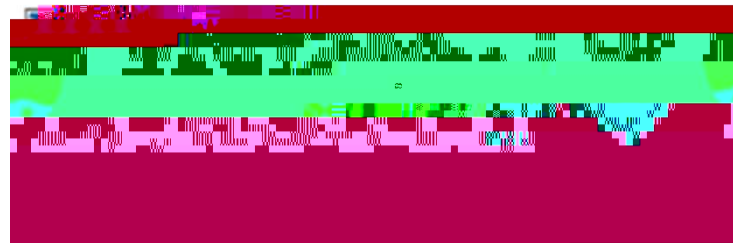


Apraxia

Neurology, Neuropsychology and Rehabilitation

Jon Masden
Professor of Rehabilitation
School of Health Professions



Tool Use



D Stout, T. Chaminade / *Neuropsychologia* 45 (2007) 1091–1100



Action Steals in the Brain



**Apraxia
Definitions, Prevalence and Impact**



**Ideomotor
Apraxia**

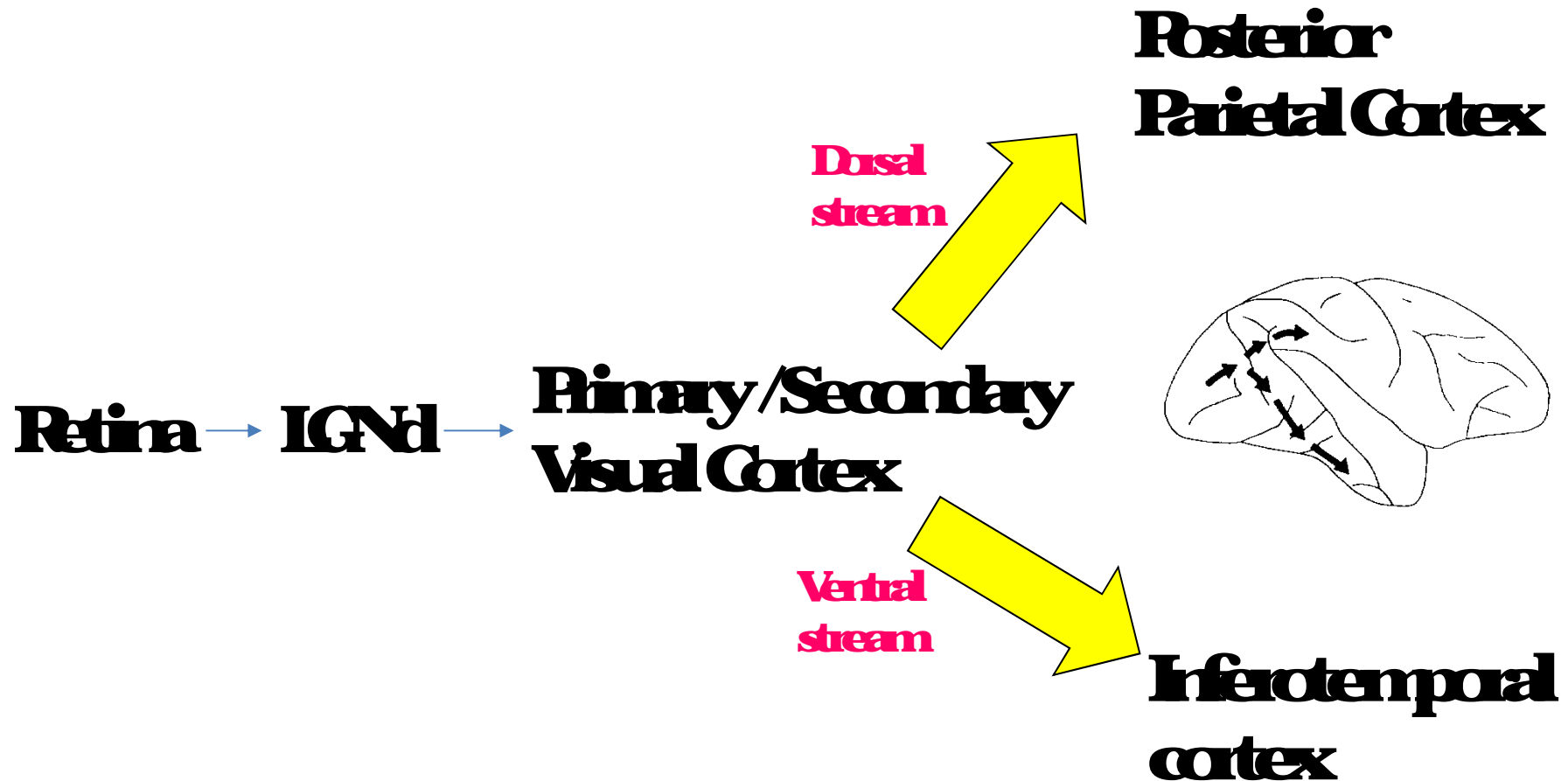
