



What is imitation?

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UCL



Formal terms

1 Object-learning

- Emulation
- Affordance learning



Social imitation

- Mimicry – copying only an action form
- Overimitation – copying unnecessary actions

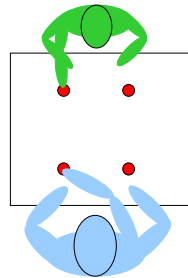


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Goal Directed Imitation

- 3-6 year olds imitate goals not means
- Revealed by hand errors on contralateral trials
- Good imitation on all other trials
- Do children with ASD show the same pattern of errors?



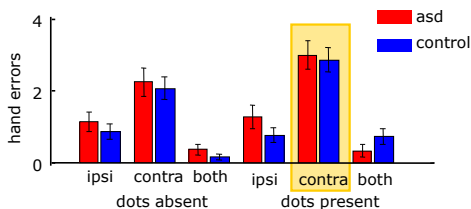
Bekkering, et al, 2000
Gattis et al, 2002

Participants

| | Autistic Spectrum Disorder | Control | Difference |
|----------------------|----------------------------|---------------------|--------------------|
| Number | 26 | 25 | |
| Chronological Age | 8 y 2 m (2 y 1 m) | 4 y 2 m (7 m) | Sig $p < 0.001$ |
| Verbal Mental Age | 4 y 3 m (1 y 2 m) | 4 y 9 m (1 y 0m) | n.s. $p = 0.11$ |
| Theory of Mind Score | 3.2 / 13 (2.9) | 7.0 / 13 (3.4) | sig $p < 0.01$ |

Goal directed imitation

Ipsi-contra $p < 0.001$, dots $p = 0.023$, interaction $p = 0.034$
Group $p > 0.6$



- Both groups replicate Bekkering et al
- No problems with goals in children with ASD

Normal emulation in autism

Good performance on:

- goal directed imitation (Hamilton et al)
- intention imitation (Aldridge et al, Carpenter et al)
- Goal imitation (Hobson & Lee)

So far ...

Object-learning

- Emulation ✓
- Affordance learning



Social imitation

- Mimicry – copying only an action form
- Overimitation – copying unnecessary actions



Over-imitation

- Copying of visibly unnecessary actions
- Present in toddlers (and adults)
- Often studied with novel / complex objects



https://www.youtube.com/watch?v=205mx_nD9cw

Social overimitation

- Familiar objects (no causal reasoning)
- Older children (n=94, age 5-8 years)
- Judge rationality – *was it sensible or silly?*



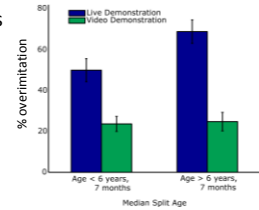
Results



Overimitation ...

- Present for familiar objects
- Increases with age
- Increases with social cues
- Increases when children judge action is 'silly'

Overimitation is SOCIAL



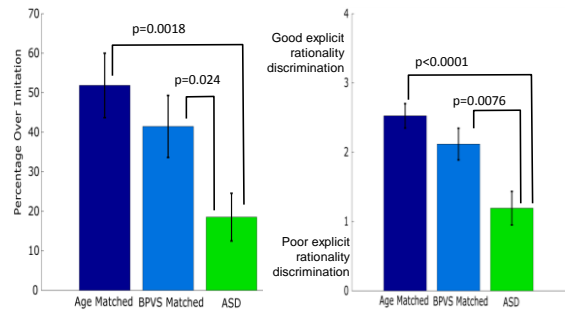
Marsh et al, PlosOne, 2014

Overimitation in autism



| Group | ASC | CA- match | VMA- match |
|--------------------|---------------------------|----------------------------|---------------------------|
| n | 31 | 30 | 30 |
| Age | 9.4 ± 2.3 (5.2 - 13.6) | 8.66 ± 2.0 (4.9 - 12.7) | 6.0 ± 1.3 (4.2 - 8.6) |
| BPVS raw | 66.7 ± 21.5 (33 - 119) | 94.5 ± 19.9 (57 - 137) | 65.9 ± 20.6 (35 - 122) |
| SAS | 9.2 ± 4.6 (0 - 19) | 27.6 ± 4.7 (10 - 39) | 24.1 ± 4.1 (17 - 32) |
| Theory of Mind (%) | 57.7 ± 28.7 (0 - 100) | not collected | not collected |
| SCQ scores | 25.5 ± 4.9 (15-33) | not collected | not collected |

Results



Marsh et al, 2013

So far ...

Object-learning

- Emulation ✓
- Affordance learning

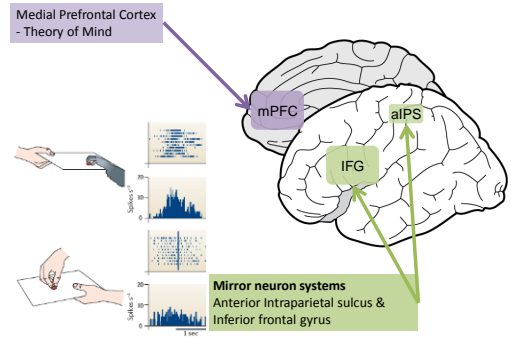


Social imitation

- Mimicry – copying only an action form
- **Overimitation – copying unnecessary actions** ✗

