

■Special Lecture

Repetitive Behaviour in Cerebral Disease

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Introduction

Repetitive action is a general feature of neuronal systems. In the CNS, meaningful signals are transmitted by repetitive firing of neurons. Groups of neurones may generate rhythmic oscillations, such as the EEG alpha-rhythm or physiological tremor.

Repetitive action may also be characteristic of pathological states. Pathological tremor occurs in extrapyramidal disease. Another rhythmic motor phenomena is myoclonus, such as in Lance-Adams syndrome. For both types of stereotyped, rhythmic motor oscillations, circumscribed generators have been identified.

Repetitive behaviour is not confined to the motor domain. It may affect perceptions, as is the case with palinopsia and stereotyped hallucinations, the cognitive domain, as in echologia (Kleist, 1934) or stereotypical thoughts (Kleist, 1934), or language (perseverations, automatisms, echolalia, speech tics). Repetitive symptoms transcend the boundaries of neurological disease, they occur normally as well as in mental deficiency and schizophrenia.

Kleist's Theory

To my knowledge, the only unitary theory of the generation of repetitive phenomena

was attempted by Kleist (1934) and his school (e.g., Merzbach, 1928). As could be expected from this author, his theory was anatomically based. Kleist defined the following repetitive symptoms:

1) uniform restlessness ("uniforme Unruheerscheinungen") and rhythmic restlessness ("rhythmische Unruheerscheinungen"); these are stereotyped, frequently rhythmically repeated, movements or movement sequences linked to mesencephalic pathology.

2) stereotypy: this may affect movement, language, thought and represents a distortion and repetition of meaningful activity. The stereotyped action content may vary. Kleist assumes that the pathophysiological source of stereotypies lies in an increased level of stimulation ("Anregungen") resulting from basal ganglia damage in connection with a reduced capacity to alter action content ("Beharrungsstrebung").

3) echo-phenomena (echolalia, echopraxia, echologia) result from increased susceptibility in cases of diffuse forebrain damage and are regarded as possibly reflecting brain stem or diencephalic pathology. Kleist notes the frequency of clouded consciousness in echoing patients.

4) iteration is viewed as resulting from a repetitive tendency ("Wiederholungsbestrebung") that is not linked to a certain action

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Table 1 Definitions of types of repetitive verbal behaviour

Echolalia :	"the automatic and compulsive repetition of words by the patient in the absence of the understanding of their meaning" (Brain, 1965 ; but see Lebrun et al., 1971)
Palilalia :	"the reiteration of single or partial syllables or combinations of syllables many times with increasing rate" (Ludlow et al., 1982)
Perseveration :	"the recurrence, out of context and in the absence of the original stimulus, of some behavioral act" (Buckingham et al., 1979)
Speech automatism :	"a constantly recurring utterance which is formally rigid, consists of neologistic sequences of syllables, interchangeable words or phrases, does not fit into the linguistic context either lexically or syntactically, and which the patient produces in contrast to the intention expected by his interlocuter" (Huber et al., 1982)
Word tics :	"any meaningful word interjected into speech and not part of communicative speech or hesitation phenomena" (Ludlow et al., 1982)

but may reveal itself in all kinds of activities in the same patient ("der ganze Kranke hat eine Iterationsneigung", p. 1110). Kleist ascribes the presence of iterativity to lesions in the basal ganglia.

5) It is interesting to note that Kleist separated perseveration from the other forms of repetitive behaviour. He defined perseveration, as it is done today, as a stimulus response identical with the reaction to a previous task. In his view, the occurrence of perseveration is linked to the presence of neuropsychological deficits of input processing, such as sensory aphasia or sensory apraxia. He deduces that perseveration is the result of a persistence of sensory images. Kleist points out that the severity of perseveration does not correlate with the severity of other focal neuropsychological deficits and that its development over time parallels that of other symptoms of diffuse brain damage. He concludes that perseveration is not a focal symptom, but one of diffuse pathology.

In summary, according to Kleist, repetitive behaviour cannot be regarded as a symptom of cortical pathology but rather indicates basal ganglia, diencephalic or mesencephalic dysfunction or a dysequilibrium

between reduced cortical capacity and intact di/mesencephalic drive.

Repetitive Behaviour in Language Production

Whereas Kleist attempted to group symptoms of repetitive behaviour across modalities into pathoanatomically meaningful categories, today's research focusses on the explanation of these symptoms within functional models that are confined to the respective domains : physiological models for motor, visual or auditory symptoms, neurolinguistic or neuropsychological models for symptoms of higher mental dysfunction. Therefore, the unitary approach of Kleist is difficult to pursue nowadays.