**Ideational
Apraxia**



**Rehabilitation and Recovery
of Apraxia**

Action Streams in the Brain

What and How in the Visual System

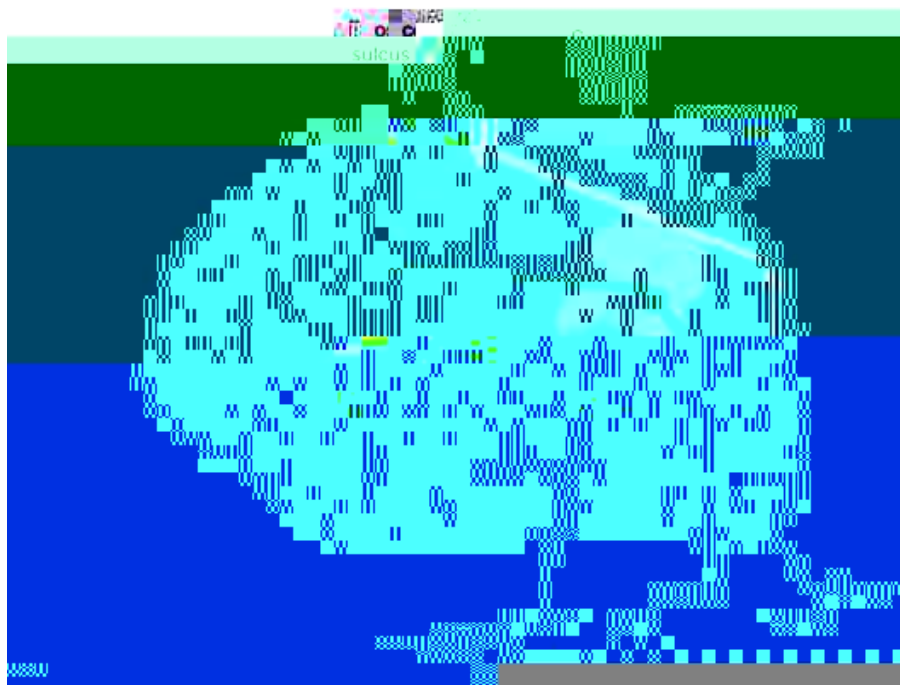


Modification of Body Schema by Tools



Interparietal Neurons

Action Streams in the brain



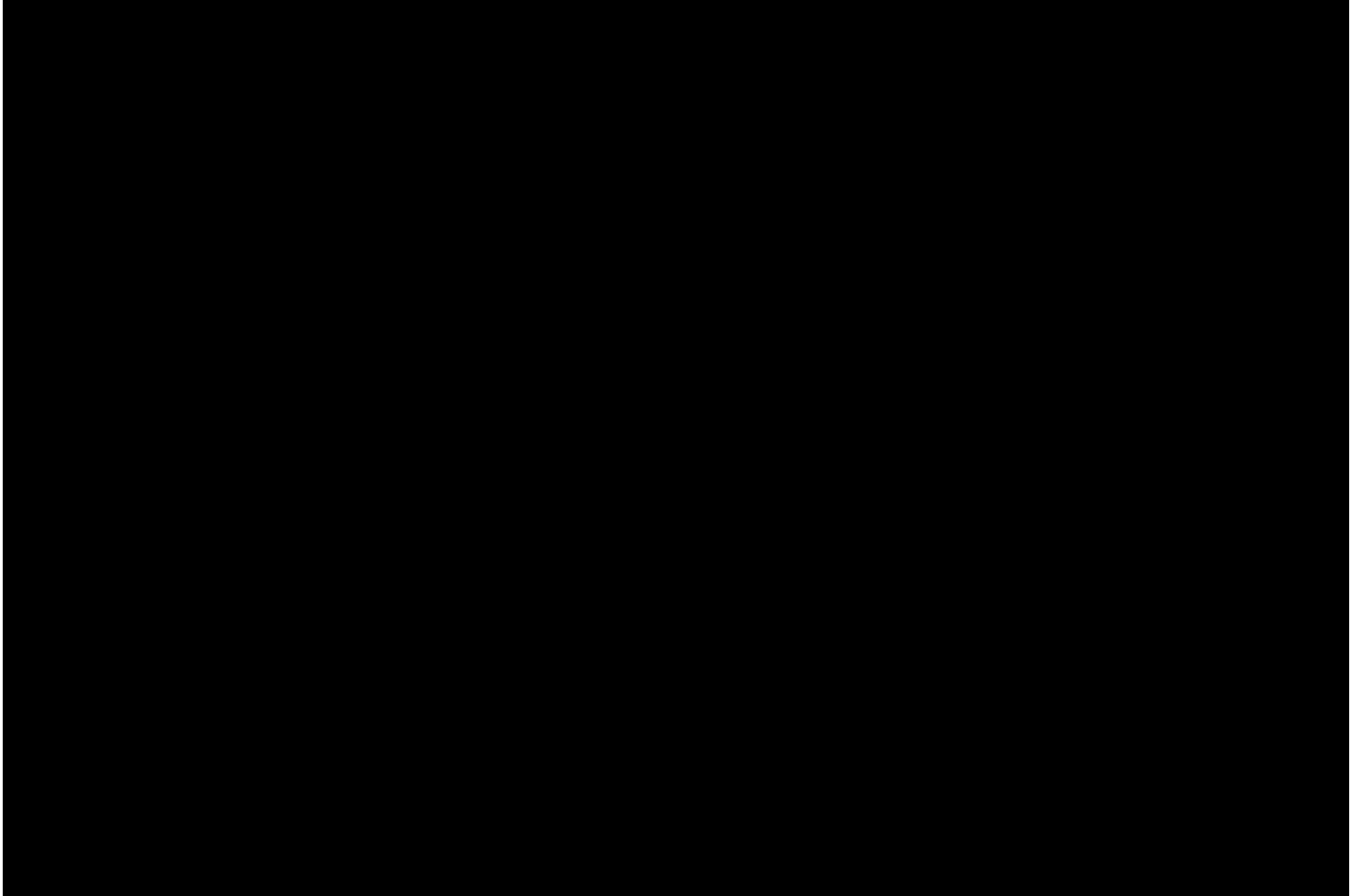
What Is Apraxia

Definitions, Prevalence and Impact

What is Apraxia?

