



Motor Planning Disturbances – Apraxia Assessment

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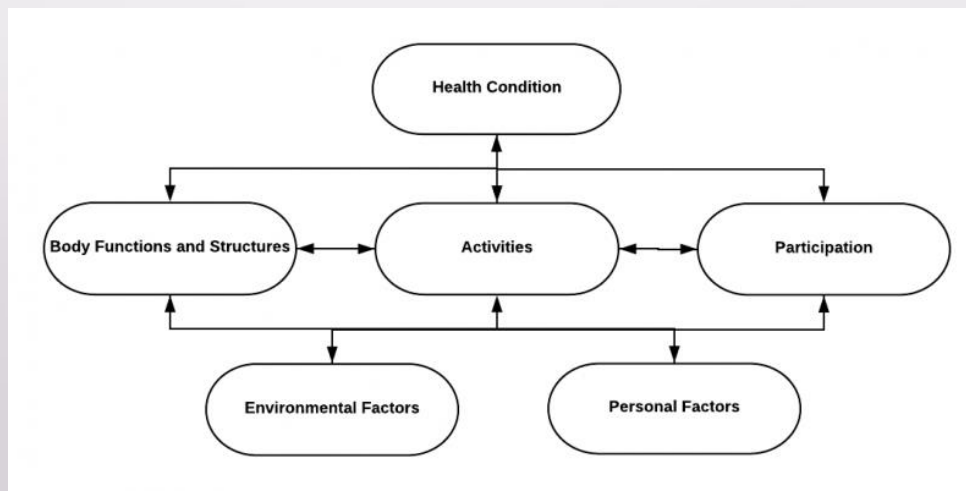
Motor Planning Deficit - Apraxia

- A heterogenous syndrome of higher motor cognition – motor planning.
- Affects 28-54 percent of left hemispheric stroke patients, to a lesser degree right hemispheric stroke patients
- May improve when in context



Apraxia in ICF

- At body function level - an inability to perform movements that can not be explained by motor weakness, language, sensory or cognitive deficits
- At activity level reduces independence in ADL
- At participation level reduces chances of returning to work, driving



Types of Apraxia

First apraxia theory postulated by Liepmann (1920)

- Ideomotor
- Ideational (and conceptual)
- Dressing – personal spatial
- Constructional – peripersonal spatial
- Buccofacial/Orofacial
- Occular
- Speech
- Limb kinetic



Ideomotor Apraxia

- Difficulty in imitating gestures (meaningful, meaningless) and pantomime (transitive, intransitive)
- Difficulty in judging correctness when watching gestures
- Spatial and temporal errors
- Don't know how to do



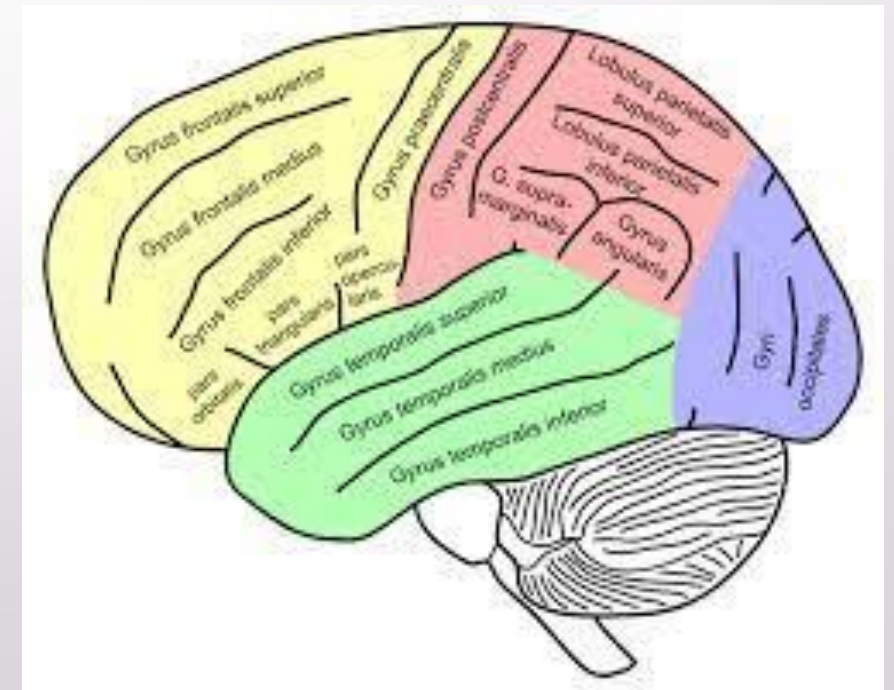
Ideational (and Conceptual)

