to language capacity. It is well-attested (see p. 15) that in normal adults, linguistic capacity is relatively localised in one brain hemisphere (usually the left). For example, clinical evidence shows that lesions in the left hemisphere are more likely to cause aphasia than lesions in the corresponding area of the right hemisphere. Similarly, Kimura (1967) showed that most normal adults repeat more of the digits presented to the right ear (functionally enervating the *left* hemisphere) than of those presented simultaneously to the left ear (enervating the *right* hemisphere). (See Bever, 1970c, for a review of these and related phenomena.) Lenneberg (1967) presents evidence that this neurological specialisation of linguistic function is not 'fixed' until the age of 12-13, since before that age aphasia resulting from lesions to the left hemisphere is quickly overcome, suggesting a 'transfer' of the function to the right hemisphere. The relative persistence of aphasia from left-hemisphere lesions sustained after that age suggests that the relative equipotentiality of the two hemispheres has been lost.

More recent research indicates that while there is some lability of dominance, which is perhaps not firmly developed until age 12, there is also a predisposition for the left-hemisphere to be dominant in speech even in the very young child. First, Wada (1969) has reported a greater anatomical development in neonates of left hemisphere brain areas involved in speech behaviour. Second, Teuber and Twitchell (Teuber, in press) have found that children with signs of early lesions in the left hemisphere have retarded verbal development compared with children showing signs of early right-hemisphere lesions. Such investigations suggest that the young child does not have total freedom to select which hemisphere is to be specialised for language; there is a genetic predisposition for the left hemisphere.

We have found a relation between the development of certain perceptual strategies for dealing with speech and the development of an ear-preference. Those children between three and five who show a strong ear preference also show a strong tendency to utilise the strategy that the first noun in a speech sequence is the actor. This suggests that there is an intimate relation between the differentiation of such strategies and the emergence of lateralisation (Bever, 1970c).

Some of our recent investigations show that environmental stimulation plays a critical role in the emergence and 'fixing' of the neurological predisposition for the left hemisphere (Bever, Palmer, Sumner and Moran, in preparation). We examined two socio-economically matched populations of boys at age four years, eight months (4/8) on

simple measures of hand, ear and eye dominance. The experimental group had participated in a diffuse 'cultural enrichment' programme (see Rees and Palmer, 1969, for a description of the programme) starting at 2/8 for some boys and 3/8 for others. A control group was tested (on standard measures of intellectual capacity) at the same intervals as the experimental groups but received no enrichment. At age 4/8 the experimental groups showed more hand/ear/eye consistency (ie preferring the right hand, right eye, and right ear to the same extent) and more children showed an overall preference for the right side (associated functionally with the left hemisphere, at least for the hand and ear). That is, while there may be a predisposition for the left hemisphere to be dominant, certain environmental stimuli can stimulate the emergence of its structural integration with sensory-motor processing.

In conclusion, the development of the ability to talk, and to listen, and of the neurological dominance underlying language all start out at age two with certain predispositions, either inborn or previously acquired. Shifts occur in each of these aspects of linguistic organisation as a consequence of interacting with the linguistic and cognitive environment. Such facts support the claim that language-learning depends on specific mental and physiological structures rather than on 'general intelligence'.

Some scholars have taken the linguists' claim that language is 'innate' to include the claim that inborn linguistic predispositions are not themselves derived from other general properties of human neurology and cognition, but are limited to their linguistic expression. It is not a necessary part of the claim that there are innate structures underlying linguistic universals that those structures are not reflected in other aspects of human behaviour. Of course, it is also not obvious what a 'general purpose' learning model would be like, despite the attempts of many psychologists to frame one. Insofar as a general learning theory predicts the impossibility of abstract linguistic structures, it is inadequate to account for the learning of human language. However, failure of one type of allegedly general purpose learning theory to account for language learning does not prove that some other general learning theory will not account for it.

C. Language as a communicative system

The previous chapters discuss specific ways in which we should modify our preoccupation with the acquisition of pure grammatical structure so as to set the psychology of language in a broader perspective. Leontiev urges that we view both social structure and language

as functions of the basic 'urge' for socially motivated and organised communication. Schlesinger makes the related argument that human language is merely one example of possible human communication systems. Wales narrows the argument further by discussing specific psychological mechanisms that may underlie highly intricate grammatical structures. Hasan maintains that grammatical structure itself cannot be studied or understood in isolation either from the semantic structure of language or from the semantic properties of specific lexical items. The two chapters concerned with the biological basis of linguistic structure both suggest that we must be cautious in assuming that every universal property of languages is necessarily 'innate'. Campbell points out that many behavioural properties recruited by human language are also utilised by presumptively more primitive communication systems. Finally, McNeill attempts to distinguish between different kinds of linguistic universals as a function of the extent to which they are derived from general (non-linguistic) cognitive properties of human beings.

Viewing all of these arguments together we can see that they represent attempts at a delimitation of the role of 'syntax' in language which we should take into account when studying its universal properties in adults and its development in children. We could represent this delimitation as a kind of conceptual algebra which describes what we must factor out from language behaviour before attributing it to a specific linguistic structure rather than to a linguistic expression of a

14. (Structure of Language Behaviour) — (SU + HCS + PN + SS + BUC + CS) = (specifically linguistic structures)

general psychological structure (where SU = social urge; HCS = common properties of all human communications systems; PM = psychological mechanisms; SS = semantic structures; BUC = biological universals of communications systems; CS = common properties of all human cognition systems).