A disorder of skilled movement characterized by:

- **an inability to perform purposeful skilled movements**
 - **an inability to pantomime and/or imitate gestures**
 - **difficulties in recognizing actions**
- **Not due to weakness, incoordination, somatosensory loss, or by poor comprehension of or inattention to commands**



What is Apraxia? Prevalence

Stroke

25% of all strokes

28.51% of left hemisphere lesions

6% Right hemisphere lesions

Can see with subcortical stroke

Zwirle et al 2004

Derkvot et al 2000

Multiple Sclerosis

26.3% associated with EDSS / Progressive Forms

Kann et al 2012

Parkinsons Disease & MSA

27% in PD

Urdz et al 2010

MSA apraxia related to cognitive decline

Corticobasal Degeneration

Severe Apraxia

Related to atrophy of pre-motor and parietal Cortex

Buel et al 2014

Alzheimer's Dementia

35% mild, 58% moderate,

98% severe dementia

Edwards et al 1991

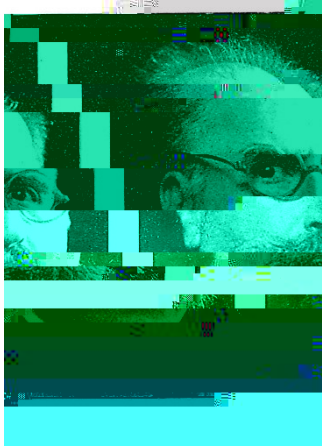
What is Apraxia? Impact

Symptoms of Ideomotor Apraxia often less when using and ject

What is Apraxia? Impact

**‘Bodily characteristics typical of the apraxia experience’
The Subjective View of Apraxia**

- **Gap between intention and bodily action**
- **Fragmented awareness in action**
- **Regular actions and odd bodies**
- **Intentionality on the loose**
 - **Fighting against tools**



What is Apraxia?



Ideomotor
Problems with
posture and/or imitation
+/- Tool Use

Ideational
Difficulties with conceptual
knowledge of tools
(aka Conceptual apraxia)

Difficulties with sequences
(aka action
disorganisation syndrome)

