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Restricted Associations in Aphasics and Schizophrenics *

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SUMMARY. Matched groups (N = 25) of fluent and nonfluent aphasics, brain-damaged and normal controls as well as schizophrenics were requested to name (1) as many animals and (2) as many things that are typically yellow as possible within 5 min. The main results of Gloning & Müller (1972) as to smaller numbers of correct responses, higher percentages of repetitions, shorter association clusters, and higher popularity in aphasics could be replicated for the animal task. Comparing the data from both tasks for fluent and nonfluent aphasics with the various control groups led to considerable doubts as to what extent these results follow directly from quantitative differences in verbal output or have to be interpreted as qualitative differences in memory storage, retrieval, and self-editing processes.

KEY WORDS: Aphasia - Schizophrenia - Restricted Associations - Word Popularity - Semantic Clustering.

ZUSAMMENFASSUNG. Parallelisierte Gruppen (N = 25) von Aphatikern mit flüssigem und nicht-flüssigem Sprechverlauf, hirngeschädigten, schizophrenen und neurologisch wie psychiatrisch gesunden Kontrollpersonen hatten (1) soviele Tiere und (2) soviele Dinge, die üblicherweise gelb sind, aufzuzählen wie in 5 Minuten möglich. Hinsichtlich der ersten dieser beiden Auf-

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gaben konnten die Befunde von Gloning & Müller (1972) im wesentlichen bestätigt werden: Aphatiker nannten weniger Tiere, brachten mehr Wiederholungen, kürzere Assoziationsketten und mehr häufige Reaktionen als Gesunde. Vergleiche zwischen den beiden Aufgabenstellungen und den verschiedenen Probandengruppen ließen es in hohem Maße unklar erscheinen, inwieweit die Unterschiede zwischen den Aphatikern und Kontrollgruppen der Funktion der geringeren Anzahl angemessener Antworten oder aber als qualitative Unterschiede in der Struktur des Gedächtnisses oder spezifischer Abruf- und Ausleseprozesse anzusehen sind.

SCHLÜSSELWÖRTER: Aphasie - Schizophrenie - Restringierte Assoziationen - Worthäufigkeit - Semantische Gruppierung.

The following study can be considered as an extension and partial replication of an investigation by Gloning & Müller (1972). Using the method of restricted verbal associations, these authors found that both fluent and nonfluent aphasics produced fewer associations, shorter clusters of associations, more perseverations and more paraphasias than normals and other brain-damaged patients (i. e., those impaired by diffuse or circumscribed frontal lesions). Further, the above differentiating variables were considered a result of various malfunctioning control mechanisms involving:
1. production of associations belonging to the class of objects asked for,
2. production of correct names of objects in questions,
3. production of only names of objects not named earlier.

In the Gloning & Müller study word frequency was found to be of considerable importance in that the verbal output of aphasics consisted of many popular words (i. e., words of high frequency) produced mainly at the beginning of the restricted association task. Also the normal controls started with the more popular words but then they continued with less popular words. These observations are well in line with experiments carried out on normal subjects by Bousfield & Barclay (1950), Christensen et al. (1957), and Kaplan & Carvellas (1969). Taking their results one might be inclined to interprete Gloning & Müller's findings by assuming that the aphasics just do not reach that point where primarily semantic aspects take over from word popularity to determine the selection process.

If this interpretation is correct the difference between aphasics and normals should be smaller when the task cannot be accomplished by searching the memory according to familiar semantic categories - as might be assumed for the common instruction to name as many "animals" as possible - but for items that are semantically so heterogeneous as "objects that are typically yellow." This task might functionally correspond to asking brain-damaged patients for words with a given initial letter (Benton, 1968; Borkowski et al., 1967; Milner, 1964; Perret, 1974; Ramier & Hécaen, 1970). As we were primarily interested in varying the saliency of the semantic aspect we decided to ask for typically yellow objects instead of words with a given initial letter to avoid possible interferences through other, nonsemantic linguistic impairments of the aphasic patients. Unfortunately, our selection of this task turned out to be far from optimal as we found ourselves confronted with a strong bottom effect.