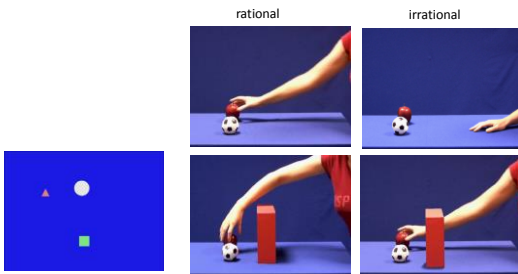


Brain systems for imitation



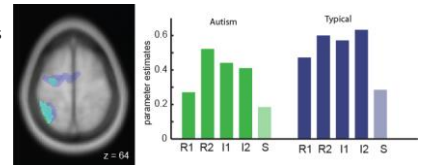
fMRI of action observation in ASD

18 adults with ASD
19 age & IQ matched typical adults

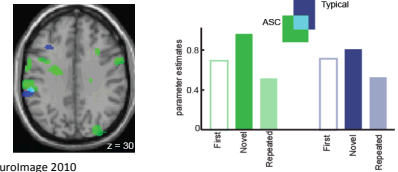


Normal goal responses in aIPS

Hands > Shapes response in left anterior intraparietal sulcus in both

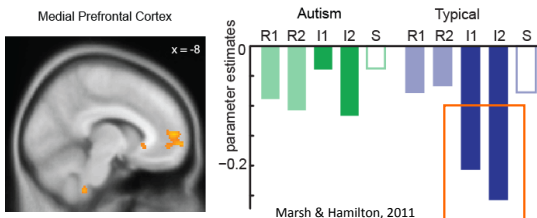


Repetition suppression for goals in aIPS for both



Marsh & Hamilton, NeuroImage 2010

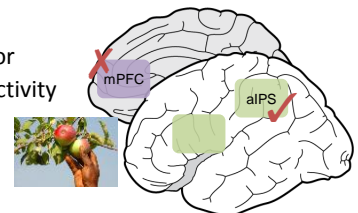
Observation of irrational action in autism



Summary

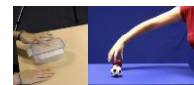
Goal emulation

- Normal behavior
- Normal brain activity in aIPS
- Normal mirror neurons

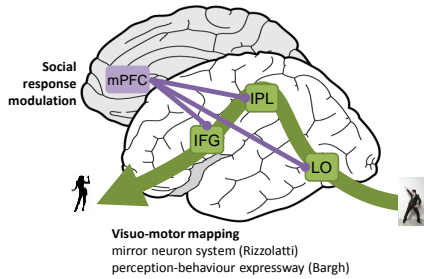


Overimitation

- Reduced behavior
- Different brain activity in mPFC



Cognitive model: STORM (Social Topdown Response Modulation)



Wang & Hamilton, FiHNS, 2012

Implications

Children with autism can imitate object-actions and when instructed

Need help with

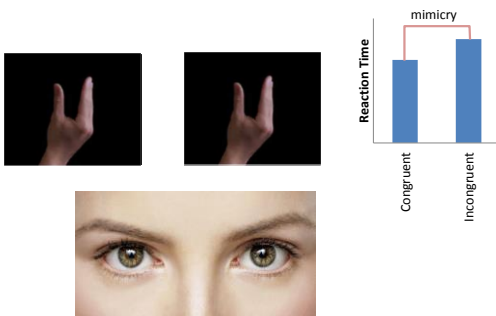
- When to imitate
- Who to imitate

When do typical people imitate?

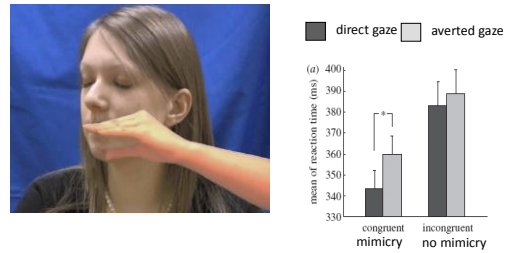
- Gaze as a social cue



Measuring mimicry in adults



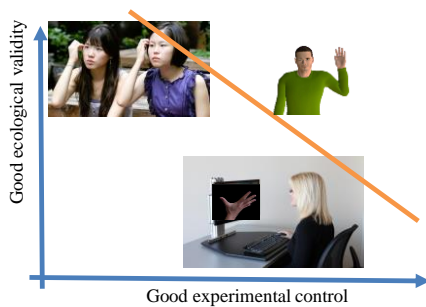
Does eye contact modulate mimicry?



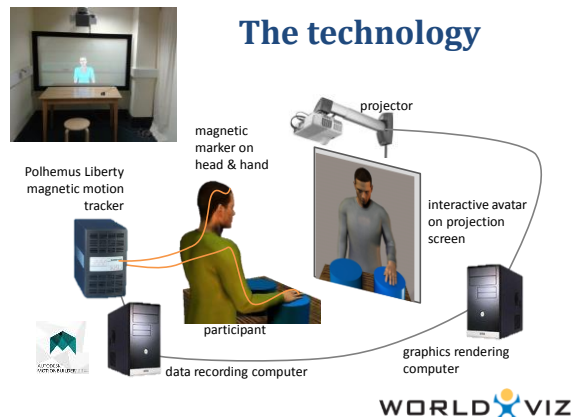
Wang, Newport & Hamilton, Biology Letters, 2010

So far

- Being watched increases imitation



The technology



Take home message

Imitation is complex

- More than one behaviour
- More than one brain network
- Social imitation matters
- Control of (social) imitation differs in autism



Lots more to do ...



Autism@icn group – participant recruitment

Thank you

Paul Forbes
Sylvia Pan
Harry Farmer
Jo Hale



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UCL



thewaterloofoundation

Lorcan Kenny
Liz Renner
Indu Dubey



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