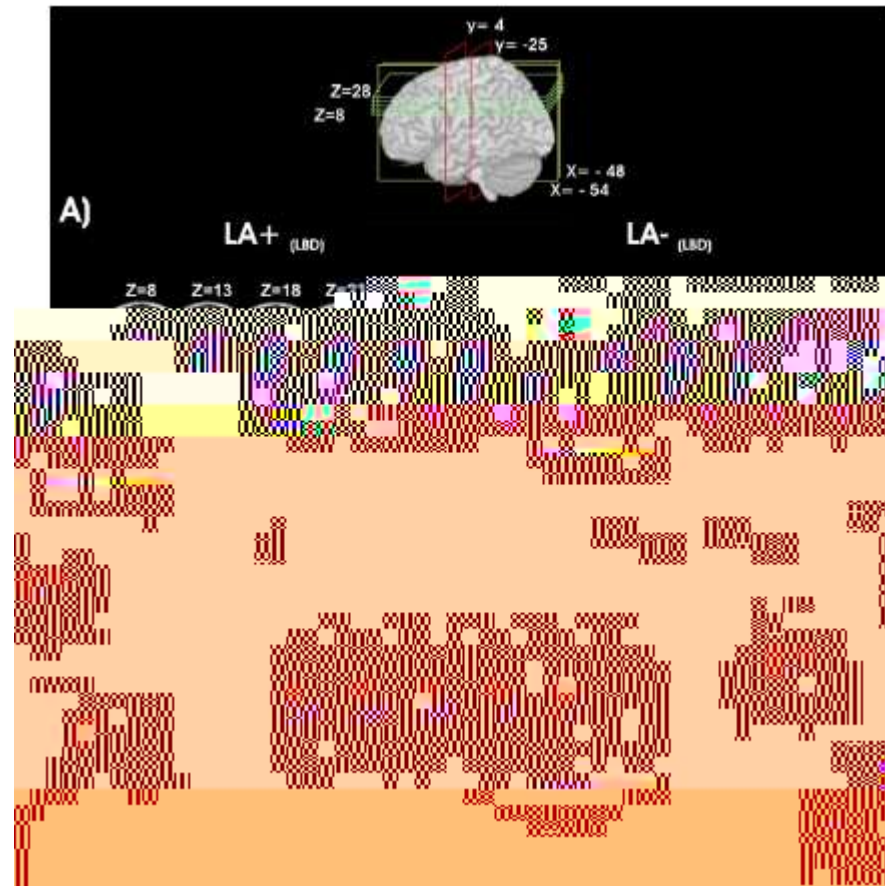
Ideomotor Apraxia

Ideomotor Apraxia Lesion Location

IA+ = has Ideomotor Apraxia IA- Does not have Ideomotor Apraxia

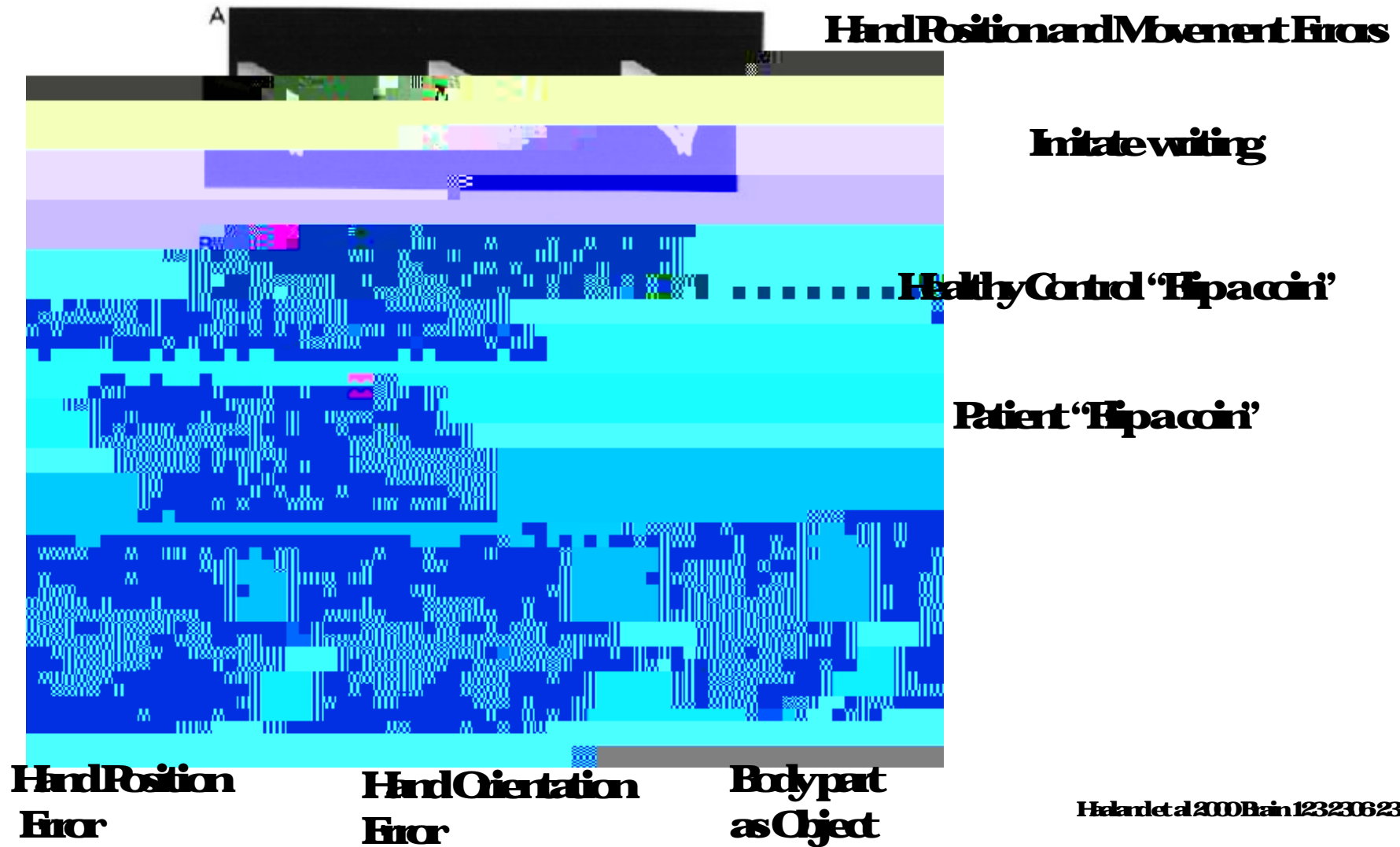
**Areas of lesion
Overlap**

**Difference between
IA+ AND IA- groups**



**left
Inferior Parietal cortex
Inferior Frontal cortex**

Ideomotor Apraxia Errors



Production Component: Ideomotor Apraxia

Action representation

Body/ Gesture Representation?



See kinematic Deficits



**Abnormal final posture
But normal kinematics**

**Abnormalities in action recognition and/or
monitoring**

Kinematic Deficits

Pantomine

Demowith Hammer

Use hammer and nail

Normal



Hand naker

Hammer naker

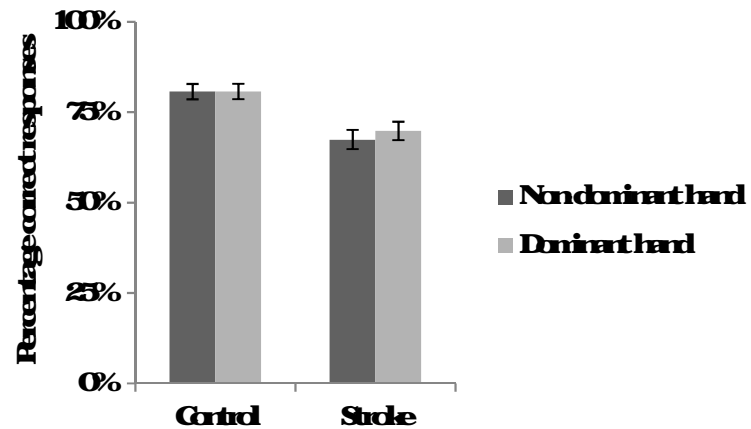
Performed using the non paretic side

Body Representations

Body Schema



- Lesions centered on Sensori-Motor areas



7

Body Representations

!