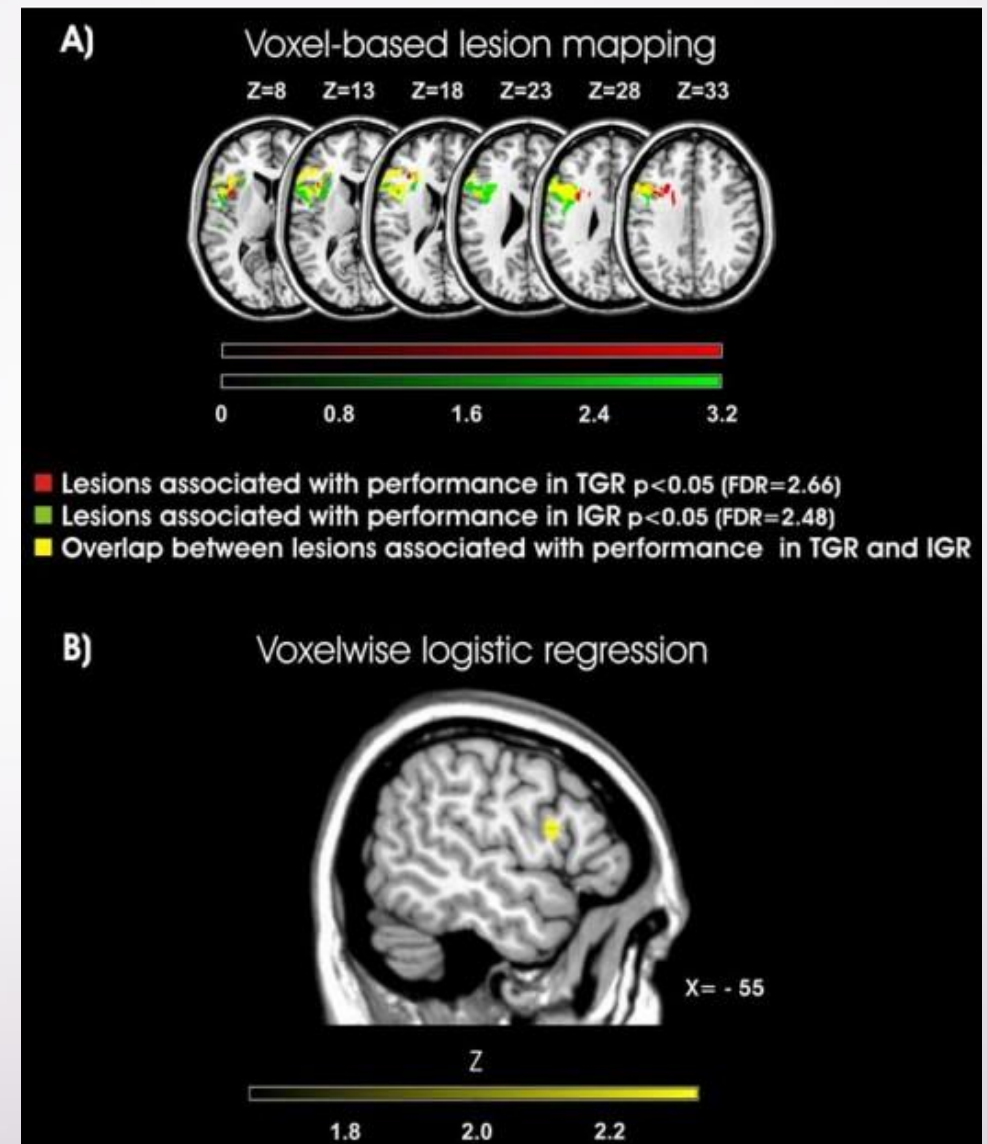
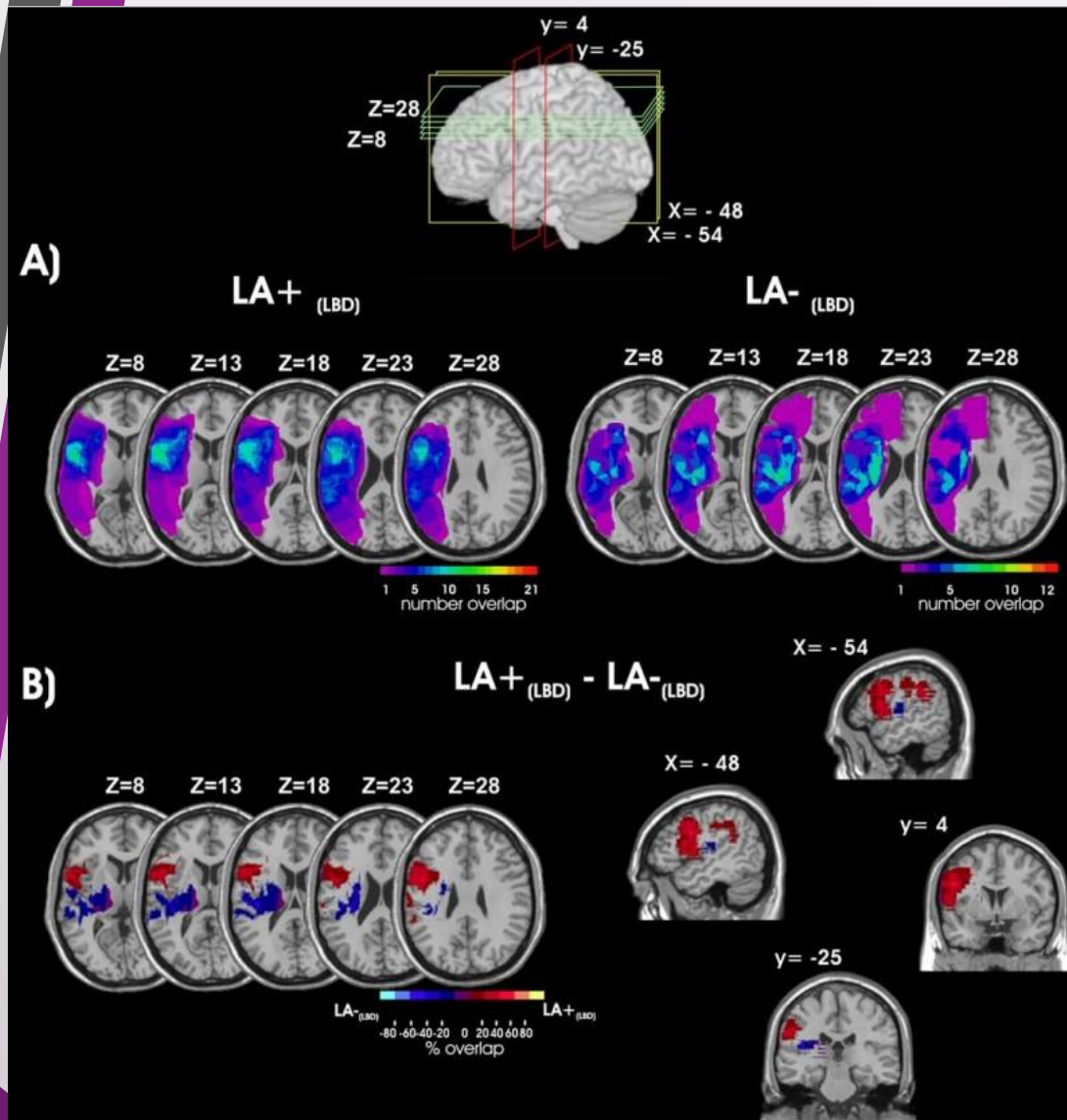
- Difficulty in carrying out a sequence of actions to achieve an intended goal
- Understanding the concept of an action and the actual use of tools
- Difficulty in actual tool use
- Conceptual apraxia introduced to differ between understanding the use of tools in a series of actions vs understanding concept of action
- Don't know what to do



