[Place, U. T. (1998). Behaviourism and the evolution of language. In Man Cheung Chung (Ed.), *Current Trends in History and Philosophy of Psychology Volume 2* (Chapter 9, pp. 55-61). British Psychological Society.]

BEHAVIOURISM AND THE EVOLUTION OF LANGUAGE

Ullin T. Place

University of Wales Bangor

Abstract

The view that linguistic competence is acquired and maintained according to the principle of selective operant reinforcement is defended, partly on grounds of evolutionary probability and the special nature of human environmental adaptation, and partly on the basis of two strands of empirical evidence: experimental evidence from studies of "verbal conditioning" and observational evidence of naturally-occurring verbal interactions in the work of discourse and conversation analysts. But, since selective operant reinforcement is as much part of animal as it is of human learning, that principle by itself cannot explain why only humans have developed language and why apes can, at best, attain to the linguistic competence of a human two-year-old.

1. *Language is learned*

Contrary to the opinion of Chomsky (1965), language, both the speaker's utterance and the listener's response, is learned behaviour. Linguistic competence, defined following Chomsky (1957 etc.) as the ability to construe and construct indefinitely many novel well-formed sentences in a particular natural language, is acquired and maintained by the same principle as that which applies in the case of animal learning and much of the learning in connectionist networks, the principle formulated by Thorndike (1911) as the "Law of Effect", by Skinner (1981/1984) seventy years later as the principle of "Selection by Consequences" and by the connectionists (Rosenblatt 1959; Widrow & Hoff 1960; McClelland & Rumelhart 1988) as the "error-correcting or 'delta' learning rule."

2. *Why language* must *be learned*

That language *must* be learned is evident from the following considerations:

(a) The pre-linguistic forms of communication analyzed by the ethologists (Tinbergen 1951) vary little within species, are demonstrably innate and permit learning only within narrow constraints, as illustrated by the phenomenon of 'imprinting' (Lorenz 1935/1957).

(b) Whereas our nearest primate relatives, the anthropoid apes, are confined to a narrow ecological niche within the tropical rain forest, *homo sapiens*, and to a lesser but nevertheless significant extent, earlier hominid species have succeeded in colonising a variety of different habitats, not by developing physical characteristics adapted to those environments, but by devising and learning a new technology appropriate to that currently occupied. Moreover, if the Tower of Babel legend is to be believed, it is by learning to modify their language so as to talk about the new environment and the technology used to adapt to it that different natural languages have evolved from a single parent stock.

3. *Why language must obey the Law of Effect*

The following considerations show that if language is learned, it must be learned in accordance with the principles described by Thorndike, Skinner and the connectionists:

(i) The Law of Effect is an application of Darwin's principle of variation and natural selection to the process of learning. The only differences are that in this case the development is ontogenetic rather than phylogenetic, and that the units that survive or are eliminated are patterns of behaviour rather than individuals with certain inherited characteristics.

(ii) The Law of Effect is the only learning principle at the molar level of analysis that can effectively promote the survival and reproduction of the social group.

(iii) The introduction of a new set of learning principles to cope with the learning of language would be a biological extravagance, if there already exists, as there clearly does, a set of such principles tried and tested over millions of years of evolutionary history.

4. *Experimental evidence for the role of reinforcement in verbal behaviour*

The proposition that linguistic competence is acquired and maintained by the Law of Effect is supported by two kinds of evidence: experimental evidence and evidence from the observation of naturally-occurring conversations and business transactions. The *experimental evidence* consists of a series of studies of what was then called "verbal conditioning" (Krasner 1958), published between 1954 and 1962 of which three stand out as both representative and evidentially persuasive.

The first and best known study is that of Greenspoon (1954; 1955). Greenspoon asked his subjects to say all the words that came into his or her head without repeating and without using sentences or phrases. He then selected a particular category of word, either plural nouns or non-plural nouns, for either reinforcement or disinforcement.[1] In two groups of subjects every time the subject produced a plural noun in one group or a non-plural noun in the other group the response was reinforced by the sound *Mmhmm*. In another two groups the same responses were disinforced by means of the sound *Uhuh*. In both cases there was a significant increase in the number of plural nouns or non-plural nouns in the groups in which these responses had been reinforced and a corresponding decrease in those categories of response in the groups in which the responses had been disinforced. Although it appeared from questioning after the completion of the experiment that 10 of the 75 subjects were able to verbalize the relation between the category of response and its reinforcing and disinforcing consequences as the case may be, the remaining 65 subjects were apparently unaware of this relationship and its effect on their behaviour.