g

i

~

Spiritual Body Description

fl

Ideational Apraxia

Choosing the Right Action

Ideational Apraxia Errors

Sequence errors

- Action Addition
- Action Anticipation
- Step Omission
- Reversion

Conceptual Errors

- Misuse
 - misappropriation of object
 - Subordinate action misuse
- Mislocation
 - Action wrong
 - Location of action wrong
- Tool Omission
- Part omission
- Replexity
- Tying



Errors don't correlate with tests of Ideomotor Apraxia
See more errors with complex movements

Ideational Apraxia Theories

**Loss of Knowledge of
Object function
“agnosia of usage”**

Conceptual Apraxia

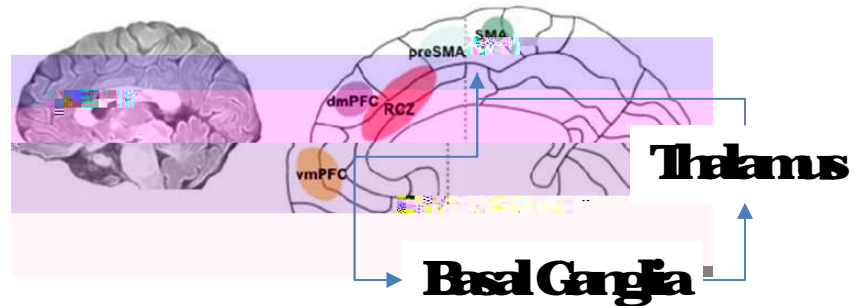
**Abnormal Contention
Scheduling and Affordance Competition**

**Abnormalities in
sequential organisation of
actions and/or in response
selection**

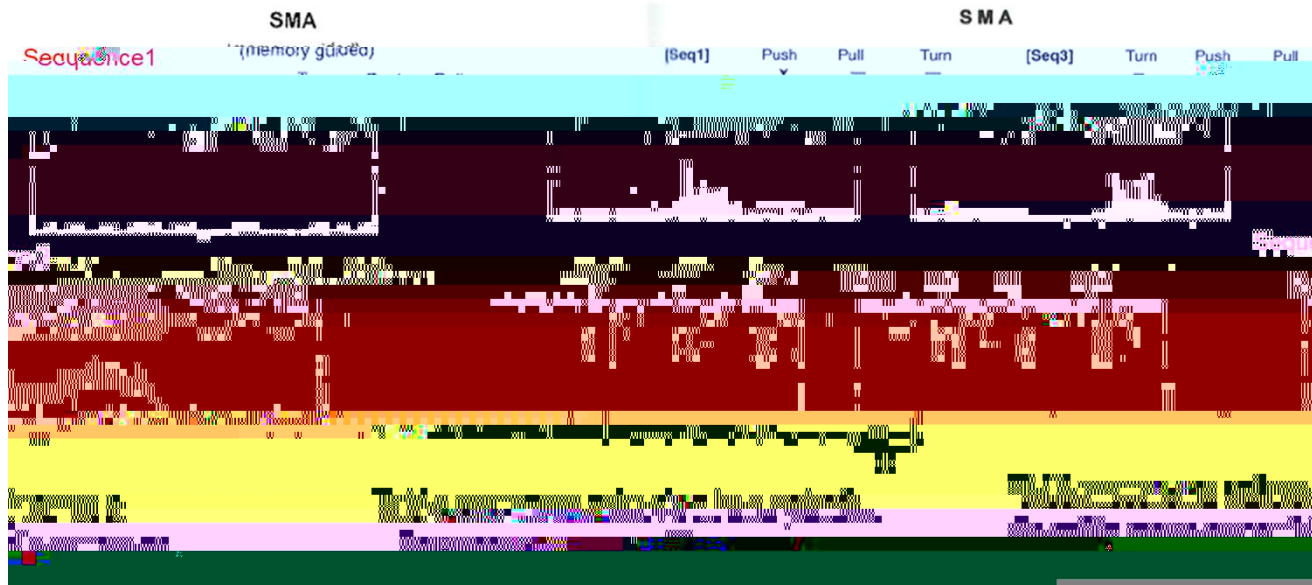
Action Disorganisation Syndrome

Sequencing Actions and Movements

Supplementary Motor Area



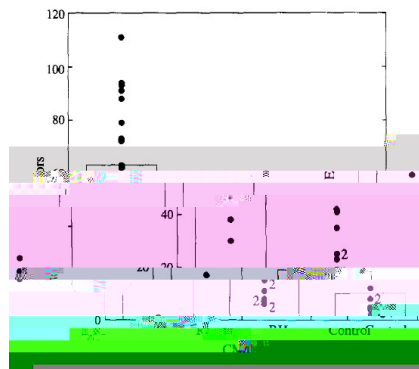
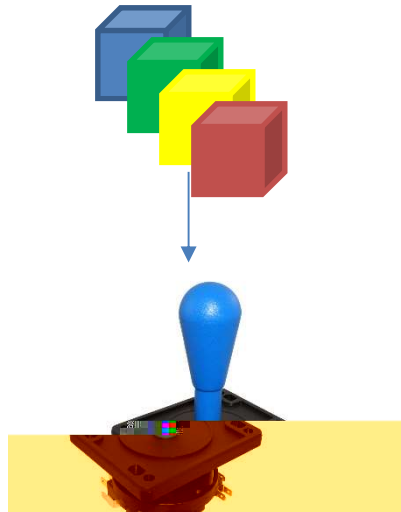
Specify Sequence → Specify the transition between elements