Anatomy of Praxis Deficits

- Most in left hemisphere but also in right
- Inferior Parietal Lobule
- Inferior and Middle Frontal Gyri
- Related to mirror neuron system





41 subacute stroke patients, left and right hemispheric damage. Assessment of ideomotor and ideational apraxia with De Renzi's tests and judging observed gestures.

Pazzaglia, Mariella, et al. "Neural underpinnings of gesture discrimination in patients with limb apraxia." *Journal of Neuroscience* 28.12 (2008): 3030-3041.

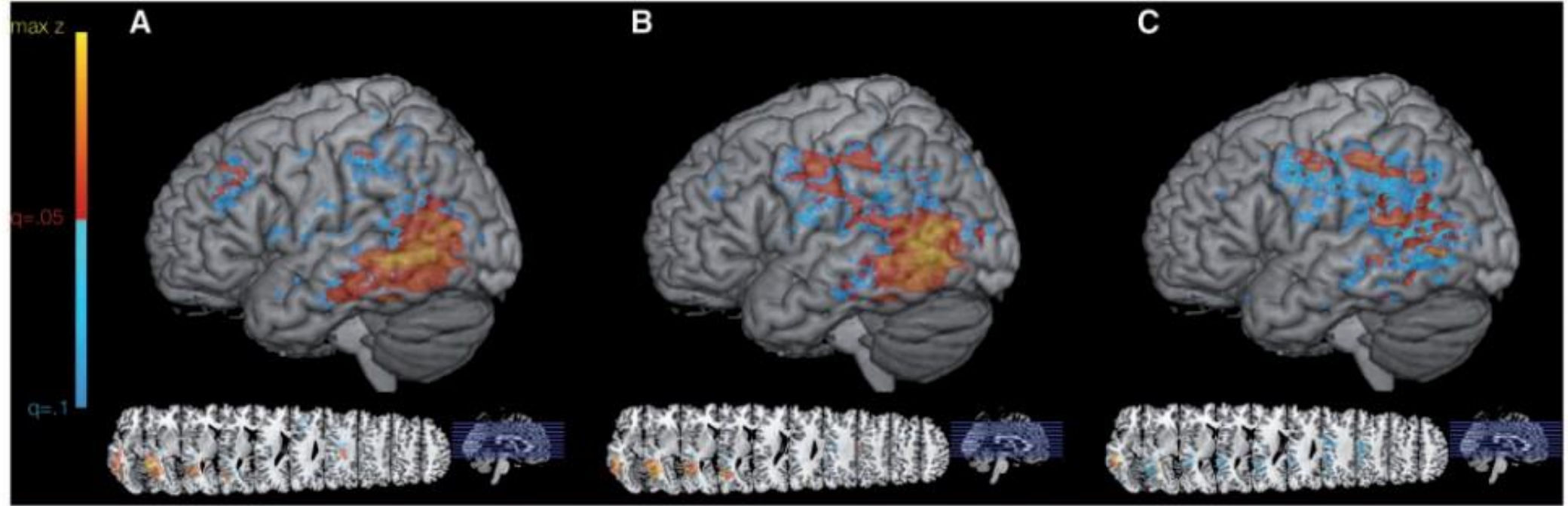


Figure 4 Maps of the reliability (Z-scores) of the difference between patients with and without lesions in each voxel in (A) gesture to the sight of tools (GestTool), (B) imitation of tool-related gestures (ImTool), and (C) imitation of novel gestures (rendered on the MNI space ch2bet volume). For each of the three maps, voxels rendered in warm/hot colours correspond to Z-scores > 3.02 , 2.7 , and 2.7 , respectively, that reached the FDR-corrected threshold of $q < 0.05$. Voxels rendered in blue correspond to voxels associated with FDR-corrected thresholds between $q = 0.05$ and $q = 0.1$.

71 patients, chronic left hemispheric stroke. Apraxia assessed by imitation of tool related gesture, imitation of novel movement and pantomime of tool related gesture

Diagnostic Tests

- Most for ideomotor apraxia
- Screening tests:
 - Apraxia Screen TULIA
 - CAS- Cologne apraxia screen
- Comprehensive tests:
 - De Renzi
 - TULIA
 - Limb Apraxia test

De Renzi

- 1980
 - Ideomotor apraxia – imitation of gestures
 - 24 items (12 meaningful, 12 meaningless)
 - Divided to items involving finger movements and hand movements. To position or in sequence.
 - Scoring 0-3 for 3 trials. No reference to error type.
 - Cutoff 68/72
 - No psychometric properties but high internal consistency
-
- De Renzi et al. 1968
 - Ideational apraxia
 - 7 objects – tool use
 - Scoring 0-2
 - Score below 14 = apraxia