Greenspoon's experiment can be criticised (cf. Spielberger and Levin 1962) on the grounds that its artificiality is liable to prevent the consequences applied from having the effect that they do in the course of normal conversation, in particular, making the consequences much more salient than they are in normal conversation. This objection cannot be raised against Verplanck's (1955) experiment in which he persuaded a group of his students to engage an unsuspecting fellow student in one-to-one conversation for half an hour. After an initial "baseline" period of 10 minutes during which the number of opinions given by the subject was recorded, supposedly without any reinforcement being given, the experimenter was instructed during a further 10 minute period to make a point of agreeing with every opinion expressed by the subject. In a final

[1] For the use of this term see Harzem & Miles 1978.

10 minute period, the experimenter was instructed to withdraw this reinforcement either by failing to respond to opinions expressed or, in some cases, by actively disagreeing with the opinion. In an alternative version of the same experiment some experimenters were asked to agree with the opinions expressed during the first ten minute period, withdraw reinforcement during the second ten minute phase and restore it during the final phase. In both cases there was a significant increase in the number of opinions expressed by the subject while the experimenter was agreeing with him. Whereas during the non-reinforced phases, particularly after a preceding period of reinforcement, not only did the number of opinions expressed decline, but

> some *S*s got angry at *E* and commented on his disagreeableness, or noted his 'lack of interest.'

Apart from this,

> No *S* ever gave evidence that he was 'aware' that his behavior was being deliberately manipulated and recorded, or that there was anything peculiar about the conversation. (Verplanck, 1955, p. 671).

The third piece of experimental evidence comes from a paper by Azrin, Holz, Ulrich & Goldiamond (1961) which records a series of attempts to repeat the Verplanck experiment. Of these I shall mention only the last in which the experimenters were trained animal behaviour researchers rather than undergraduate students, as in Verplanck's original study. With these experimenters

> Out of 12 attempts, not one of the four *E*s could complete his experiment. It may be recalled that the procedure requires that the *E* restrict himself to agreement (or disagreement) of opinions, and stipulates no questions, statements, nods, smiles, or other types of interaction. The reason for forbidding such behavior proved to be obvious: *E*s reaction, however subtle, could often be seen to exert profound but uncontrolled effects upon the conversation of the subject. In the absence of any reaction by the four *E*s, however, all of the twelve *S*s terminated the conversation within 10 minutes by leaving the room where the conversation was taking place." (Azrin *et al.* 1961, p. 29)

This result is taken by the authors as casting doubt on the reliability and validity of the original Verplanck experiment. In fact what it shows is that you cannot maintain a conversation unless the speaker's verbal behaviour is reinforced in some way by the listener.

5. *Observational evidence of reinforcement in naturally-occurring verbal interactions*

The observational evidence for the role of reinforcement in verbal behaviour is to be found in the massive corpus of tape-recorded conversations that has been collected over the past 25 years both by social psychologists and linguists working in the field known as "discourse analysis" and by sociologists in the field

known as "conversation analysis". What this corpus shows is that verbal reinforcement of the kind investigated in the three experimental studies I have described are to be found in every naturally-occurring verbal interaction between two people whether on the telephone or face-to-face. But, because of the disrepute into which behaviourism and its technical terminology have fallen over that period, they are not referred to as verbal reinforcers. Discourse analysts call them "back-channels". Conversation analysts call them "response tokens". Table 1 (Place 1991; 1992; 1997a) is typical of this evidence. It is part of a tape-recorded conversation which took place in the Philosophy Departmental office at the University of Leeds in October 1985 between Rose Purdy, the Departmental Secretary, and Penny Ewens then a mature student in the second year of a philosophy degree. The upward pointing arrows show the points where a sentence is completed by the speaker. You will see that in almost every case, each sentence triggers a response from the listener. Most of these are reinforcers. 'Yes' where the speaker's sentence is affirmative 'No' where it is negative. On two occasions, on lines 8 and 11, the listener's response is a disinforcer in the form of a question requiring the previous speaker to either confirm the listener's interpretation or restate what has just been said.

