A NEUROPSYCHOLOGICAL APPROACH TO THE STUDY OF GESTURE AND PANTOMIME IN APHASIA

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SUMMARY

The impairment of gesture and pantomime in aphasia was examined from a neuropsychological perspective. The Boston Diagnostic Test of Aphasia, Luria's Neuropsychological Investigation, Pickett's Tests for gesture and pantomime and the Performance Scale of the Wechsler Adult Intelligence Scale were administered to six aphasic subjects with varying etiology and severity. Results indicated that severity of aphasia was positively related to severity of gestural disturbance; gestural ability was associated with verbal and non-linguistic aspects of ability, within receptive and expressive levels respectively; performance on gestural tasks was superior to that on verbal tasks irrespective of severity of aphasia; damage to Luria's second and third functional brain units were positively related to deficits in receptive and expressive gesture respectively; no relationship was found between severity of general intellectual impairment and gestural deficit. It was concluded that the gestural impairment may best be understood as a breakdown in complex sequential manual motor activity. Theoretical and therapeutic implications were discussed.

OPSOMMING

Die versteuring van gebare is vanuit 'n neuropsigologiese oogpunt ondersoek in ses proefpersone met afasie. Verskillende oorsake en grade van aantasting het voorgekom. Navorsing is deur middel van die "Boston Diagnostic Test of Aphasia", Luria se "Neuropsychological Investigation", Pickett se "Test for Gesture and Pantomime" en die "Wechsler Adult Intelligence Scale" gedoen. Resultate dui op 'n positiewe verband tussen graad van afasie en die graad van gebareversteuring. Die vermoë om gebare te gebruik hou verband met die verbale en nie-linguistiese vermoëns op beide die reseptiewe en ekspressiewe vlakke. Desnieteenstaande die graad van afasie, is in die ondersoek gevind dat die vaardigheid om gebare te gebruik beter was as die vaardigheid op 'n verbale vlak. Beskadiging van Luria se tweede en derde funksionele breineenhede hou positief verband met 'n gebrek in reseptiewe en ekspressiewe gebare onderskeidelik. Geen verband is gevind tussen die graad van algemene intellektuele versteuring en gebareversteuring nie. Dus kan die versteuring in die gebruik van gebare beskou word as 'n belemmering in die komplekse opeenvolgende motoriese aktiwiteit van die hande. Implikasies vir die teorie en terapie is bespreek.

The role of gestures in communication has been demonstrated by several authorities[2, 4, 7, 11, 20, 48] and has been crystallised by Vetter[51], when he stated that "gestures are language". However, speech pathologists have, for a long time, recognised speech as the only "true form" of language in the aphasic population. In the desire to elicit verbal communication, the clinician frequently overlooks the aphasic patient's need to communicate in some fashion.[19, 48]

The present study was concerned with an aspect of non-verbal communication, namely, gesture and pantomime, which will be used synonomously to refer to a *condition in which a person uses a series of sequential manual movements, in the absence of speech, in an apparent attempt to communicate.*[43]

A number of experimental studies on non-clinical populations[17, 22, 23, 25, 26, 28] have suggested that a strong relationship exists between speech and manual motor activity. For example, Kimura[22, 23, 24, 25, 26] has attributed the relationship to the neural overlapping of cerebral areas which control speech and gesture and has further suggested that both gestural and speech activity are sub-classes of a more general mechanism for the control of sequentially organised motor activity. Within this theoretical framework, Kimura[25] has derived and validated the proposition that aphasia and gestural disturbance are related.

A considerable body of literature dealing with aphasic[1, 10, 12, 15, 26, 43] and deaf aphasic populations[5, 9, 25, 45, 49] has further supported the idea of a relationship between speech and manual communicative behaviour. For example, Goodglass and Kaplan[15] have suggested that gestural deficits are essentially apraxic disturbances. However, Liepman's concept of ideamotor apraxia suggests the existence of an ideational component in addition to an essentially apraxic component. There are also a number of fairly extreme ideational theories which have viewed gesture and pantomime as part of a general asymbolia[25] or in terms of a generalised non-specific intellectual deficit.[15]

The close relationship between gesture and speech has also been conceptualised within an evolutionary and ontogenetic framework. The work of Hewes[19] has lent considerable credence to the hypothesis that a manual communicative system developed prior to the vocal communicative system in a phylogenetic sense. From an ontogentic point of view, McNiell[37] has stated that gestures appear during Piaget's sensory motor operational stage. McNiell cites as evidence the fact that during the holophrastic stage utterances are typically produced together with an ongoing action.