For further comparisons as to where the aphasic disorders lead to clearly different impairments of performance than psychotic thought disorder, we also included a group of chronic process schizophrenics. These patients are usually characterized by a diffuse loosening of associative bonds and conceptual bounderies which may lead to highly idiosyncratic responses (e. g., Storms & Broen, 1972), though there is also evidence for an excessive yielding to normal biases in verbal tasks (Chapman & Chapman, 1973).

METHOD

Subjects

Subjects were matched subgroups of 25 fluent and 25 nonfluent aphasics, 25 brain-damaged patients without aphasia, 25 chronic schizophrenics, and 25 normal controls tested in 14 different hospitals in Western Germany (cf. Cohen et al., 1975). All subjects were male native German speakers. The five groups were matched for age ($43.0 < \bar{x} < 44.3$; $F = 0.07$; $df = 4/120$; $P > .10$) and for an index of combined level of education and occupation ($2.2 \leq \bar{x} \leq 2.6$; $F = 1.62$; $df = 4/120$; $P > .10$). As a control for severity of more general impairments caused by brain-damage the two aphasic groups and the brain-damaged patients without aphasia were matched also with regard to their scores on Form A of the Trail Making Test ($1.90 \leq \bar{x}_{\log s} \leq 1.96$; $F = 0.45$; $df = 2/72$; $P > .10$). This test (Reitan, 1959) has high discriminative power in separating brain-damaged patients highly heterogeneous as to etiology, localization, and duration of illness from normal controls (Gordon, 1972; Hegenscheidt & Cohen, 1972).

Brain-damaged patients who were or had been left-handed or ambidextrous according to the items of Oldfield's scale (Oldfield, 1971) were excluded as were patients having defective vision or hearing, not corrected by glasses or hearing aids. Patients with epileptic seizures, agnosia, apraxia, or dysarthria mentioned in their clinical records were excluded. To be included in the brain-damaged control group it was crucial that there was no indication of aphasic symptoms at any time in the clinical files.

All aphasic patients had been diagnosed as aphasics by the neurological staff of the respective hospitals. All of them turned out to have more than nine errors on the Token Test (De Renze & Vignolo, 1962) and to show an impairment score of at least 9% in the Sklar Aphasia Scale (Sklar, 1966). The two aphasic groups did not differ with regard to their scores in these two tests ($z \leq 1.00$; $P > .10$) which can be considered as estimates for the overall severity of aphasic disorder (Cohen et al., 1976). Fluency of speech (Benson, 1967; Howes, 1964; Kerschensteiner et al., 1972) was determined by the average rate of speech in the immediate reproduction of four short stories. A score of 50 words per min (wpm) was used as a cut-off point to separate fluent ($\bar{x} = 96.4$ wpm; $s = 31.8$ wpm; range 56-183 wpm) and nonfluent aphasics ($\bar{x} = 32.8$ wpm; $s = 10.0$ wpm; range 14-46 wpm). No member of the normal control group, two brain-damaged patients without aphasia, and one schizophrenic had a rate of speech lower than 50 wpm. Global aphasics with recurrent utterances and less than 12 wpm were excluded, so were patients with aphasic jargon. The correlation between the neurological diagnosis as to aphasic subgroup and the fluent/nonfluent dichotomy was Phi = 0.76 ($P < .01$).