6. *Do verbal reinforcers reinforce?*

Verbal reinforcers are of two kinds (Place 1997) "*continuers*" whose function is to reassure the speaker that the sentence has been understood and accepted and thus allow her to move on to the next sentence and "*terminators*" whose surface effect is to close a speaker's turn and allow the listener to take over as speaker. The implication of describing such events as 'reinforcers' is that they have two kinds of effect. On the one hand a reinforcer may have an *intra-episodic* effect whereby the current on-going flow of the organisers behaviour is maintained. In the reinforcement of verbal behaviour only continuers have this intra-episodic function; and the fact that they have it is clearly demonstrated both by the experimental and by the observational evidence I have cited. Much less easy to demonstrate is the *extra-episodic* effect of both continuers and terminaters, their effect in maintaining and enhancing the speaker's linguistic competence, her propensity to construct and utter sentences in the future which are relevantly similar to those that have been successful in the past, while avoiding constructions and usages that have proved unsuccessful. For the

Penny:	it's *just* this bus'ness of (.) th' *par*ty [for the *fi*rst y:e:ars.	01
Rose:	[ye:(s) yes=	02
Penny:	=*I* won't (.) be *i*n tomorrow mo:rning.	03
Rose:	no=	04
Penny:	=I've *left* a *no*tice on the *board*.	05
Rose:	yeah.=	06
Penny:	=and there's a *no*te for them °of the money.	07
Rose:	wh*o* wants to pick it up?=	08
Penny:	=we:ll (.) th*e:*re on that li:[st.	09
Rose:	[oh the're °all on that *li*st.=	10
Rose:	= (.) and any-any of these people [can *have* it, (.) can they.=	11
Penny:	[yes:: (.)	12
Penny:	=I *do*:: know John's girl friend *knows* about it.=	13
Penny:	=bu(t) *she's* not *free* at the same time as *them* tomorrow.=	14
Penny:	=so:th't *lots* of people *know* about it.=	15
Rose:	=anan *the:*re goin(g) to *get* the shoppin(g) *ou*[t of it. (.) I *see*=	16
Penny:	[yes (.)	17

Table 1 The Party 10/85

behaviourist, of course, the existence of such effects is an article of faith which is seldom questioned. For others, given the virtual impossibility of conducting a controlled experiment on the effect of systematically reinforcing incorrect usage and disinforcing correct usage, the evidence is at best circumstantial. Of this the most persuasive to my mind is the existence within every verbal community of social conventions backed up by speaker's anger and a serious threat of social ostracism, if they are not observed, whose function is to

ensure that every intelligible utterance by the speaker is suitably reinforced, and that where a disinforcing interjection is required, its effect in provoking the speaker's anger is minimised, as in the phenomenon known to conversation analysts as 'preference organisation'. The universality of such conventions only makes sense on the assumption that adequate reinforcement of the speaker's verbal behaviour by the listener is essential to the maintenance of linguistic communication within the verbal community constituted by speakers and interpreters of the natural language in question.

7. *The peculiarities of verbal reinforcement*

But while there is good evidence that the acquisition and maintenance of linguistic competence obeys the Law of Effect, the learning situation involved is very different from that encountered in the Skinner box. Four differences stand out:

(i) In the Skinner box the behavioural unit that secures the reinforcement, the key-peck or bar-press, is the same unit that is subsequently repeated. In verbal behaviour the unit that secures reinforcement is the utterance of a complete sentence. But sentences, as Chomsky has often reminded us, are seldom repeated word for word. They are typically constructed anew on each occasion of utterance. The units that *are* repeated, the words, phrases and sentence frames, secure reinforcement only as part of an uttered sentence.

(ii) Whereas the Skinner box provides a *win-stay/fail-shift* contingency, at the level of sentence construction, verbal behaviour is on a *win-shift/fail-stay* contingency (Place 1997a; 1997b). When your sentence succeeds as evidenced by the listener's response, you do not repeat yourself; you go on to the next sentence. You repeat yourself only when the first attempt fails, usually saying the same thing in slightly different words.

(iii) The delivery of food which reinforces responding in the Skinner box strengthens the organism's propensity to emit *any* behaviour which regularly precedes it. Verbal reinforcers are specific to a particular class of behaviours and act as reinforcers only with respect to behaviour of that kind. Thus opinion-stating is reinforced by an expression of agreement, instruction-giving by an expression of comprehension, news-

telling by an expression of interest or surprise, troubles-talk (Jefferson 1988) by an expression of sympathy, and joke-telling by laughter.

