an early stage between punctuality and aspect — their determination depends rather on the Aktionsart either inherent in the verb or conveyed by the interaction of the verb and its arguments (Tenny, 1987) and the situational context of the utterance. Bickerton (1989) suggests that the verb's situation determines its punctuality. Research in this field indicates that the distinction inherent in

1. One might also add that this is also the beginning of education for the human child regarding "power".

2. That is, an interest in the "victim".
the punctuality and **aspect parameters**, namely, the end results being more **salient** rather than the **transitional** phase and punctual events being more likely, is adhered to.

**Volitionality** in a child's language is defined **more** in terms of initiation of events rather than the adult concept of agency. Children first encode the notions of animate subjects or inanimate objects in terms of movement and **intentionality**. Bloom, et al. (1975) suggest that movement controls early word order.

As far as **mode** is concerned, children's language is based on the real world and real **events** in it. Sachs (1983) reports that before the age of three her subjects rarely made reference to objects or events based on fantasy or prior experience.

Crucial aspects of individuation, as we have seen, are **referentiality** and **definiteness**. The individuated entity is discrete, bounded, and separate from its environment. Bower (1982) found that young children (2-4 **months**) expressed surprise when an object did not appear after being covered by a screen. These studies show that infants perceive objects as being unitary and separate from their surroundings. Also, because their early speech is grounded in the here and now, words at this stage tend to be definite and have specific reference at all times.
Regarding **affectedness** of **object**, the change should be apparent and **visible**, causing the object to move or alter its state. Nelson (1973) found that the first fifty words children use consist of words describing changeable states rather than words relating unchanging attributes. For example, 'allgone', 'dirty', 'hot' vs. 'red', 'round', 'pretty', etc. The basic underlying fact (or universal) seems to be the one of kinesis.

For **HT**'a affirmation parameter no substantial evidence is found which points towards the use of one over the other. Typically, in the early stages children use 'no' in isolation to express rejection or refusal, while non-existence is expressed in a sentence and is generally considered to be learned later.

In **general**, Slobin's hypothesis **seems** to hold true in other studies as well (such as Balcom 1990), that is, children begin by attending to and encoding events of cardinal transitivity and subsequently apply the grammatical device thus acquired (for example, SVO word order in these studies) to events of low transitivity.
2.8 Syntactic Transitivity

Having established transitivity as an indispensable fundamental relation, let us look at a proposal of syntactic transitivity. Murasugi (1992) tries to account for the difference between Accusative and Ergative languages by proposing a difference of movements (of syntactic heads) in these languages and a difference of valency of TrP and TP among these two types of languages. The respective differences in movements are depicted in (58) and (59) below:

(58) ACCUSE tive language (Subj\textsubscript{NOM} Obj\textsubscript{ACC})

\begin{center}
\begin{tikzpicture}
  \node {TP}
  child {node {SPEC} edge from parent[draw=none]
    child {node {T'}}
    child {node {TrP}
      child {node {[NOM]} edge from parent[draw=none]
        child {node {[AGR]} edge from parent[draw=none]
          child {node {Tr'}}}
      child {node {[ACC]} edge from parent[draw=none]
        child {node {[AGR]} edge from parent[draw=none]
          child {node {NP\textsubscript{1}} edge from parent[draw=none]
            child {node {V'} edge from parent[draw=none]
              child {node {V edge from parent[draw=none]
                child {node {NP\textsubscript{2}}}}} }}}}}}}
  child {node {\ldots}};
\end{tikzpicture}
\end{center}
The strong head in each case is indicated by bold face — T in the case of Accusative languages and Tr in the case of Ergative languages. Notice that the series of movements result in crossing paths in the former and nested paths in the latter. In Accusative languages the Case features contained in T and Tr are respectively NOM and ACC whereas in Ergative languages they are respectively ABS and ERG. Movement, as standardly assumed in minimalism (Chomsky, 1993), is due to Case (and agreement) reasons.

Murasugi (1992) differs from Chomsky (1991, 1993) and Pol-
lock (1989) in having any AgrPs in her representation. Agreement in her system is mediated through T and Tr -- by V to Tr to T movement. The other features carried by T and Tr are [+TNS] and [+Trans] respectively. In intransitive clauses the value of Tr is [-Trans] and the subject moves to SPEC TP for Case reasons in such clauses in both types of languages under discussion. So it is only the transitive paradigm that distinguishes the two movements shown in (58) and (59).