Table 1. Distribution of etiology and duration of illness in the three groups of brain-damaged patients

		Fluent aphasics	Nonfluent aphasics	Brain-damaged without aphasia
Etiology	Vascular	8	14	5
	Traumatic	11	8	18
	Neoplastic	3	1	1
	Several, other	3	2	1
Duration of illness	Median in years	1. 29	1. 21	1. 04
	Range in years	0. 08-30. 0	0. 17-32. 5	0. 08-30. 0
	Less than 4 months	5	3	4
	More than 3 months	20	22	21

For the brain-damaged control group brain-damage had also been diagnosed independently by two neurologists. Subject selection occured regardless of etiology or duration of illness; there was a preference for patients with diffuse lesions, excluded were patients with only minor, well-circumscribed lesions. Table 1 shows the distribution for etiology (Chi^2 = 11. 37; df = 6; $10 > P > .05$) and duration of illness (Chi^2 = o. 60; df = 2; $P > .10$) in the three groups of brain-damaged patients.

Selection of schizophrenics was not made with regard to specific syndromes to keep the group as representative as possible within the following limits. All schizophrenics were diagnosed as chronic process schizophrenics with insidious onset. All of them had been hospitalized continuously for at least 1 year prior to testing; all were under neuroleptic medication which had been kept unchanged for at least 3 months. Patients considered to be too uncooperative by the staff or showing primarily paranoid symptomatology were excluded.

Normal control subjects were hospitalized because of diseases other than those involving the nervous system above the dorsal spinal level. According to the clinical staff, none had any indication of neurological or psychiatric illness in their histories.

Procedure and Data Analysis

Subjects performed the animal task and the yellow object task on two different days within 1 week. The instruction was "to name as many animals (resp. objects which are typically yellow) as possible during the next 5 min." This time corresponds to the time used in the study by Gloning & Müller (1972). Subjects were asked not to talk to the experimenter during these 5-min periods. During this time the experimenter did not face the subject so as not facilitating any conversation.

As some subjects were not willing to cooperate till the end of the 5-min period, only the maximal time available for all the subjects - 4 min 20 s - was analyzed.

Transcriptions of the tape recordings were scored independently by three raters. The protocols from the five subject groups were presented in random order with all information about diagnoses removed. As scorable "associations," we accepted all utterances that could be interpreted as following the task instructions and excluded all utterances understood as comments addressing the experimenter. All "associations" were further classified according to the following scheme:

1. Adequate responses

1.1. "Correct" responses: naming of objects specified by the instruction, e.g., "lion" on the animal task; "daffodil" on the yellow object task. In the latter task responses were also scored "correct" if the raters agreed that most people might think of the object in a yellow color even though other colors are also not rare.

1.2. "Acceptable responses: generic terms that are immediately followed by a specification (e.g., "... bird, sparrow, ..." or "... fruit, lemon, ..."). On the yellow object task a score of "acceptable" was also given when the subject referred to an object that was not necessarily yellow but often has this color (e.g., "blouse").

1.3. Word distortions: utterances which have clearly recognizable resemblance to a word, that would be scored as a "correct" response e.g., "telephant" on the animal task; "dallodil" on the yellow object task).

2. Inadequate responses

2.1. Neologisms: utterances which are neither words nor have any resemblance to words that would be scored as "correct" responses.

2.2. "False" responses: naming of objects that do not fall in the category indicated by the instruction. When in doubt - and this occured only with respect to the yellow object task - they were scored as "acceptable" responses (e.g., "spring flowers").

2.3. Circumlocutions: strings of words describing a specific class of objects without naming it explicitly (e.g., "those animals which are in Africa, wild and dangerous ...").

3. Repetitions

3.1. Immediate repetitions: naming of the same word, a diminuitive or a plural form of it, or a synonym, which had been named immediately before.

3.2. Delayed repetitions: naming of objects which had been named earlier in the sequence (including diminuitives, plural forms, and synonyms).

Most - if not all - of the responses in 3.1 and 3.2. could also have been called "perseverations." The more descriptive term "repetitions" was preferred only to make clear that at the stage of scoring no assumptions were made as to their neuropsychologic implications.

Percent of agreement of the three raters was 98.2% for the animal task and 95.9% for the yellow object task. In case of divergent ratings the decision was made according to the majority.