(iv) Whereas the delivery of a food pellet is an extremely salient stimulus event which cannot fail to occupy the focus of the organism's attention, the speaker is almost totally oblivious of the delivery of the reinforcers supplied by the listener, as is the listener of supplying them. As Verplanck remarks, they attract attention only when they are omitted on an occasion when their delivery is to be expected.

8. *The peculiarities of verbal reinforcement are not unique*

Despite these differences there is nothing in the way verbal behaviour is reinforced which does not have its parallels in the operant or instrumental reinforcement of animal behaviour. The dissociation between the response that secures reinforcement and the behaviour that is strengthened as a result has its counterpart in the reinforcement of any non-stereotyped skilled performance. Win-shift/fail-stay contingencies have their counterparts in the foraging behaviour of animals from which the concept derives. The restriction of the reinforcement of particular varieties of verbal behaviour to a particular reinforcer has its counterpart in the secondary reinforcers whose appearance allows the animal to move on to the next component in a behavioural chain (Gollub 1977). The analogy with the reinforcement of verbal behaviour is particularly close in the case of a chain in which two organisms are required to respond in alternation in order to obtain the primary reinforcer at the end of the chain. Note also that secondary reinforcement within a behavioural chain is another case of a win-shift/fail-stay contingency. Finally the reinforcement of behaviour in the absence of awareness of the reinforcer almost certainly has a counterpart in the reinforcement of behaviour by electrical stimulation of the hypothalamus (Olds & Milner 1954), a form of stimulation which we can be tolerably certain from what we know about the effect of stimulating other sub-cortical structures, produces no awareness of the stimulus in human subjects. One may surmise that such stimulation will be accompanied by a vague glow of satisfaction. But so, in my experience, is a well reinforced conversational turn, even though the reinforcers themselves are barely noticed. While it is difficult to be sure that what humans are and are not conscious of corresponds to what animals are and are not conscious of, the recent work of Cowey and Stoerig (1995) showing that monkeys with unilateral lesions of the striate cortex can learn to reach for objects

they cannot "see", in exactly the same way that human blindsighted patients can, makes such inferences much more plausible than they used to be.

9. *Operant Learning cannot explain the evolution of language*

But if the learning process involved in language acquisition is in principle no different from that which we observe in animal learning, it follows that we cannot appeal to the principles of learning in order to explain why it is that only human beings have developed language and why, although apes, can be trained to communicate by means of linguistic symbols, even the most intelligent and symbolically sophisticated cannot progress beyond the linguistic competence of a two-year-old human child. Nor, by itself, is the mutation or set of mutations which have changed the conformation of the human mouth and larynx so as to permit vocal speech sufficient to explain the phenomenon. For the congenitally deaf can learn to communicate in a distinctively linguistic way, even without being taught an official sign-language (Goldin-Meadow & Mylander 1984; 1990). Something has happened to the human brain associated with the development of such structures as the angular gyrus, Wernicke's and Broca's area in the dominant hemisphere of the cerebral cortex which have made it very much easier for human beings to learn the kind of associations and generalisations involved in language than it is for any animal species.

10. *Conclusion: towards a plausible theory of language evolution*

Chomsky (1965) asks us to believe that language evolved fully grown with all its syntactic complexity in a single gigantic mutation. Like many others, I find this view frankly incredible. The ability to learn those special associations that are peculiar to language must have evolved along with the development of the human vocal apparatus in a sequence of steps or stages. At each stage a mutation must have occurred which was passed on to the descendants of those in whom it occurred by virtue of its utility in securing the survival and reproduction of the social group and groups constituted by those descendants. But, conceding a role for mutations and the innate learning capacities with which they endow the organism should not be seen as in any way diminishing the importance of learning in the acquisition and maintenance of linguistic competence. Selection by consequences is a linguistic universal.

References

Azrin, N. H., Holz, W., Ulrich, R. and Goldiamond, I. (1961) The control of the content of conversation through reinforcement. *Journal of the Experimental Analysis of Behaviour*, 4, 25-30.

Chomsky, N. (1957) *Syntactic Structures*. 'S Gravenhage: Mouton.

Chomsky, N. (1965) *Aspects of the Theory of Syntax*. Cambridge, MA: MIT Press.

Cowey, A. and Stoerig, P. (1995) Blindsight in monkeys. *Nature* **373**, 6511: 247-9.