The nature of the present study required that a formal distinction be made between the recognition of gesture (receptive gesture) and performance of gesture (expressive gesture). Receptive gesture is regarded as distinct from the afferent control of gestural praxis at a kinaesthetic level and "receptive gesture" is here regarded as a visuoperceptive phenomenon. In more exact terms, receptive gesture involves the perceptual recognition of sequentially occuring manual postures within a visuospatial system of coordinants, and the translation of this perception into a symbolic system. Within the theoretical system of Luria,[31] receptive gesture involves the translation of sequential recognition processes into instantaneous recognition and their incorporation into a simultaneously perceived logical scheme. To the extent that this holds true, receptive gesture is subserved by the secondary occipital cortex, parietal cortex and temporo-parieto-occipital functions, the structures representing Luria's second functional unit.[31]

Because receptive gesture involves both analytic and synthetic perceptual processes it would appear to depend on both left and right cerebral hemispheres.

Expressive gesture may be defined as the encoding of information transmitted via the use of sequential motor movements which are superimposed on manual postures and are unaccompanied by speech. Therefore, expressive gesture may be conceptualised as a phenomenon which is subordinated to the demands of goal directedness and symbolic processes.[31] It is therefore essentially dependant on the integrity of Luria's third functional unit which is comprised of the frontal and prefrontal motor systems.[31] To the extent that gestural praxis is brought into correspondence with symbolic or propositional constraints, it is also dependant on the integrity of the parietal tertiary corteses. The propositional and temporal nature of expressive gesture suggests its dependance upon the left hemisphere. This conceptualisation of receptive and expressive gesture within Luria's neuropsychological framework forms the basis for the present research and contains several implications for a clinical approach to aphasia.

The major aims of the present study were to examine the relationship between gestural deficit and integrity of neuropsychological systems as determined by means of Luria's Neuropsychological Investigation[3] and to examine the relationship between gestural deficit and severity of aphasic disturbance. A subsidiary aim was to explore possible relationships between residual intellectual efficiency and gestural competence.

METHOD

SUBJECTS (Ss)

Six aphasic patients of varying etiology and severity were selected on the basis of the following criteria:-

Ss were to

1. Have been diagnosed as aphasic by a neurologist and speech therapist — this was to be further confirmed by a formal rating on the Boston Diagnostic Test of Aphasia.[16]
2. Have suffered their cerebral insults at least six months prior to testing and were thus regarded as neuropsychologically stable.[8, 45, 52]
3. Be native speakers of the English language.
4. Show no evidence of sensory deficits in the auditory, visual and tactile modality.
5. Come from similar cultural backgrounds and have a minimal educational level (Std. 8).
6. Have passed two preliminary screening tests adapted from Pickett[43] which determine abilities in recognition and naming of objects and tactile-visual matching tasks — prerequisites for the gesture tests to be used in the present study.

Description of subjects — see Table I for relevant clinical and biographical data.

Ss	S1	S2	S3	S4	S5	S6
Age	46,4	48,1	6,3	59,11	70,2	59,6
Mean Age	57,83					
Age Range	46 years 4 months to 70 years 2 months					
Sex	M	F	F	F	M	F
Education Level	University degree	Std. 8	Std. 8	Std. 8	Matric	Matric
Home Language	E	E	E	E	E	E
Premorbid Occupation	Civil Engineer	Manicurist	Saleslady	Varied. Saleslady Collector	Company Director	Typist Bookkeeper
Occupation Changed Due to Illness	Y	Y	Y	N collector	Y	Y
Laterality	R	R	R	R	L	R
Hemiplegia	N (recovered)	R	R	N (recovered)	R	R
Pathology	Trauma followed by removal of tissue due to infection	Vascular Arterio-sclerosis in carotid artery. Hypercholesterolmic	Cerebro Vascular accident	Aphasia Cerebral Thrombosis followed by absces in left inferior carotid artery. Surgery resulted in right hemiparesis	Vascular Arterio-sclerosis Etiology: Hypertension	Cerebro-vascular accident
i) Loss of Sensation	Recovered	R side	R side	R side	R side	R side
ii) Oral Apraxia	Y	Y	Y	N	Y	Y
Months Post Onset	37	36	8	168	7	99
Therapy at	Sp. & H. Clinic	Sp. & H. Clinic	J.G. Stryd Hospital	Sp. & H. Clinic	Bramley Old Age Home	Sp. & H. Clinic
Ambulant	Y	Y	N	Y	N	Y

Key: M = Male, F = Female, E = English, R = Right, L = Left, Y = Yes, N = No

TABLE 1. Relevant Biographical and Clinical Information Pertaining to the Subjects (Ss).