Therefore, I shall focus upon one well studied functional system, language production. At present, this is probably the neuropsychological system that is best suited for an analysis of repetitive behaviour, because there are theories that are detailed enough to generate predictions and allow for interpretations, and, secondly, repetitive symptoms can be easily detected and elicited in a variety of experimental tasks. Due to the lack of unified theories, the taxonomy of repetitive symptoms is inconsistent and

Table 2 Repetitive verbal behaviour : written language and motor correlates

Type	occurrence in written language	motor correlate
perseveration	+	apraxic perseveration
echolalia	rate	echopraxia, stimulus boundness, utilization behaviour
stereotypies	rare	stereotyped motor behaviour
verbal tics	(-)	motor tics
palilalia	(-)	propulsion? inability to stop?
automatism	(-)	uniforme Unruheerscheinungen (Kleist, 1934), very rare

remains equivocal, even if the analysis is restricted to expressive language symptoms (for a discussion, see Wallesch, 1990). The definitions applied in the present analysis are given in Table 1.

The feature of stereotypicality is shared by automatisms and tics, iterativity by palilalia and automatisms, if they occur as recurring utterances. Repetitive speech phenomena are not mirrored in other modalities, as Kleist (1934) implied. Table 2 demonstrates that direct correlates of speech automatisms are exceedingly rare in the written and motor modalities, if they exist at all (but see Wallesch, 1990; Blanken et al., 1990).

Neurological Pathogenesis

A) Repetitive behaviour as a variation of normal behaviour

Perseveration and echolalia may occur in normal subjects, and some otherwise healthy persons may develop tics. The rate of verbal perseverations both in normals and in patients is markedly increased by fatigue, distraction and intoxication, and it is a common symptom in states of clouded consciousness (Freeman & Gathercole, 1966). Neurological diseases, in which perseveration is common, are the dementias, especi-

ally Alzheimer's disease (with prominent occurrence of so-called "intrusions" = delayed perseveration with intervening normal responses; Fuld et al., 1982, Shindler et al., 1984), schizophrenia, and aphasia.

According to Lebrun et al. (1971), echolalia "may run the whole gamut from the non-compulsive repetition of what has been understood.....to the irrepressible parroting of utterances which the patient fails to comprehend". The latter type is characteristic of severe degrees of cortical dementia. The neurological disorders of Gilles-de-la-Tourette-syndrome, Latah, and Myriachit are characterized by the frequent occurrence of echolalic responses (Goetz, 1986).

Speech tics have been demonstrated to reflect a heightening of stereotypical non-purposive behaviour that is also found in normals (Ludlow et al., 1982). They are a common feature of Gilles-de-la-Tourette's syndrome and occur frequently in schizophrenic psychosis.

B) Abnormal repetitive speech motor behaviour

Palilalia is frequent in Parkinson's disease (e.g. Critchley, 1927) and a characteristic symptom of Parkinson dysarthria. It is questionable whether it occurs in other disease conditions, as it is difficult to dif-

ferentiate from acquired stuttering, another repetitive speech motor symptom (for a detailed analysis, see Ludlow et al., 1987). At a first glance, it may seem contrainuitive to describe palilalia as a nonlinguistic, articulatory phenomenon. However, in a detailed linguistic analysis of palilalia there has been no evidence of defects in the ability to handle linguistic and symbolic aspects of communication (Boller et al., 1973).

C) **Abnormal repetitive language behaviour**

Speech automatisms are a frequent symptom of severe aphasia and may occasionally occur in advanced dementia (Leischner, 1951). They have been considered as a prominent symptom of global aphasia (Stachowiak et al., 1977, Brunner et al., 1982), but have recently been demonstrated to occur with milder forms of aphasia (Blanken et al., 1990).

Kornhuber's suggestion (1977) that the production of speech automatisms indicated basal ganglia damage was supported by Brunner et al. (1982), but disputed by Poeck et al. (1984) who found no correlation between any lesion site and recurring utterances. Haas et al. (1988) investigated the CT-scans of 18 patients with prominent production of consonant-vocal neologistic recurring utterances and compared them with other severely aphasic patients without automatisms. They found a common lesion of the automatism producing patients in the deep frontoparietal white matter close to the ventricle, which, however, could only explain a fraction of the variance in the occurrence of automatisms. They also found a significant interaction with age. The lesion in the area of supply of deep lenticulostriate arteries was thought to indicate either a hemispheric disconnection and/or

a basal ganglia pathology.