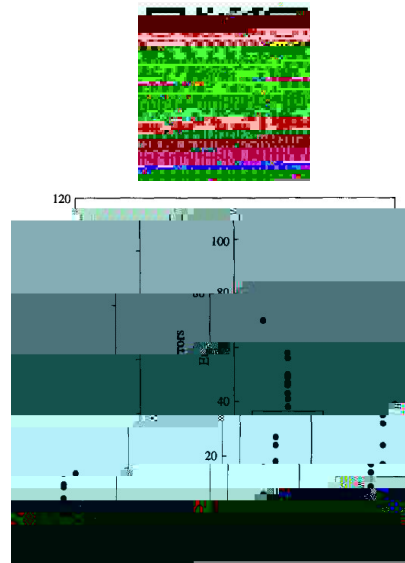
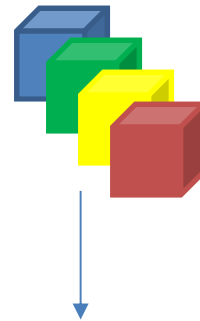
Tarj, j (1996) *In Vision and Movement: Mechanisms in the cerebral cortex*

Sequencing and response selection in Apraxia

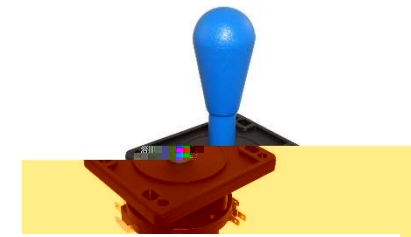
Match cube colour
to movement



Match cube colour
to pattern

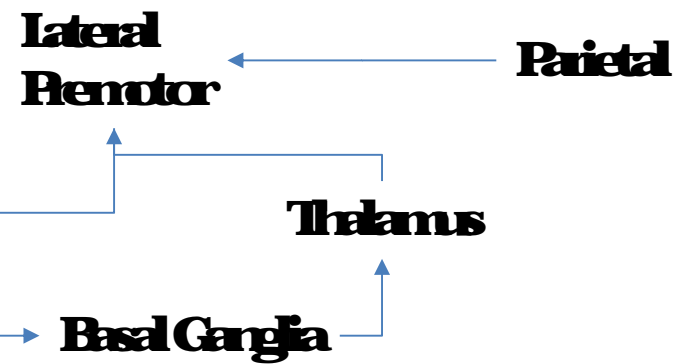
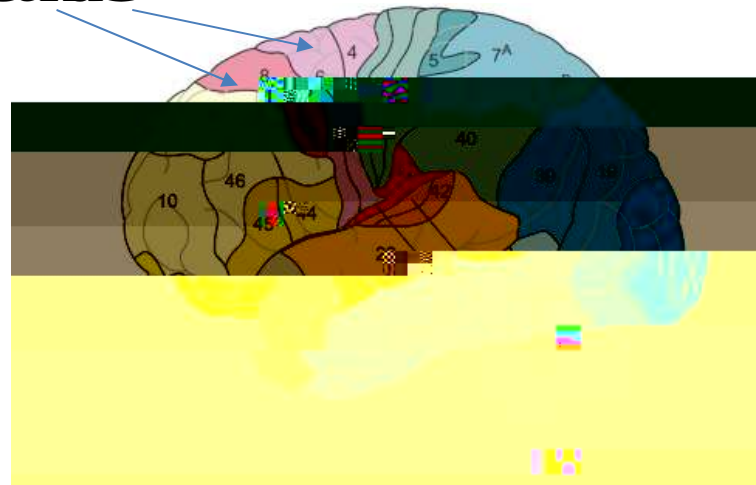


Learn a sequence
through trial and error



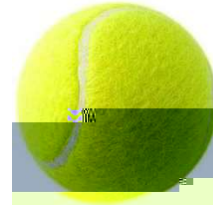
Response selection

**Motor
Area 6 and 8**



Contention Scheduling and Affordance Competition

Objects can 'afford' actions = 'graspability'



Functional Affordance: Different tools have different abilities to achieve a Goal