The feature system adopted is something like this:

```
T      Tr      NP      Vt      Vi
[+TNS] [+Trans] [0] [0] [0] [0] [0]
[NOM] [ACC/ERG] [Case] [+Trans] [-Trans]
          [+TNS] [±TNS]
```

In English the 0 features of the subject can be checked only at LF where the V raises to T. Features are not necessarily checked at the same level as their movements.

Now, Murasugi's notion of transitivity is purely syntactic and therefore transitivity in this system is simply a matter of counting the number of arguments in the VP (as also the subject of embedded clauses in ECM structures). She qualifies it later to say that transitivity is a matter of the number of arguments the Tr head governs. If it governs just one argument then the clause is [-Trans] and if it governs two arguments then it is [+Trans]. This is slightly unfortunate and anachronistic since
the notion of government is no longer a theoretical prise in the framework she has chosen to present her thesis.

Different types of clauses show the following type of movements in her system:

(60) **Transitive Clause**

<table>
<thead>
<tr>
<th>Acc - language</th>
</tr>
</thead>
<tbody>
<tr>
<td>TP</td>
</tr>
<tr>
<td>/\</td>
</tr>
<tr>
<td>/ \</td>
</tr>
<tr>
<td>T TrP</td>
</tr>
<tr>
<td>/ \</td>
</tr>
<tr>
<td>Tr VP</td>
</tr>
<tr>
<td>/ \</td>
</tr>
<tr>
<td>NP1 \</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>V NP2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Erg - language</th>
</tr>
</thead>
<tbody>
<tr>
<td>TP</td>
</tr>
<tr>
<td>/\</td>
</tr>
<tr>
<td>/ \</td>
</tr>
<tr>
<td>T TrP</td>
</tr>
<tr>
<td>/ \</td>
</tr>
<tr>
<td>Tr VP</td>
</tr>
<tr>
<td>/ \</td>
</tr>
<tr>
<td>NP1 \</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>V NP2</td>
</tr>
</tbody>
</table>

(61) **Intransitive Clause**

Note: [-Trans] Tr has no Case feature so only SPEC TP is available for Case checking.
(62) **Unergatives**
As we have indicated earlier, although in Murasugi's treatment of TrP is nothing but a place holder, there are reasons to believe that it carries more weight than that. Natural languages like Chukchee and Eskimo were shown to exhibit morphological features of transitivity and intransitivity which itself is a good reason to suppose that the projection proposed is more real than a more place holder. How it can be useful for our purpose will be depicted in the section after the next.

2.9 Computation of Transitivity

In this section we intend to show how the two notions of transitivity presented in this chapter — Discourse/Semantic transitivity (of HT) and syntactic transitivity (of Murasugi, 1992) — can be accommodated into a broader algorithm to serve our purpose.
First let us try to imagine what kind of computational processes transitivity represents. Or to rephrase the question in terms of what we have tried to establish so far, namely, to study salience is to study transitivity, what kind of computational processes are reflected by salience? What role does it play in the coordination of our processing certain information in our surroundings?

2.9.1 Model - Driven Computation of Salience

It is worth our pursuit to look at how Parma, Hanson and Riseman's (1980) UMASS VISIONS system works. The approach of the VISIONS system combines the bottom-up analysis of regions and edges in the raw visual image with top-down testing of frame-based hypotheses about the content of photographs of natural scenes. The VISIONS system is, therefore, model-driven, once it moves away from the low level problem of identifying regions. For example, if the system ascertains, from available edge and region data, that there is a house in the photograph, the system will use its generic knowledge to disambiguate regions. Even if the image is actually that of a boat in the water, it might still trigger the house hypothesis because of certain similarities in the features of the house and the boat. In such a case, the elements of the picture, inconsistent with a house-scene frame,
like the blue colour of the ground plane, would be vital in stopping the instantiation of that frame any further.

Generally speaking, an attempt is made to construct an inner model of the external world excerpt based on sensory data from that world and generic knowledge about it. Components of salience are therefore the following:

(i) First, the system relies on a region of size and centrality of a region to approximate the most likely model for identifying the rest of the scene.