Besides classifying each association according to this scheme we determined for each subject the average popularity of his responses and the average length of his association clusters:

Following Gloning & Müller (1972) the popularity of a response was defined as the number of subjects within our total sample that had produced this association.

To determine the length of an association cluster, we made a list of acceptable categories, the longest possible ones of which had to be chosen for scoring. For the animal task there were biological categories (hoofed animals, beasts of prey, rodents, birds, reptiles and amphibians, fishes, insects) as well as ecological categories (domestic animals, native nondomestic animals, nonnative animals, and animals, which mainly live on the ground or in the water or air). For the yellow object task the following categories were used: food, plants, animals, postal objects (usually yellow in Germany), metal, light, signals, and parts of the human body. For each subject with at least three correct responses the average length of association chains was determined by dividing the number of correct responses by the number of association clusters.

RESULTS

All results are based on comparisons between the five matched groups with N = 25. Only for the analysis of response popularity and length of association clusters all those patients were excluded who produced less than three associations: these were four fluent and one nonfluent aphasics on the animal task, seven fluent and nine nonfluent aphasics as well as two control subjects on the yellow object task. This reduction in the number of subjects had no major influence on the means and standard deviations of the matching criteria - age, educational level, and performance on the Trail Making Test.

Number of "Adequate" Responses

For both tasks - the animal task as well as the yellow object task - percentages of "adequate" responses were somewhat lower for the fluent aphasics (Mdn = 92.8% resp. 83.8%) and the schizophrenics (Mdn = 95.1% resp. 89.0%) than for the other three groups (98.1% < Mdn < 99.9%) according to the Mann-Whitney U test ($2.34 \leq z \leq 5.21$; $P < .05$). The $\sqrt{}$-transformed numbers of adequate responses were submitted to an analysis of variance (groups x tasks) with repeated measures on the second factor. There were significant differences between groups ($F = 25.39$; $df = 4/120$; $P < .01$), between tasks ($F = 585.65$; $df = 1/120$; $P < .001$), and a significant interaction between these factors ($F = 4.72$; $df = 4/120$; $P < .05$) Mean number of "adequate" response (retransformed) was $\bar{x}_a = 27.3$ for the animal task and $\bar{x}_y = 4.7$ for the yellow object task; the simple main effects between the tasks - indicating to what an extent the difference between the two tasks influenced the number of adequate responses for a given group of patients - increased in the following order: The difference was smallest (F = 69.80) for the nonfluent aphasics ($\bar{x}_a$ = 12.4; $\bar{x}_y$ = 0.71), next came the fluent aphasics ($\bar{x}_a$ = 13.7; $\bar{x}_y$ = 1.8) with F = 90.59, the schizophrenics ($\bar{x}_a$ = 30.9; $\bar{x}_y$ = 6.5) with F = 111.34, and the brain-damaged patients without aphasia ($\bar{x}_a$ = 34.7; $\bar{x}_y$ = 6.9) with F = 135.34; the difference between the two tasks was largest for the normal controls ($\bar{x}_a$ = 45.6; $\bar{x}_y$ = 7.8) with F = 197.53. With 1 and 120 degress of freedom all these values are significant above the 1% level. According to Newman-Keuls tests, both groups of aphasic patients produced less responses in both the tasks than the other groups ($P < .01$). In the yellow object task the three other groups did not differ from each other, but in the animal task the normals gave more adequate responses also in comparison to the schizophrenics and the brain-damaged controls ($P < .01$).

Percentages of Specific Response Categories

"Correct" Responses. Kruskal-Wallis tests for the percentages of "correct" responses (see Table 2) showed significant differences between the groups in the animal task (H = 11.06; df = 4; $P < .05$) as well as in the yellow object task (H = 24.99; df = 4; $P < .001$). In the animal task Mann-Whitney U tests showed smaller percentages for the fluent aphasics and the schizophrenics than for the two control groups ($2.08 \leq z \leq 2.45$) In the yellow object task not only the fluent aphasics and the schizophrenics, but also the nonfluent aphasics differed from the two control groups ($1.97 \leq z \leq 4.79$). There was no significant difference between the two aphasic groups either in the animal task or in the yellow object task.