De Renzi Assessment

Finger movements

- 1) Forefinger and middle finger extended and abducted (sign of victory)
- 2) Thumb and forefinger together in a ring (sign of OK)
- 3) Forefinger and little finger extended, other fingers flexed (sign of cuckold)
- 4) Forefinger extended, other fingers flexed
- 5) Middle finger arched over the dorsal aspect of top joint of forefinger, other fingers flexed
- 6) Thumb imprisoned between the flexed forefinger and middle finger, other fingers flexed
- 7) Flick middle finger three times over top of thumb
- 8) Click middle finger three times with the thumb
- 9) 'Walk' forefinger and middle finger on the table
- 10) Make scissor movement with forefinger and middle finger, other fingers flexed
- 11) Tap the table top with four fingers in succession starting with forefinger (drum fingers)
- 12) Back of the hand on the table top. Forefinger and middle finger extended, other fingers flexed. Flex the forefinger and straighten, flex the middle finger and straighten. In turn. three times.

Hand and arm movements

- 1) Open palm of the hand onto the opposite shoulder
- 2) Open palm of the hand onto the back of the neck
- 3) Open hand on the chin
- 4) Salute
- 5) Hand circled as a tube, place to mouth and blow
- 6) Halt somebody – arm forward, elbow extended, open hand vertical
- 7) Sequence:
Closed fist – thump sideways on the table top. Open hand – slap palm on table top. In turn, three times
- 8) Sequence:
Fist on forehead, open palm to mouth. In turn, three times
- 9) Movement:
Open hand forwards on one side, perpendicular to body. Sweep slowly across front of body to opposite shoulder, extended fingers moving from spaced apart (abducted) to touching each other (adducted) as the hand moves
- 10) Make the sign of the cross (touch forehead, chest, opposite shoulder, other shoulder)
- 11) Extended fingers, closed together. Touch forehead three times with fingernails (palmar surface of hand facing forward)
- 12) Send a kiss. (Fingertips and thumb together.) Touch mouth, extend and abduct arm, spacing the fingers as you do so. Three times

TULIA- Test for Upper Limb Apraxia

- Vanbellingen et al. 2009
- Ideomotor Apraxia – imitation and pantomime
- 48 items. 6 subtests
- 0-5 points per item
- Cut-off score 194/240 (2 SD below mean score for healthy subjects)
- Validated- internal consistency, inter and intra-rater reliability
- High correlation with De Renzi's test

TULIA

Imitation, non-symbolic

1. Put index finger on top of nose
2. Bring thumb extended on forehead, other fingers point upwards
3. Bring back of the hand under chin, shoulder 90° abducted
4. Place the hand flat on top of the head
5. Lift only the hand from the table (forearm stays on the table)
6. Spread little finger outwards
7. Extend the arm sideward up to shoulder height
8. Lift middle finger

Imitation, intransitive

9. Make a catholic cross sign
10. Show as if someone is crazy[§]
11. Wipe dust from shoulder[§]
12. Salute like a soldier
13. Hitch for a car[§]
14. Make a stop sign
15. Clasp fingers
16. Point to a bird in the sky

Imitation, transitive

17. Drink from a glass
18. Comb hair[§]
19. Pick up telephone
20. Smoke a cigarette
21. Use a hammer[§]
22. Use a key
23. Use scissors[§]
24. Use a stamp to post-mark

Pantomime, non-symbolic

25. *Place your hand flat on your head*
26. Put your hand on your right (or left) shoulder
27. Take your left (or right) ear between thumb and index finger
28. *Put your extended thumb on your forehead, other fingers point upwards*
29. *Extend your arm sideward up to shoulder height*
30. Bend your elbow and look at the palm of your hand
31. *Lift only your hand from the table*
32. Lift your index finger from the table

Pantomime, intransitive

33. *Salute like a soldier*
34. Throw me a kiss
35. *Show as if someone is crazy[§]*
36. Scratch your head[§]
37. *Point to a bird in the sky*
38. Wave goodbye[§]
39. *Make a stop sign*
40. Make a threatening sign

Pantomime, transitive

41. Brush your teeth[§]
42. *Comb your hair[§]*
43. Eat soup[§]
44. *Smoke a cigarette*
45. Use a screwdriver[§]
46. *Use a key*
47. *Use a stamp to post-mark*
48. Cut bread that is put on the table[§]

Appendix 2 – Scoring method

5: Normal movement or identical to the demonstrated movement.