Goldin-Meadow, S. and Mylander, C. (1984) Gestural communication in deaf children: The effects and non-effects of parental input on early language development. *Monographs of the Society for Research in Child Development*, **49**, 1-121.

Goldin-Meadow, S. and Mylander, C. (1990) Beyond the input given: The child's role in the acquisition of language. *Journal of Child Language*, **17**, 527-563.

Gollub, L. (1977) Conditioned reinforcement: Schedule effects. In W. K. Honig and J. E. R. Staddon (eds.) *Handbook of Operant Behavior*. Englewood Cliffs, NJ: Prentice-Hall.

Greenspoon, J. (1954) The effect of two non-verbal stimuli on the frequency of two verbal response classes. *American Psychologist*, **9**, 384. (Abstract)

Greenspoon, J. (1955) The reinforcing effect of two spoken sounds on the frequency of two responses. *American Journal of Psychology*, **68**, 409-416.

Harzem, P. and Miles, T. R. (1978) *Conceptual Issues in Operant Psychology*. Chichester: Wiley.

Jefferson, G. (1988) On the sequential organization of troubles-talk in ordinary conversation. *Social Problems, 35*, 418-441.

Krasner, L. (1958) Studies of the conditioning of verbal behavior. *Psychological Bulletin*, **55**, 148-170.

Lorenz, K. (1935/1957) Der Kumpan in der Umwelt des Vogels; die Artgenoße als auslösendes Moment sozialer Verhaltungsweisen. *Journal of Ornithology*, **83**, 137-213 and 289-413. English translation as 'Companionship in bird life: fellow members of the species as releasers of social behavior' in C. H. Schiller (Ed.) *Instinctive Behavior*. New York: International University Press.

McClelland, J. L. and Rumelhart, D. E. (1988) *Explorations in Parallel Distributed Processing*. Cambridge, MA: MIT Press.

Olds, J. and Milner, P. (1954) Positive reinforcement produced by electrical stimulation of septal area and other regions of the rat brain. *Journal of Comparative and Physiological Psychology*, **47**, 419-427.

Place, U. T. (1991) Conversation analysis and the analysis of verbal behavior. In L. J. Hayes and P. N. Chase (eds.) *Dialogues on Verbal Behavior: The First International Institute on Verbal Relations*. Reno, Nevada: Context Press, Chapter 5, pp. 85-109.

Place, U. T. (1992) Eliminative connectionism and its implications for a return to an empiricist/behaviorist linguistics. *Behavior and Philosophy*, **20**, 21-35.

Place, U. T. (1997a) Contingency analysis applied to the pragmatics and semantics of naturally occurring verbal interactions. In J. L. Owen (ed.) *Context and Communication Behavior*. Reno, NV: Context Press, Chapter 18, pp. 369-385.

Place, U. T. (1997b) Rescuing the science of human behaviour from the ashes of socialism. *Psychological Record* **47**, 649-659.

Place, U. T. (1998) The role of the hand in the evolution of language. Poster and accompanying paper presented to the 2nd International Conference on the Evolution of Language, City University, London, 6th-9th April 1998.

Rosenblatt, F. (1959) Two theorems of statistical separability in the perceptron. In *Mechanisation of Thought Processes: Proceedings of a Symposium held at the National Physical Laboratory, November 1958. Vol. 1*. London: HM Stationery Office, pp. 421-456.

Skinner, B. F. (1981/1984) Selection by consequences. *Science*, **213**, 501-504. Reprinted with peer commentary in A. C. Catania and S. Harnad (Eds.) Canonical papers of B.F. Skinner. *The Behavioral and Brain Sciences*, **7**, 477-481.

Spielberger, C. D. and Levin, S. M. (1962) What is learned in verbal conditioning? *Journal of Verbal Learning and Verbal Behavior*, **1**, 125-132.

Thorndike, E. L. (1911) *Animal Intelligence*. New York: Macmillan.

Tinbergen, N. (1951) *A Study of Instinct*. Oxford: Clarendon Press.

Verplanck, W. S. (1955) The control of the content of conversation: reinforcement of statements of opinion. *Journal of Abnormal and Social Psychology*, **51**, 668-676.

Widrow, G. and Hoff, M. E. (1960) Adaptive switching circuits. *Institute of Radio Engineers, Western Electronic Show and Convention, Convention Record, Part 4*, 96-104.