TESTING

The following tests were administered:-

1. Gesture and Pantomime Tests, Adapted from Pickett.
   This test was selected from currently available tests[10, 12, 15, 43, 44] as it

tests both comprehension and expression of gesture; makes use of homogeneous items between tests; capitalises on all sensory modalities to elicit performance and hence eliminates the contamination of an impaired sensory modality on performance potential; and, allows for verbal as well as non-verbal means of communication in giving the instructions and hence facilitates optimal comprehension about the nature of the task.

Description of Gesture Tests:

Each test was centred around 10 commonly used homogeneous objects, contained in the Porch Index of Communicative Ability.[43] Two test items were modified so as to render them suitable for the South African population.

The tests were graded in order of extent of information given about the test. Ss were cautioned not to talk during the administration of the tests.

Gestural Test 1 (G1) — Expressive:
Ss were presented with a picture of an object and were required to pantomime the function.

Gestural Test 2 (G2) — Expressive:
Ss were given the actual object to use in pantomime.

Gestural Test 3 (G3) — Receptive:
Ss were presented with pictures of persons in postures associated with the function of the test objects and were required to point to the appropriate object.

Gestural Test 4 (G4) — Expressive:
Ss were given auditory instructions to pantomime.

Gestural Test 5 (G5) — Receptive:
The E pantomimed the functions of each object, and the Ss were required to point to the appropriate object.

Gestural Test 6 (G6) — Imitative:
The E pantomimed the functions of an object, and subsequently, the Ss were required to imitate the E.

2. Luria's Neuropsychological Investigation.[3]
This was administered so as to yield a measure of functioning at various neuropsychological levels; to localise the lesions of each subject; and, to gain an understanding of the basic factors upon which gesture depends and the critical structures involved.
The following subtests were selected on the basis of their relevance to this study:-
   (i) Motor Functions
   (ii) Acoustico-motor Organisation
   (iii) Higher Cutaneous and Kinaesthetic Functions
   (iv) Higher Visual Functions
   (v) Impressive Speech
   (vi) Expressive Speech
   (vii) Mnestic Processes

In addition, two total scores were obtained for visuo-spatial functions and dynamic organisation since it was hypothesized that these functions are involved in receptive and expressive gesture, respectively. The totals of the following subtests were used to yield the two measures.

(viii) Visuo-Spatial Functions:
Kinaesthetic Basis of Movement
Optico-spatial Organisation of the Motor Act
Stereognosis
Objects and Picture Recognition
Spatial Orientation
Intellectual Operations in Space
Form Recognition
Size Contrast Effects
Immediate Reproduction of Visual, Acoustic, Kinaesthetic and Verbal Traces

(ix) Dynamic Organisation:
Dynamic Organisation of the Motor Act
Oral Praxis
Speech Regulation of the Motor Act

Scoring

A set of optimal criteria (optimality range) was drawn up for each of the 44 subtests. A score of 1 was assigned to each optimal criterion which corresponded to the S's performance e.g. for the subtest entitled Optico-Spatial Organisation, 4 optimal criteria were drawn up:-

(i) Muscle Power and Tone
(ii) Accuracy of Movements
(iii) Symmetry
(iv) Immediacy of Response

Thus, a S who performed within this range would get a score of 4.
The optimality ranges were compiled on the basis of Christenson[3] and Luria.[30]

3. Boston Diagnostic Test of Aphasia.[16]
To obtain an unequivocal diagnosis of aphasia and an objective severity rating of the Ss' linguistic abilities.

4. The Performance Scale of the "Wechsler Adult Intelligence Scale.[52]
To yield a measure of performance I.Q., the latter defined as a deviation score on the Wechsler Adult Intelligence Scale.

RESULTS AND DISCUSSION

The principle statistical analysis applied to the present data was the Spearman Rank Order Correlation Coefficient and the associated tests of significance.[35] Because of the small number of subjects involved in the present study, apparently high correlations may be non-significant and further, the non-significant correlations cannot be interpreted in a totally unambiguous fashion. Hence, only those correlations which were significant were interpreted as reflecting a systematic relationship and the non-significant correlations, no matter how high the r value, were interpreted as being no different from zero.