(ii) Unexpected elements of a scene, that is, those which do not have a good fit with their slot in the hypothesized frame, are important for efficient allocation of resources (the instantiation of a particular frame) and will be tagged with some measure of goodness of fit.

(iii) The intrinsic importance of certain elements in the scene is also useful for further allocation for confirmation of identification. For example, given the knowledge that people are intrinsically more important than objects, the system will make sure that this is indeed true when it identifies an image region as people.

The elements of model building for which the notion of salience is important, as we saw in the last paragraph, are the following three:

(a) structural knowledge about the location in the external field of data where resources are to be focussed initially (e.g. size and centrality).

(b) use of a measure of "goodness of fit" to guide the instantiation of generic features.
(c) prior knowledge about intrinsic salience of objects in relation to a particular situation.

2.9.2 Mixed Mode Parsing

The parsing technique used here is a mixed-mode method which uses varying degrees of both top-down and bottom-up techniques to retain only the advantages of both approaches. Top-down parsing has the advantage that it will never consider word categories in positions where they cannot occur in a legitimate sentence. This is because the parser works from a syntactic category and checks the word that fits that category. For example, if we use the grammar (64) for a sentence the can broke, the parsing will start with rule 1 and will expect to find an NP to start with ART as in 4 and 5, to be followed by either a NOUN as in 4 and ADJ as in 5. But since can is a NOUN it finds it as expected and the AUX and VLRB senses of the word are never considered.

(64)

1. S --> NP VP
2. S --> NP AUX VP
3. S --> NP VERB
4. NP --> ART NOUN
5. NP --> ART ADJ NOUN
6. NP --> ADJ NOUN
7. VP --> AUX VERB NP
8. VP --> VERB NP

The problems of repetition and long processing are avoided in a bottom-up system. For example, a sentence like the man jumps will require a top-down parser to backtrack twice (after failing
to parse with 1 and 2), in a **bottom-up** approach *the man* will be constructed only once and rule *would match* to give an S. Among mixed-mode approaches there is one where a top-down approach adds each constituent as it is constructed to a chart. AB the parse continues, before rewriting a symbol to find a new constituent, it can first be checked whether it is already there in the chart or not.

However, the model-driven mixed-mode parsing that was used for VISIONS could have been made more efficient, we think, if there had been some way to pick up the salient features instantaneously instead of first trying to construct a model. This, we believe, can be achieved by using the concept of syntactic transitivity of the kind we have looked at. For the purpose of execution a Principle-Based parsing technique could give us the right measure of **sophistication** we need to build in a network like the one we are considering. For details regarding Principle-Based parsing, see chapter 5 where we take up the issue of **Noun-classification** in this context. The added advantage of using Principle-Based parsing techniques for a syntactic framework like **minimalism** is that due to a reduction in the number of principles in the current framework, parsing would become simpler **computationally**. We emphasize that at this point of derivation or analysis the transitivity parameters are not taken into ac-
count. After we have worked out the agreement system in the following chapter, it will become a trivial operation to pick up the object of an input clause. Depending on how exactly this is done by the agreement algorithm, we will be in a position to assign a feature to the Tr and T heads. Case/Agreement checking can then take place according to the set of operations depicted in (60) - (63). Apart from the transitivity feature, agreement will also decide the [$\pm$TNS] features on T which has a crucial effect on Case/Agreement checking.

Once we have a broad idea of what the clause looks like, by performing the set of operations proposed so far, that is, a principle-based parsing through syntactic transitivity, we can now think of finding further details in connection with the participants in the clause. This can be achieved, we propose, by properly working out HT's parameters to suit our purpose. That is, all the lower level computations to achieve the correct status of various participants is done through HT parameters. Parsing here will proceed in a bottom-up fashion working out how different parameters and the input words interact to give us all possible senses of the input words. In cases where we have to resolve the reference of anaphors, we will construct a computational version of our field-view of discourse and use essentially the techniques elaborated in this section for the purpose.
We have tried to show in this section how both syntactic and semantic/pragmatic studies of transitivity are justified to serve but one goal — that is, to be efficiently used in a mixed-mode parsing strategy — in short, a computational goal.