4: Goal of the movement is achieved, but errors occur not affecting trajectory (normal movement plane relative to goal object [tool or own body], normal joint coordination and movement shape).

Movement is too slow, hesitating, robot-like, sloppy with minor spatial errors such as reduced amplitudes.

3: Goal of the movement is achieved, errors subtly affecting trajectory occur, but are corrected.

Extra movements and omissions are present (mainly distal), even brief content errors (substitutions, perseverations) may occur; however, corrections are made in the ongoing movement.

2: Goal of the movement is achieved, errors subtly affecting trajectory occur, but are not corrected.

Body-part-as-object errors, extra movements and omissions (mainly distal) occur without correction.

1: Goal of the movement is not achieved, errors grossly affecting trajectory occur or semantic content is incorrect.

Final position is false, major errors in spatial orientation, overshoot and extra movements (particularly proximal), however, overall movement pattern remains recognizable. Persisting substitutions (related or unrelated) and perseverations occur.

0: No movement, unrecognizable movement.

Seeking and amorphous movements, no temporal or spatial relationship to the requested gesture.

Interesting Findings - TULIA

- 68% of left hemisphere damage patients were apraxic vs. 39% in right
- Severe apraxia only in left sided damage
- Apraxia more prevalent in cortical than subcortical damage
- Right sided damage effected imitation of gestures more than pantomime
- In left sided damage lower scores for pantomime more than imitation
- Lower scores for pantomime transitive vs. intransitive for all groups

Limb Apraxia Test

- Van Heugten et al. 1999
- Ideomotor and Ideational Apraxia
- 3 tools for pantomime by verbal command, 3 pantomime by visualization of tool, 3 actual tool use demonstration
- 6 gesture imitation
- Score 0-3, two attempts per item
- Homogeneity of subtests showed they were measuring the same underlying construct
- Cutoff 86/90 (1 SD below mean score for healthy subjects)

Limb Apraxia Test

Sets of objects are presented to the patient with the same instruction: "Show me how you would use ... (this object)".

Set 1: key, hammer, and toothbrush – presented only by verbal request

Set 2: spoon, hammer, and scissors – presented visually only

Set 3: eraser, comb, and screwdriver – objects are handed to the patient

Imitation of 6 gestures: sticking out one's tongue, blowing out a candle, closing one's eyes, waving goodbye, saluting, and making a fist

Limb Apraxia Test - Scoring

- The performance is correct and appropriate (3 points)
- The performance resembles the correct one, but is somewhat imprecise or the patient uses a body part as object (2 points)
- The performance only weakly resembles the correct one but is executed in the correct place, or it is correct but carried out in a wrong place (i.e., moving the toothbrush in front of the forehead (1 point)
- The performance is not correct or so incomplete that it is not recognizable (0 points).

Screening Tests

- Apraxia Screen of Tulia (AST)
 - 12 items
- Cologne Apraxia Screen (CAS)
 - 20 items



Apraxia Screen of TULIA (AST)



Name patient:

Test date:

Name examiner:

Diagnosis (incl. lesion localization):

Imitation

General instruction: "Seven gestures are demonstrated in a mirror fashion, imitate them as precisely as possible"

	right	left
1. Bring thumb extended on forehead, other fingers point upwards		
2. Wipe dust from shoulder		

Additional instruction: "For the next five gestures, imagine holding a tool or an object in hand, don't use your fingers as a tool"

3. Drink from a glass		
4. Smoke a cigarette		
5. Use a hammer		
6. Use scissors		
7. Use a stamp to postmark		

Pantomime

General instruction: "Now gestures are asked. Listen very carefully and perform them as precisely as possible"

8. "Show as if someone is crazy" *		
9. "Make a threatening sign" **		

Additional instruction: "Again, imagine holding a tool or an object in hand, don't use the fingers"

10. "Brush your teeth"		
11. "Comb your hair"		
12. "Use a screwdriver"		
Total Score		

Apraxia Treatment

- No standardized treatment protocol
- Gesture training
- Strategy training
- Practical tool use training
- Functional activity training – in context



Take Home Message: How to Assess Apraxia

- Consider using more than one test
- Type of apraxia (ideomotor vs. ideational)
- Time for examination (screen test vs. comprehensive)
- Discrimination and recognition of gestures





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