Goal ↔ Tool Object

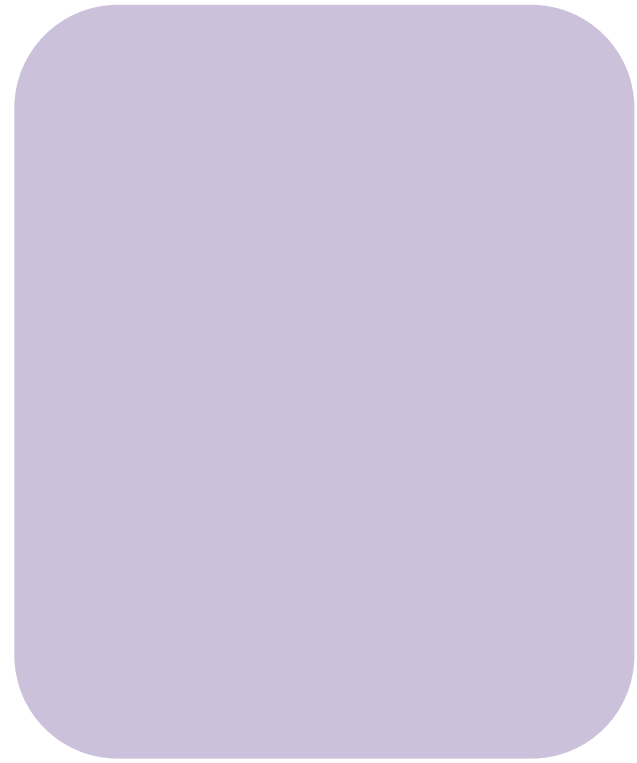


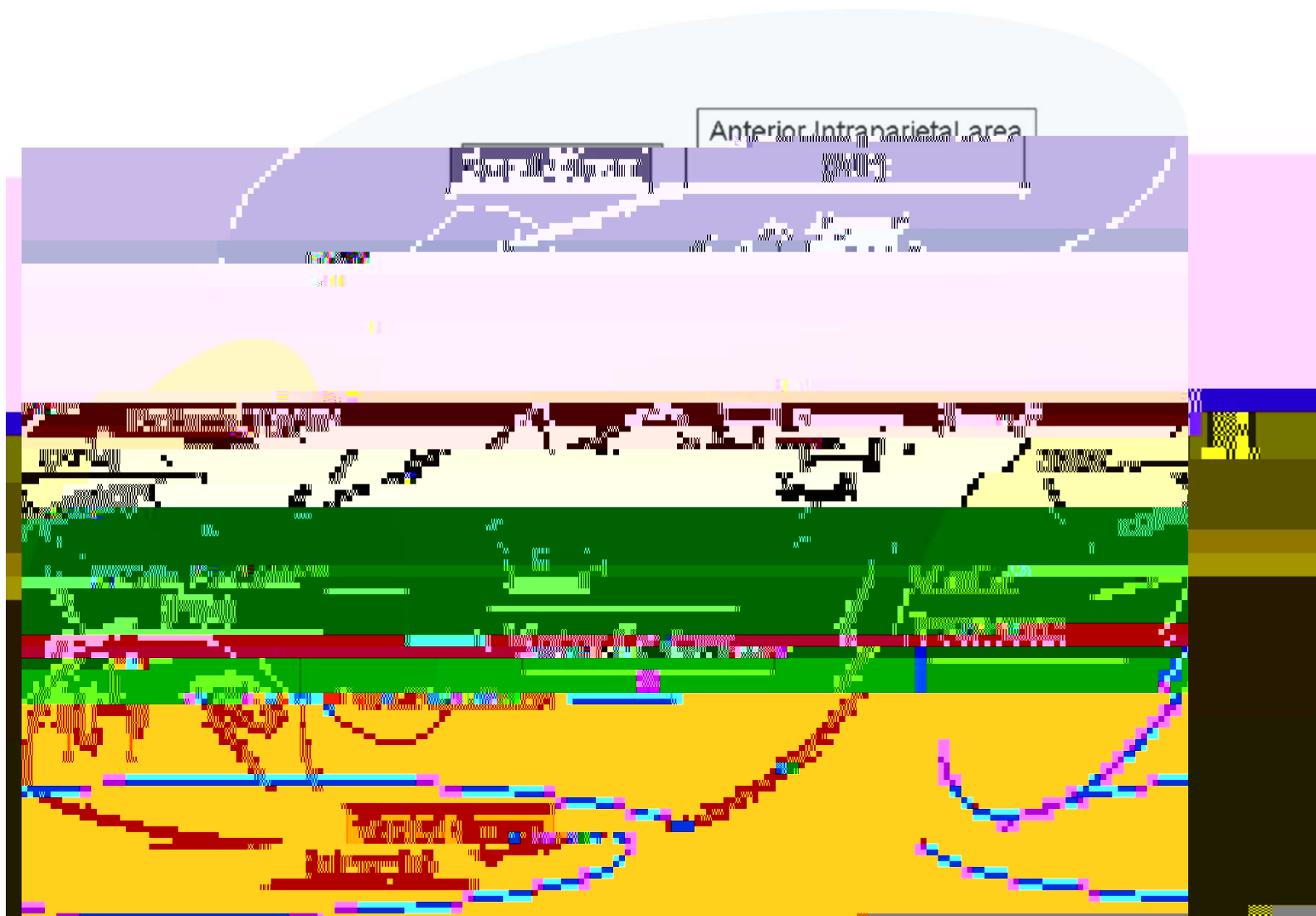
Affordances may aid people with apraxia
= better with tools than part on line / imitate

Affordance Competition may occur
when there are multiple affordances



Pick wrong object / action for a task





Rehabilitation and Recovery of Apraxia

Retraining Pantomime and Imitation

Tain

Transitive symbolic

A Show object and use it (affordances)

B Show picture using and object -- produce gesture

C Show picture of and object -- produce gesture

Intransitive symbolic

A Context gesture -- reproduce

B Context -- gesture

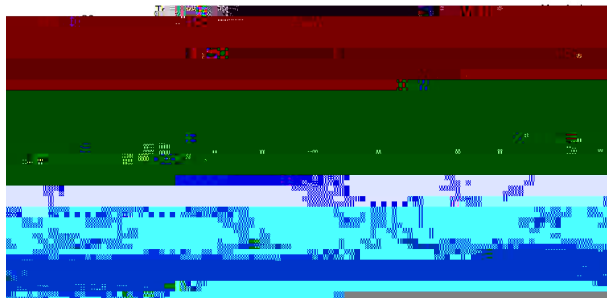
C New context -- gesture

Intransitive nonsymbolic

Initiate static and dynamic

Nonsymbolic intransitive gestures

Involving distal and proximal components



Task Related Training in Apraxia

12 weeks

35x/ week

Focus of relevant functions

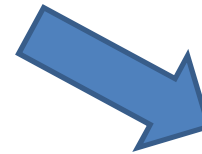
Assess activity in terms of errors in
initiation, execution and control