GESTURE

The scores obtained on the gesture tests are represented in Table II. Table III represents the matrix of intercorrelations between the gesture tests. The findings presented in Table III suggest that a gestural impairment encompasses a deficit which incorporates the manipulation of real and pretended objects. The deficit clearly extends from the level of the formulation of a motor sequence to the execution of that sequence, and additionally involves imitation. The significant correlation coefficients obtained between receptive (G3; G5) and expressive (G1) gesture tests suggests the existence of a general underlying process which represents gestural competence, i.e. reception and expression seem to be part of a continuum as opposed to being dichotomous alternatives.

	Receptive Gesture	Expressive Gesture
S1	20	463
S2	20	453
S3	17	404
S4	20	476
S5	7	118
S6	20	417
Maximum Score	20	480

TABLE II. Scores Obtained on Receptive and Expressive Gesture Tests for all Ss.

	G1(E)	G2(E)	G3(R)	G4(E)	G5(R)	G6(1)
(E)G1		0,81426*	0,857143*	0,942857*	0,857143*	0,942857*
(E)G2			0,58714	0,9*	0,585714	0,671429
(R)G3				0,714286	1*	0,914286*
(E)G4					0,714286	0,885714*
(R)G5						0,914286*
(1)G6						

Key: E = Expressive Gesture
R = Receptive Gesture
* = Significant Correlation (r_s = 0,829; N = 6; P 0,05). Spearman correlation coefficient of at least 0,829 is required for significance (P = 0,05) when N = 6.
I = Imitation

TABLE III. Spearman Rank-Order Intercorrelation Coefficients Between the Six Gesture Tests.

	Severity	Dynamic Organisation	Visuo-spatial Functions	Acoustico Motor	Impressive Speech	Expressive Speech	Mnestic	Performance IQ
Receptive Gesture	0,8571429*	0,8142858	0,8714286*	0,8	0,8714286*	0,8	0,8571429*	0,8
Expressive Gesture	0,8857143*	0,4857143	0,7	0,4285715	0,5285715	0,4285715	0,8	0,7714286
Impressive Speech	0,6714286	0,8428572*	0,8714286*					0,6142858
Expressive Speech	0,7142858	0,6857143	0,8428572*					0,7142858
Severity		0,4571429	0,8428572*	0,7142858			0,9428572*	
Visuo-spatial	0,8428572*							0,8714286*
Dynamic Organisation	0,4571429							0,2857143

* = Spearman rank-order correlation coefficients of at least 0.829 are required for significance ($P = 0.05$ when $N = 6$).[35]

TABLE IV. Spearman Rank-Order Intercorrelations Between Various Categories of Verbal Language, Gesture and Neurological Function.

Neuropsychological Functions and Gesture.

Although a general gestural competence has been postulated, it is nevertheless true in terms of the model proposed that they are dependant on separate neurological subsystems and therefore the question of whether they are dependant on different neuropsychological functions becomes relevant. Spearman rank-order correlations were obtained between gesture (receptive and expressive respectively) and several neuropsychological functions as tested on Luria's Neuropsychological Investigation.[3] (See Table IV). The findings suggest that receptive gestural ability is closely and differentially related to visuo-spatial functioning and mnestic ability. There is therefore an association between receptive gesture and the various perceptual processes which are dependant upon Luria's unit 2 i.e. the posterior secondary and tertiary corteses.[30] This finding then suggests that receptive gesture, in common with other perceptual processes, is similarly dependant on unit 2.

In terms of the present framework, the absence of a correlation between expressive gesture and dynamic organisation and acousticomotor organisation, respectively, is surprising since gesture is often regarded as a form of praxis.[30, 31] However, it is clear that future research is required to elucidate this problem.

CASE STUDIES

Detailed results obtained from tests administered for each subject are summarised in Table V.

Although detailed case studies formed a large part of the present study, it is not within the scope of this paper to discuss them in depth. For the purposes of this article, only one case will be presented in terms of what is directly relevant to the stated aims.

Subject 2 (S2)

(a) S2 showed symptoms indicative of a lesion of the posterior frontal or fronto-temporal areas of the left hemisphere, manifesting as symptoms typical of "transcortical aphasia"[33] i.e. difficulty in connected motor speech, breakdown occurring when extent of repetition is broadened to several words, difficulty in the smooth transition between words, and symptoms of pathological inertia.[3] Furthermore, there was evidence of a breakdown in "kinetic melodies"[32] of motor skills, writing difficulties and confusion between articulemes, all of which were suggestive of a lesion of the lower portion of the premotor zone.[32] While simple motor functions of the hands seemed unimpaired, the latter lesion seemed to manifest in apparent difficulties in the dynamic organisation of movement functions. S2 performed well on acoustico-motor functions, cutaneous and kinaesthetic functions and mnestic processing tests, (the latter corresponding to an "average" performance IQ of 100) which suggests intact functioning of the posterior regions of the brain.

