A Meta-Analysis of Imitation Abilities in Individuals with Autism Spectrum Disorders

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Introduction

Impairments in imitation are considered a risk factor for developing autism spectrum disorders (ASD), and the ability to imitate is a hallmark of success in clinical and educational interventions for these individuals. Despite longstanding attention to imitation in individuals with ASD in the empirical literature however, mixed findings across studies have made it difficult to ascertain the nature and extent of imitative abilities in autism [1]. Where deficits were found in a systematic review of action imitation undertaken by Williams, Whiten and Singh [2], they were unable to calculate effect magnitudes, which are essential to understanding how these deficits may affect the daily functioning of individuals with ASD. Here I am carrying out a meta-analysis of existing literature on imitation in ASD. Specifically, I seek to answer the questions:

1. Do individuals with ASD show impairments (as compared non-ASD individuals) on tests of imitation?
2. What is the magnitude of any between-group differences in imitative abilities between individuals with and without ASD?
3. Since the answers to the above research questions are likely to encompass (and conceal) significant variability, I also seek to assess the extent to which between-group differences in imitation in individuals with and without ASD vary by:
    a. Gender
    b. Age
    c. Severity of ASD
    d. Verbal Instruction
    e. Demonstration format (live vs. video/static)
    f. Study setting
    g. How imitation is operationalized

Method

Literature Search

- Journal of Autism and Developmental Disorders, Autism Research, Child Development for search terms
- Electronic Databases
    - Academic Search Premier, ERIC, Education Abstracts, Dissertation Abstracts, PsycINFO, PubMed, Web of Science

Exclusion Criteria

- Studies had to have at least 1 matched (chronological or developmental age) comparison group to enable calculation of effect sizes
- No fewer than 5 subjects in each group
- No deferred imitation (to avoid memory confounds)
- No vocal imitation (to avoid confounds with language)
- Experimental data only (no parent report)
- Behavioral imitation only (no neural correlates)
- No studies of contagion or mimicry (ie unconscious imitation)
- Elicited imitation only (no spontaneous/naturally occuring)

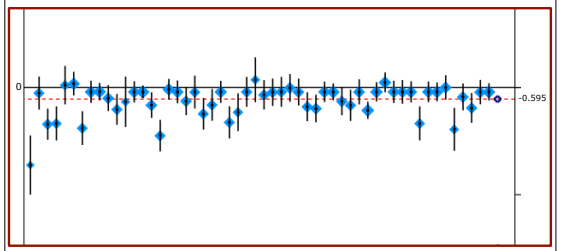
Coding Effect Sizes

- Hedges *g* (adjustment for small samples)
- Effect sizes were given a confidence rating depending on the information from which they were calculated
- Data that was treated as continuous in studies were treated as continuous in this analysis
- In cases of multiple replication studies of the same (or overlapping) cohort, the first time point was coded
- Effect sizes for different types of imitation tests on the same cohort were combined as one effect size by simple averaging

Overview of Study Characteristics

- 56 studies, 2462 subjects (1016 ASD, 854 TD, 708 DD)
- Publications from March 1, 1984 to November 16, 2012
- Age of subjects: *M* = 9.35 yrs, *SD* = 6.55 yrs, *Range* = 4.6mths – 37yrs
- 86.08% male in ASD groups
- ADOS Scores:
    - *M* = 11.17
    - *SD* = 4.04
- 32 live, 11 video/static
- 21 lab, 11 school, 4 home studies

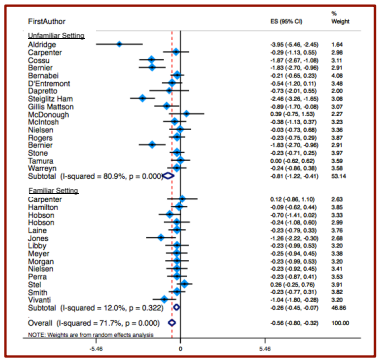
Results: Overall Imitation



Hedge's g (ASD vs. non-ASD) = -0.595 (95% CI [-0.66,-1.87]; z=7.19; p<0.001)
ASD vs. TD = -0.95 [-1.19, -0.71] (17th %ile); ASD vs. DD = -0.49 [-0.75, -0.23] (34th %ile)
I^2 = 70.3% (p<0.001)

Subjects with ASD showed significantly lower performance than subjects without ASD on tests of imitation. More specifically, subjects with ASD performed 0.6 standard deviations below those without ASD on the tests of imitation analyzed here. Practically, this means that the average subject with ASD performs in the 27th percentile of subjects without ASD on imitation tasks. There is also significant variability between the magnitudes of the effect sizes across studies, in excess of sampling error.