Hierarchical Progression

Instructions
Verbal
Correct environment
Alert patient
Use gestures
Demonstrate task
Show pictures of activity
Write down instructions
Use of objects in correct sequence
Adjust task

Assist
Verbal
Gestures
Pictures
Physical assistance
Take over task

Feedback
None
Verbal
Visual (minor)
Physical



N=33 No Control
Improvements in ADL and
Apraxia Tests

Hemiplegia

Stroke



Aphasia



Ideomotor

Ideational

Aphasia

Representational

Dynamic

Conceptual Selection Deficits

**Hand and
Posture
Recognition training**

**Transitive & Intransitive
Gesture
Representation
Training**

**Affordance
Training**

**Task Related
Training**

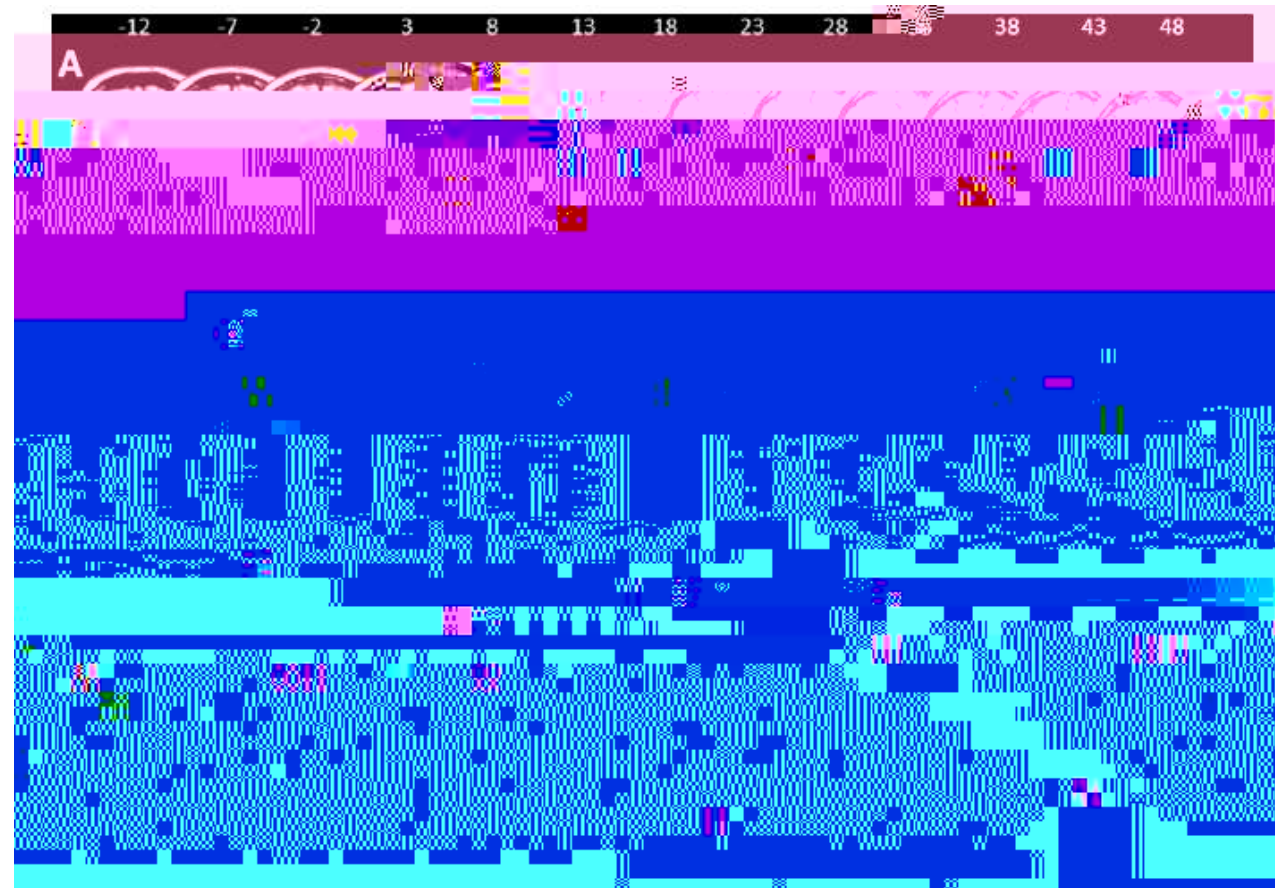
**Communicative
Gesture
training**

Changes in representation overtime?

**Lesions associated
with initial apasia**

**Lesions associated
with recovery of
apasia**

**Lesions associated
with persistent
apasia**



- **Left insula associated with remission**
- **Inferior parietal lobe and superior longitudinal fasciculus associated with persistent deficits**

Conclusion

- **Fronto parietal Circuits interact with Subcortical areas particularly the Basal Ganglia to control reaching grasping and tool use**
- **Many dissociations can occur in apraxia**
- **Impairment based and task based training may lead to improvement in Apraxia**
- **Action Representation/Recognition Systems may be capable of adaptation post lesion**