The Functional Pathogenesis of Repetitive Language Behaviour

This discussion will be restricted to those phenomena that affect the prearticulatory linguistic stage of language production, i.e. automatism, perseveration, and echolalia.

A) **Automatisms**

In a series of investigations, Blanken and collaborators attempted to localize the generator of speech automatisms in a neurolinguistic model (Blanken et al., 1988, 1989, 1990). They found evidence for two conditions resulting in automatism production (Blanken et al., 1988): one lexically based with largely preserved but disconnected peripheral language mechanisms, and another, in which these peripheral mechanisms themselves were severely damaged. Pure cases of the first type suffer from a severe central language deficit but are able to recite overlearned series as the days of the week, familiar songs and prayers (Blanken et al., 1988). Patients of the latter type are unable to do this, but may have retained some command over written expressions (Blanken et al., 1989).

B) **Perseveration**

The functional basis of perseveration is controversial, depending on the theoretical point of departure, i.e. a neurological, neuropsychological, or neurolinguistic approach. These different approaches are reflected in various taxonomies some of which are outlined in Table 3. Only intentional perseveration as defined by Liepmann (1905) will be further considered.

Some authors (e.g. Buckingham et al., 1979; Haag et al., 1985) followed Goldstein's (1948) suggestion that the occurrence of perseveration may indicate a "catastrophic

Table 3 Some taxonomies of perseveration (p.)

Neurological taxonomies :

Liepmann (1905) :

tonic : continuous innervation after completion of action

clonic : continuous repetition of action

intentional : inappropriate repetition of previous response to subsequent stimulus

Helmick & Berg (1976) :

repetitious : recurrence of all or part of a response after delay

continuous : continuation of response beyond point of completion

Neuropsychologic taxonomies :

Yamadori (1981) :

stuck : multiple inappropriate repetitions

immediate : repetition in response to the subsequent stimulus

delayed : repetition after intervening stimuli

Sandson & Albert (1984) :

stuck-in-set : inappropriate maintenance of current activity

recurrent : unintentional repetition of previous response

continuous : inappropriate repetition without interruption

Neurolinguistic taxonomies :

Haag et al. (1985) :

mode of failure : required response cannot be accessed

mode of disinhibition : p. supersedes other productions

Santo Pietro & Rigrodsky (1986) :

semantic selection p. : p. only when related to target word

program of action p. : p. initiated by same phoneme as target

phonemic carry-over p. : p. of parts of phonemic structure

reaction" when the correct response cannot be accessed. Buckingham et al. explained perseveration as an impairment in switching from one program of action to another, which notion has been shared by other authors (e.g. Santo Pietro & Rigrodsky, 1986). In a later study, Buckingham (1985) pointed out that perseveration occurred in analogous positions and concluded that they set in at a level of ideational planning where the perseverate behaves as a competing plan, either filling in for unaccessible plans or even hindering access. Haag et al. (1985) have demonstrated that these two modes of perseveration generation are quite dis-

tinct.

Whether or not perseverations may be viewed as a frontal lobe symptom has been controversial for decades. Goldberg (1986) took a reconciliatory position arguing that although the executive functions of cognitive programming, planning and maintenance of behavioural selectivity were controlled by the prefrontal brain, any diffuse damage would disrupt these executive functions before it affects other cognitive systems. Goldberg's theory has no difficulty explaining the occurrence of perseveration in healthy subjects as a symptom of situational overload or fatigue of the executive

system.

Linguistically, perseveration seems to have a multiple basis ranging from semantic selection to speech motor programming (Santo Pietro & Rigrodsky, 1986). Therefore, the pathogenesis of perseveration can hardly be reduced to a single defective component in a language production model. It seems to affect any component that deals with a large number of degrees of freedom.

C) Echolalia

An important aspect for the functional analysis of echolalia are the variations many patients are able to perform with the echoed phrase (Whitaker, 1976). In a very detailed study of two echolalic aphasic patients, de Bleser and Bayer (1975) demonstrated that a considerable amount of word formation rules were preserved, such as production of the correct article, inflection of adjectives and production of the correct plural. In consideration of the structure of the German language, these patients demonstrated access to lexical mechanisms. Consequently, the functional generator of echolalic responses in these patients can be situated above these processes in a top-down model of language production. Already Critchley (1964) related echolalia to a lack of supralinguistic inhibition.

Synopsis

This review demonstrates that the various repetitive speech symptoms are generated by different neurological substrates and indicate functional pathology at different levels within a neurolinguistic framework of language production. Their detailed analysis may therefore contribute not only to a neurological understanding of the underlying disease but is also relevant for a specific therapeutical approach.

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