Receptive Tests						
Gesture		Language	Neuropsychological Functions			
			Visuo-spatial organisation	Mnestic processing	Acoustico-motor perception	Cutaneous and Kinestic perception
S1	20	23	26	27	6	17
S2	20	35	29	27	10	19
S3	17	21	18	4	2	12
S4	20	23	31	20	7	18
S5	7	2	15	4	4	7
S6	20	24	31	14	8	18
Maximum Score	20	42	45	31	10	19
X = 17,3						

Expressive Tests					
Gesture		Language	Neuropsychological Functions		
			Motor Functions of hand	Dynamic Organisation	Acoustico Motor Performance
S1	463	37	16	26	12
S2	453	48	18	29	13
S3	404	3	17	18	3
S4	476	36	17	31	10
S5	118	13	6	15	3
S6	417	45	13	31	13
Maximum Score	480	58	22	44	13
X = 338,5					

Tests	Subjects					
	S1	S2	S3	S4	S5	S6
Performance Scale of the Wechsler Adult Intelligence Scale	110	100	28	96	32	89
Boston Diagnostic Aphasia Test Severity Rating	3	3	0	3	1	2

TABLE V. Scores Obtained for Gestural, Linguistic and Neuropsychological Tests, on Receptive and Expressive Levels Respectively, in addition to Performance IQ, and Severity Rating.

(b) The areas implicated above seemed to overlap with those presumed to subserve expressive gesture, while the posterior cerebral areas concerned with receptive gesture appeared intact. Hence, it may be predicted that some difficulty on expressive gesture would be evident, associated with no apparent receptive gesture difficulties.

(c) As demonstrated in Table IV, scores yielded by the gesture tests confirmed the above i.e. a score of 453 out of a maximum score of 480 obtained for expressive gesture, while a score of 20 out of a maximum of 20 obtained for receptive gesture.

Summary of Case Studies

1. Dynamic localisation of a lesion affords one the opportunity to predict a S's receptive and expressive ability on gestural tasks.
   (a) Lesions of the posterior divisions of the cerebral cortex invariably manifest as an impairment on receptive gesture tasks. This was clearly evident in S1, S3 and S5.
   (b) Lesions of the anterior divisions of the brain result in expressive gestural impairments as was the case in all Ss.
2. The relation between verbal language and gesture was demonstrated in that all Ss manifested concomitant deficits on both receptive and expressive levels.
3. For all subjects, performance on verbal language tests was superior to that on gestural tests.

Gesture and Speech

A significant correlation coefficient was obtained for impressive speech and receptive gesture (r_s = 0,8714286; N = 6; P 0,05).
This has been supported by several authorities all of whom attributed the relationship to an underlying communication breakdown.[10, 43] However, within a neuropsychological framework the results assume another dimension. According to Luria,[30] the areas of the brain subserving impressive speech include posterior-superior and middle zones of the left temporal region, temporo-occipital and temporo-parieto-occipital zones of the left hemisphere. The latter two areas were found, in the present study, to be a part of the mechanism responsible for the comprehension of gesture. Thus speech and gesture, on a receptive level, appear to have a similar neurological basis.
At an expressive level, the absence of a relationship between gesture and speech is not consistent with the framework proposed here and again must be a subject of future research.
An important finding of the present study was that gestural language suffers considerably less than does verbal language, on both receptive and expressive levels, irrespective of the severity of the aphasia. This contrasts with those of Duffy et al[10] who found inferior performance on pantomime recognition tests irrespective of whether they were pathological or not.