"Acceptable" Responses. In both tasks the group differences with respect to "acceptable" responses (see Table 2) were significant according to Kruskal-Wallis tests (H = 20.98 resp. 17.33; df = 4, $P \leq .01$). As to Mann-Whitney U tests this time only the nonfluent aphasics had a lower percentage of "acceptable" responses in the animal task than all the other groups ($2.64 \leq z \leq 3.98$). In the yellow object task fluent aphasics produced a higher percentage of "acceptable" responses than the two control groups (z = 2.95 resp. 3.98), and schizophrenics more than the normal controls (z = 2.92).

"False" Responses. No significant differences between the groups were obtained on the animal task (see Table 2), while on the yellow object task both fluent aphasics and schizophrenics produced significantly higher percentages of false responses as compared with the other two control groups ($8.15 \leq Chi^2 \leq 27.40$; df = 2; $P < .05$) by means of Kolmogorov-Smirnow tests.

Word Distortions, Neologisms, and Circumlocutions

In both tasks word distortions appeared with only low frequencies ($0.02 \leq$ Mdn ≤ 0.25) and Kolmogorov-Smirnow tests gave no evidence of group differences ($Chi^2 \leq 2.92$; df = 2; $P > .10$). Neologisms and circumlocutions were given by only 12 subjects (4 nonfluent and 5 fluent aphasics, 2 schizophrenics, and 1 brain damaged patient without aphasia).

Table 2. Medians and ranges for the percentages of specific response categories

		Nonfluent aphasics	Fluent aphasics	Schizo-phrenics	Brain damaged without aphasia	Normals	Kruskal-Wallis test (df = 4)
% "Correct" responses	Animal task	99.0 67-100	90.3 72-100	93.7 60-100	96.1 85-100	96.8 87-100	$H = 11.06$ $(P < .05)$
	yellow object task	32.5 0-100	19.5 0-45	33.3 0-100	61.0 42-100	66.5 0-100	$H = 24.99$ $(P < .001)$
% "Acceptable" responses	Animal task	0.2 0-17	4.0 0-13	5.3 0-29	3.6 0-10	3.1 0-13	$H = 20.98$ $(P < .001)$
	Yellow object task	40.5 0-100	71.5 22-100	59.3 0-88	32.8 0-63	19.0 0-100	$H = 17.33$ $(P < .001)$
% "False" responses	Animal task	2.2 0-7	2.8 0-9	3.0 0-7	1.3 0-2	0.7 0-2	
	Yellow object task	3.3 0-38	6.6 0-67	4.8 0-52	3.2 0-29	3.6 0-17	
% Immediate repetitions	Animal task	3.2 0-43	2.1 0-20	3.1 0-21	0.5 0-4	0.1 0-11	
	Yellow object task	1.7 0-40	2.5 0-38	4.2 0-39	2.9 0-17	1.7 0-16	
% Delayed repetitions	Animal task	3.6 0-29	16.7 0-43	3.2 0-31	2.9 0-15	2.7 0-7	
	Yellow object task	0.3 0-4	0.6 0-33	1.2 0-10	0.7 0-3	1.3 0-25	

Fluent aphasics and schizophrenics produced significantly higher percentages of false responses as compared with the other two control groups ($8.15 \leq Chi^2 \leq 27.40$; df = 2; $P < .05$) by means of Kolmogorov-Smirnow tests. Nonfluent aphasics did not differ from any of the other groups.

Repetitions

In both tasks the Kruskal-Wallis test showed significant differences between the groups with respect to percentage of repetitions (H = 24.98 resp. H = 13.57; df = 4; $P < .01$). In the animal task both groups of aphasics and the schizophrenics produced higher percentages of repetitions than the two control groups ($2.28 \leq z \leq 3.82$), whereas in the yellow object task this was the case only for the fluent aphasics and schizophrenics ($2.30 \leq z \leq 3.12$) but not for the nonfluent aphasics (z = 0.20 resp. 0.38).