Results: Study Design

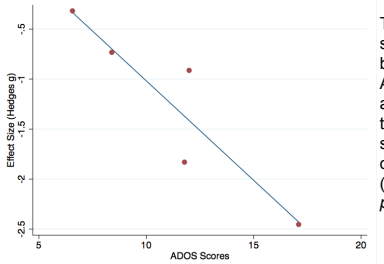


Studies in which subjects were explicitly told to imitate the experimenter did not have effect sizes that were significantly different from studies that did not employ specific instructions to imitate.

The format of the imitation demonstration (live vs. video or static display) did not significantly predict the magnitude of the imitation deficit.

Individuals with ASD performed significantly worse than subjects without ASD on tests of imitation conducted in laboratory settings (*g* = -0.81, [-1.22, -0.41], I^2 = 80.9%). However, subjects with ASD only performed marginally worse than subjects without ASD on tests of imitation carried out in familiar settings such as the school and home (*g* = -0.26, [-0.45, -0.07], I^2 = 12.0%).

Results: Participant Features

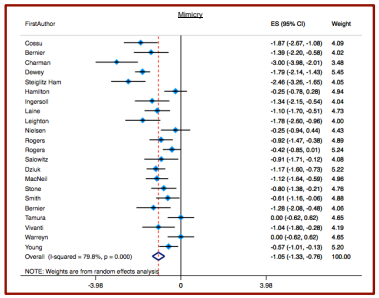


There was a significant association between average ADOS total scores and the magnitude of the imitation deficit in samples for which this data was reported. (5 studies, r^2 = -0.92, *p*= 0.027).

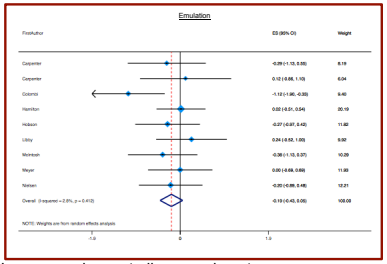
There was no significant association between average age or gender of participant samples with ASD and the magnitude of the imitation deficit.

Results: Operationalizing Imitation

Sevlever & Gillis [1] argue that an inconsistent operational definition of imitation is at the root of contradictory findings about this ability. They distinguish between **emulation** (copying the intention or end point of an act) and **mimicry** (the precise reproduction of the form of a demonstrated act), and posit that true imitation is the combination of emulation and mimicry.



The average magnitude of the imitation deficit was large when mimicry was inherent in the ways that studies measured imitation (*g* = -1.05 [-1.33, -0.76]).



However, when studies used outcome measures of emulation only, on average, subjects with and without ASD did not perform differently on tests of imitation (*g* = -0.02 [-0.19, 0.15]).

Conclusions

- Compared to subjects without ASD, those with ASD show deficits in imitation. The average subject with ASD performs in the 27th %ile of non-ASD subjects.
- As the non-ASD groups measured contain both TD and DD individuals, the observed deficits in imitation are specific to the condition of having ASD, rather than a more general symptom of developmental delay.
- Individuals with more severe ASD (as measured by the ADOS) showed greater deficits in their imitative abilities compared to non-ASD groups.
- Studies conducted in research labs found large imitation deficits in ASD; those conducted in the home or school found very small ASD imitation deficits.
- Differences in the ASD imitation deficit were not explained by age or gender, explicitness of the instruction given or the modality through which the imitation demonstration was delivered.
- Studies that measured emulation but not mimicry found that this aspect of imitation is intact in individuals with ASD.

References

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