The sparing of gestural communication relative to the verbal counterpart may be viewed in a number of ways: Firstly, in terms of the ontogenetic framework proposed by McNiell[37] and Hacean[18] aphasia may be viewed as a regression to Piaget's sensori-motor stage. This theory would lend support to "Ribot's Rule" which states that in the dissolution of aphasia the last acquired functions are first to be involved, while the first acquired, offer the greatest resistance to extinction.[42]
A second interpretation, although somewhat less plausible than the first one, may be derived from the socio-cultural evolutionary framework proposed by Hewes[19] which hypothesises that gesture occurs earlier in the evolutionary sequence than speech or independently of speech. In this context, aphasia may be viewed as a regression to an earlier phylogenetic stage. Finally, one may view this finding in terms of Minkowski's Principle[38] that stressed the "affectional, psychological and emotional" background of language and suggested that language supporting emotional content will recover best. This seems particularly relevant to the language of gesture which has been reported to be an important vehicle for the transmission of emotionally charged information.[2]

Residual Intellectual Capacity and Gestural Ability

Intellectual efficiency can no longer be ignored as a factor which contributes to the capacity to perform gesture and pantomime.[15]
Spearman rank-order correlation coefficients obtained between scores yielded by the Performance Scale of the Wechsler Adult Intelligence Scale[53] and receptive and expressive gesture respectively failed to reach the 0,05 level of significance.
($r_s = 0{,}8$; $N = 6$; $P\ 0{,}05$) and ($r_s = 0{,}7714286$; $N = 6$; $P\ 0{,}05$).
This suggests that performance on the intelligence test did not predict gestural ability, either receptively or expressively.
However, these results must be viewed with caution since it is important to bear in mind the criticisms levelled against the reliability of non-verbal intelligence tests when applied to the brain damaged population.[36, 43, 50]

Aphasia and Gesture

Defining a gestural deficit as part of an aphasic communication disorder requires that it be correlated with the severity of aphasia.[15] Spearman rank-order correlation coefficients computed between severity of aphasia and receptive and expressive gesture respectively were significant:
($r_s = 0{,}8571429$; $N = 6$; $P\ 0{,}05$) ($r_s = 0{,}8857143$; $N = 6$; $P\ 0{,}05$).
This finding suggests that a gestural impairment is a component of the aphasic syndrome and concurs with findings by Duffy et al[10] and Pickett.[43] However, the latter authors regarded gesture and aphasia to be related on a linguistic or cognitive level, through symbolism or representation.
On the basis of criteria enumerated by Goodglass and Kaplan[15] and within the present framework, the findings seem to lend credence to the following suggestions:-

1. The notion of a complex sequential motor movement disorder was not supported by results of the present study and the tentative nature of the present finding does not allow a definitive interpretation with respect to this relationship. However, this conclusion receives some support from the fact that
   (a) there was a strong relationship between formulation of gestures and expression of gestures which was not accounted for by the verbal impairment and
   (b) there was a relationship between manipulation of real objects in addition to pretended ones which, according to Goodglass and Kaplan[15] conforms to the definition of a movement disorder. In the light of these findings, the notion of asymbolia seems unlikely but can not be entirely discounted.
2. The close associations found between impressive speech and receptive gesture, from statistical analysis as well as from case study data, suggests that these two functions are dependant on common underlying neurological substrate. However, this interpretation cannot as yet, in terms of the present findings, be extended to expressive gesture and expressive speech. At an expressive level, no association was found between speech and gesture on statistical analysis, even though a positive relationship was found in the case studies.

   The finding of a strong relationship between verbal language and gesture in general, supports the idea of a common underlying neurological substrate.

   Moreover, the evidence relating to overlapping areas of brain function involved in visuo-spatial functioning, mnestic processes, impressive speech and receptive gesture and the evidence that a lesion of the left cerebral cortex manifested in concomitant expressive verbal language and expressive gestural language impairments, further served to render this hypothesis compelling. Finally, the relationship between severity of aphasia and gestural ability, may also serve as evidence for this conclusion.

CONCLUSION

The neuropsychological approach adopted served to highlight the reliance of receptive and expressive gesture on certain areas of the brain.

1. Receptive gesture subserved by the posterior regions of the brain encompassing the secondary occipital cortex, occipito-parietal cortex, parieto-temporal and temporo-parieto-occipital area. Hence receptive gesture appears to be linked with Luria's second functional unit.[31]
2. Expressive gesture subserved by the anterior regions of the brain, incorporating the basal areas of the cerebral cortex, postcentral regions, premotor divisions and frontal systems. Hence this seems to involve Luria's third functional unit of the cerebral cortex.[31]

The conclusion that a gestural impairment is a part of the aphasic syndrome would necessitate a broader view of aphasia than many authorities present.[10] In addition, the need for a revised conception of the neurological basis of language was indicated. In conclusion however, the present results must be regarded as tentative and further research employing larger samples is indicated. If the hypotheses suggested here are supported by future research, intervention strategies involving gesture may become a valuable part of the therapy regime.

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