Separate analyses for immediate and delayed repetitions yielded some differences between the conditions (see Table 2): On the animal task both nonfluent aphasics and schizophrenics produced significantly higher percentages of immediate repetitions than the two control groups ($6.34 \leq Chi^2 \leq 11.14$; df = 2; $P < .05$); on the yellow object task only the schizophrenics differed significantly from the two control groups (Chi^2 = 6.02 resp. 7.83; df = 2; $P < .05$); the nonfluent aphasics showed as low a percentage as the normals. With delayed repetitions there were significant group differences only on the animal task and according to Kolmogorov-Smirnov tests only with respect to the fluent aphasics who produced a much higher percentage of delayed repetitions than all the other groups reaching significance in comparison to the control groups (Chi^2 = 7.92 resp. 7.14; df = 2; $P < .05$).

Response Popularity

There were clear-cut differences between the groups as to the average response popularity of their associations on the animal task (F = 6.90; df = 4/115; $P < .01$). Average response popularity was higher for the nonfluent ($\bar{x}$ = 54.2) and the fluent aphasics ($\bar{x}$ = 53.8) than for the schizophrenics ($\bar{x}$ = 45.0), the brain-damaged patients without aphasia ($\bar{x}$ = 40.9), and the normal controls ($\bar{x}$ = 37.0). However, these results are difficult to interprete because the more responses a person gives the more infrequent responses have to be among them; the correlation between response popularity and number of associations in the animal task - determined separately for each group - ranged from Rho = -0.68 to Rho = -0.88 ($P < .05$). Consequently an analysis of covariance was carried out with the number of associations as covariate. When number of associations was controlled for all earlier differences between groups with respect to response popularity disappeared (F = 0.69; df = 4/114; $P > .10$).

Probably due to the above-mentioned bottom effect there were no group differences as to response popularity in the yellow object task (F = 0.54; df = 4/102; $P > .10$); under this condition the correlations between response popularity and number of associations had also to be low throughout ($-0.21 < Rho < 0.19$). An analysis of covariance corresponding to the animal task resulted in F = 1.50 (df = 4/101; $P > 0.10$).

To examine the relationship between response popularity and the temporal order of response, rank correlations were determined within subjects between the order number of his responses and their respective popularity scores. As the average number of adequate responses was too low in the yellow object task, this could be done only for the animal task. The average Fisher Z-values of these correlations were $\bar{x}_Z$ = 0.30 for the nonfluent, $\bar{x}_Z$ = 0.43 for the fluent aphasics and the brain-damaged controls, $\bar{x}_Z$ = 0.44 for the normal controls, and $\bar{x}_Z$ = 0.58 for the schizophrenics. An analysis of variance of these intraindividual correlations resulted in significant group differences ($F = 2.74$; $df = 4/115$; $P < 0.05$), which - according to Newman-Keuls tests - is due to the difference between nonfluent aphasics and schizophrenics ($P < 0.05$).

Length of Association Clusters

There were significant group differences with respect to the mean length of association clusters for the animal task ($H = 17.86$; $df = 4$; $P < 0.01$). For the yellow object task the Kruskal-Wallis test resulted in an insignificant $H = 4.69$ ($df = 4$), which might have been due to an overall bottom effect (see Table 3).

According to Mann-Whitney U tests, both aphasic groups produced significantly shorter clusters in the animal task than the two control groups ($2.12 \leq z \leq 3.53$), and the schizophrenics produced shorter clusters than the brain-damaged controls ($z = 2.53$), who turned out to be the group with the longest clusters.

Rank correlations between the mean length of association clusters and the number of correct responses were Rho = 0.22 for the schizophrenics, Rho = 0.34 for the normal controls, Rho = 0.45 for the brain-damaged controls, and Rho = 0.55 resp. 0.60 for the two aphasic groups, only the last three correlations reaching the 5% level of significance.