Of course such conceptual articulation is possible only when the items are mutually exclusive and functionally independent (ie when what is represented by one term is not affected by what is represented by any of the other terms). Unfortunately, such independence is the exception rather than the rule; we cannot add and subtract aspects of behaviour as though they were integers. Rather we must view language as an organizing communication system within which different mental and neurological mechanisms interact and modify each other. In discussions and research we may refer to each mechanism as though

it had isolable properties, but this must be viewed as a necessary idealisation and a scientific metaphor rather than a reflection of the true state of affairs.

Dissatisfaction with the current devotion to syntactic phenomena in language behaviour is a natural outgrowth of the progress and speed of the structuralist revival that has occurred within linguistics. It is indeed time to expand our horizons beyond the treatment of syntax to more inclusive treatments of language behaviour. However, we must tread carefully lest our enthusiasm to describe all available 'facts' about language leads us into the same kind of behaviourist swamp that engulfed the last structuralist period between 1920 and 1950. We can avoid this danger and bring the study of language into line with other areas of behavioural science if we recognise that language behaviour is itself a function of a variety of interacting systems, none of which is logically prior in its influence on language behaviour.

In this sense the study of language is like the study of an animal within biological science. Consider for example the description of a rabbit: it includes such items as the fact that the rabbit engages in hopping behaviour, is herbivorous, has a specific normal body temperature, has a certain kind of liver, has a unique genetic structure, lives in holes in the ground, and so forth. All of these facts are part of the description of what a 'rabbit' is; yet none of them alone is an exhaustive or sufficient description of 'rabbit'. All of the physiological and behavioural subsystems of the rabbit exist simultaneously and can modify each others' structure and function. Thus, while we can study the function of the rabbit's liver as though it existed in total isolation, there are certain points where our description of the liver must take into account other subsystems of the animal—eg, the body temperature, normal heart rate, the behavioural patterns accompanying elimination of body wastes and so on. Of course, certain aspects of the animal might appear to be so remote as to be functionally distinct from each other; for example, one might think that there is no mutual influence between the length of the rabbit's ears and the function of his liver. However, interactions between each subsystem set up for isolated description cannot be ruled out *a priori*, but must be examined empirically. For example, one might argue that the length of a rabbit's ears is involved in increasing body surface to increase control over body temperature (cf the fact that desert-rabbits' ears are particularly oversized). Thus after all, there is an interaction between ear length, and *all* internal organs via temperature regulation. An animal is a coherent whole in which no component is entirely distinct from any other.

An analogous line of argument holds for the study of language. During the past few years we have concentrated on the study of the structure and acquisition of the syntactic aspect of language; we have made the simplifying assumption that the interactions between syntax and other aspects of language behaviour are sufficiently remote so that theoretical conclusions about the structure of syntax will not turn out to be spurious when placed in a larger context. However, as we consider other subsystems of language behaviour it is becoming clear that the attempt to study syntax *in vitro* has certain limits which we may have already exceeded.

In the remainder of this discussion I shall review three aspects of the interaction of syntactic structures with other behavioural aspects of language. First, there are many sources for the unacceptability of potential sentences in addition to structural 'ungrammaticality': in some cases linguists may mistakenly construct a syntactic theory to rule out particular utterances as 'ungrammatical' which in fact are unacceptable due to non-grammatical facts about their use. Second, the role in laboratory studies of particular grammatically defined structures is greatly influenced by the subject's task: thus certain structures which are necessarily primary in linguistic descriptions play a secondary role in many other kinds of speech behaviour. Finally, the nongrammatical mechanisms of speech behaviour in the child can be seen to play a part in the formation of the child's grammar itself. As a result the linguist may claim as a structural 'grammatical universal' a property of language which is really due to extra-grammatical properties of the language-learning child.

1. *The multiple source of sequence unacceptability*

Linguistic grammars are descriptions of a range of structural facts about speech sequences, the most basic of which is that some are grammatical and that some are ungrammatical. The intuitions of native speakers about the acceptability of potential sentences is the main source for such facts. For example, the sequences in (15) are clearly ungrammatical, while those in (16) are clearly grammatical.

15. a. *I believe it that John to be a Martian.
    b. *Paul Bunyan falled the trees as fast as J. Apple seed growed them.
    c. *Me Tarzan, you Jane.
    d. *White man speak with forked tongue, steal land, sell firewater braves.

*This symbol indicates that the sentence following is not an acceptable English sentence.

16. a. I believe John to be a Martian.
    b. P. Bunyan felled the trees as fast as J. Appleseed grew them.
    c. I'm Tarzan, you're Jane.
    d. The White men spoke with a forked tongue, stole the land and sold firewater to braves.

These cases are perfectly clear and will be agreed upon by all native speakers of English. Thus the factual basis of grammars can be quite solidly grounded in intuitions about acceptability of sequences.

However, there are many bases for unacceptability judgements in addition to the violation of grammatical constraints. First, there are cases in which sentences are unacceptable because they appear to place an inordinately heavy load on the system of speech perception. For example (a) is far less acceptable than the grammatically parallel (b) in each of the pairs below:

17. a. ?The horse raced past the barn fell.
    b. The horse ridden past the barn fell.

    a. ?The pitcher tossed the ball tossed the ball[1]
    b. The pitcher thrown the ball tossed the ball.

    a. ?They didn't like even considering discussing continuing selling buildings.
    b. They didn't like even considering a discussion of continuing to sell buildings.

There are also cases in which sentences are unacceptable because they are impossible to utter (at least without special practice which allows one to circumvent the usual system of speech production):

18. a. ?Peter Piper picked a peck of pickled peppers.
    b. Peter Johnson picked a lot of ruined peppers.

    a. ?She sells seashells by the sea shore.
    b. She hawks mollusks by the sea shore.

    a. ?Rubber baby buggy bumpers bug Bugs Bunny.
    b. Metal baby carriage bumpers upset Bugs Bunny.

? This symbol indicates that the acceptability of the sentence following is questionable.