Relationship with Overall Measures of Aphasic Impairment and of Severity of Brain Damage

The rank correlation between the number of adequate responses in the animal task and the error-scores in the Token Test and in the Sklar-Aphasia Scale, as overall measures of aphasic impairment, was Rho = -0.57 resp.

Table 3. Medians and ranges for length of association clusters

	Nonfluent aphasics	Fluent aphasics	Schizophrenics	Brain damaged without aphasia	Normals
Animal task	2.31 1.0-5.6	2.00 1.5-4.4	2.07 1.2-4.5	3.38 1.9-6.0	2.80 1.7-5.9
Yellow object task	1.80 1.0-3.0	1.50 1.0-3.0	1.60 1.0-2.5	1.50 1.0-5.0	1.54 1.0-2.5

- 0.69 for the nonfluent aphasics, and Rho = - 0.41 resp. - 0.66 for the fluent aphasics, all being significant at least at the 5% level. The number of adequate responses correlated also significantly with the general retardation in the Trail Making Test with Rho = 0.44 and Rho = 0.52 for the nonfluent and fluent aphasics, respectively. The correlation with the rate of speech determined for the reproduction of four short stories was insignificant for both groups (Rho = -0.06 resp. - 0.03).

DISCUSSION

In good agreement with Gloning & Müller (1972) our results on the animal task show both aphasic groups to have produced fewer adequate responses, higher percentages of repetitions, shorter association clusters, and relatively more words with high response popularity than either of the control groups. According to Gloning & Müller (1972) these results suggest, that the aphasics have a reduced number of available items in their memory store, have difficulties in categorizing according to similarity or using semantic strategies for retrieval, and appear to be less critical in editing their responses as to their adequacy with regard to instructions. On the yellow object task, however, we found that while both aphasic groups again had fewer adequate responses relative to the control groups, only the fluent aphasics produced a higher percentage of repetitions, and that no differences at all were obtained with respect to either average response popularity or length of association clusters; in fact, all groups produced fewer responses and shorter association clusters on this task than on the animal task. This reduction of group differences may be taken as the result of a general "bottom effect." But another interpretation should also be taken into consideration, namely that there are genuine differences between the two tasks, which are relevant with regard to retrieval processes and memory structure: In contrast to the animal task, where for response retrieval the subject could make use of all the various semantic properties different animals have in common, the yellow object task required a sampling of responses, which have just one property in common - the yellow color - and belong to very heterogeneous semantic categories (Collins & Loftus, 1975). However, no matter which of the above possibilities we consider, the disappearance of differences in cluster length in the semantically more heterogeneous task with still existing differences in the number of adequate responses, indicates that the inferiority of the aphasic groups with respect to the latter can hardly be the result of an impairment of the ability to categorize according to semantic similarity.

Finding the relative impairment of aphasics to be different in three types of restricted association tasks (naming "objects," animals," "birds and colors alternately"), Newcombe (1969) supposed that word-frequency, known to be of significance for aphasics in naming tasks (Newcombe et al., 1965; Rocheford & Williams, 1965) may also be critical for restricted association tasks. Gloning & Müller (1972) found higher percentages of frequent or "popular" responses for the aphasics than for the control groups; bringing this finding in relation to the aphasics' smaller amount of adequate responses, Gloning & Müller suggested that aphasics may have a limited store of available items with low popularity. On first glance this appears consistent with our results, for both our aphasic groups had higher mean popularity scores than the control groups; however, some caution seems necessary as the above interpretation as group differences were not found with regard to the correlation between number of responses and average response popularity ($- 0.68 \geq Rho \geq - 0.88$), and further, differences between groups in mean popularity score were no longer discernible when the number of responses was controlled for statistically. Thus, the group differences observed may be a result of aphasics producing fewer responses than normals; it seems as if the aphasics, being restricted in their verbal output, just do not reach that point in performing the task like that where, in normal subjects, the effect of word popularity vanishes in favor of more refined semantic search strategies. We can then say, that although there is clear-cut evidence for quantitative differences in the number of correct responses, there is no proof whatsoever for qualitative differences in the underlying processes as suggested by Gloning & Müller (1972). This conclusion is further supported by the fact that within-subject correlations between the popularity of a given response and its position in the sequence of responses were about the same for the aphasics and the normal controls, only the schizophrenics having somewhat higher correlations than the others, especially than the nonfluent aphasics.

Again, in good agreement with Gloning & Müller (1972), we found in the animal task higher percentages of repetitions for both aphasic groups than for the control groups. Further analysis revealed that nonfluent aphasics produced predominantly immediate repetitions, while fluent aphasics produced predominantly delayed repetitions. Gloning (1974) supposed different disturbances responsible for the two types of repetitions; according to his interpretation our results would indicate that nonfluent aphasics cling to their productions because of a deficit in verbal extinction, while fluent aphasics suffer from a mnestic impairment. However, we have difficulties in accepting these interpretations: As in our study the brain-damaged controls did not produce more delayed repetitions than the normal controls, a general memory derangement due to cortical brain damage does not seem to be a likely explanation of this specific error tendency of the fluent aphasics; insufficient editing processes or poor correctness control as also indicated by the higher percentage of false responses obtained for the fluent aphasics in both our study and that of Gloning & Müller (1972) may be a more plausible interpretation. We are also reluctant to accept the notion of an extinction deficit in aphasics; the higher percentages of immediate responses obtained for the nonfluent aphasics can be just as well understood as the struggle of these patients to keep verbal contact with the experimenter and to follow the instructions as far as possible with only a few correct responses available. If we take the percentage of "false" responses an an index of impairment in control for correctness, the nonfluent aphasics seem not disturbed with regard to these self-editing processes. Thus, in this group, most responses scored as not quite "correct" may perhaps be motivated primarily pragmatically. Differences between the two tasks in quality of responses - indicating greater problems with the yellow object task - may best be considered with respect to those studies that showed patients with left frontal lobe lesions to be especially impaired in the production of words with the same initial letter (Benton, 1968; Borkowski et al., 1967; Milner, 1964; Perret, 1974; Ramier & Hécaen, 1970) which Perret (1974) interpreted as a deficiency in the adaptation of behavior to unusual demands.

Turning now to the schizophrenic patients, our results show that in most aspects their performance is rather similar to that of the fluent aphasics: a small number of adequate responses, a low percentage of "correct" responses, and high percentages of the less appropriate "acceptable" and "false" responses. However, this similarity in pattern does not necessarily imply similarity in the underlying processes. Our results are in good agreement with several studies by Cohen and his co-workers (Cohen, 1975; Cohen & Camhi, 1967; Cohen et al., 1974) dealing with communication behavior of schizophrenics and suggesting a malfunction of self-editing in schizophrenics defined as the inability to reject responses samples from memory that do not meet the task criterion. Such an impaired self-editing process may also explain that schizophrenics - in contrast to fluent aphasics - produced a rather high proportion of immediate repetitions. This result, together with the reduced length of their association clusters, is well in line with the notion of "perseverative chaining" (Cohen, 1975) as the unsuccessful attempt of schizophrenics to procede from an earlier response without losing contact with the referential concept specified in the instruction. In this peculiar state schizophrenics seem to rely more than other groups on the bias to produce their responses in the order of their popularity. Though the schizophrenics produced about the same percentage of immediate repetitions in the animal task as the nonfluent aphasics and showed an even higher average popularity score of their associations, the correlations between the popularity of a given response and its position in the sequence of responses was significantly higher in the schizophrenics than in the nonfluent aphasics. This finding corresponds precisely to what Chapman & Chapman (1973) termed the "yielding to normal biases."

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