Generalization of novel object categories by children with Down syndrome as a function of training context

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Summary

1. First question: capacity of Down Syndrome children and normally developing children matched on mental age to learn the relation between a concept regarding the function of an object, a physical feature of this object, and the object name.
2. Second: assess to what extent do children, normally developing and Down Syndrome, generalize the association between the function of an object and its structure to perceptually (i.e., structurally) transformed objects?
3. Third: Assess the role of perceptual similarity between the learning and transfer stimuli on classification.

Context

- What does it mean to learn a novel word for an artifact? At least,
  - Learn the word phonology
  - Associate the word with properties of the referent
  - i.e. , construct a representation of the referent (an artifact) including perceptual and functional properties.
  - Generalize the novel word to new referents that are not necessarily perceptually similar to the training object.

Children's conceptual development

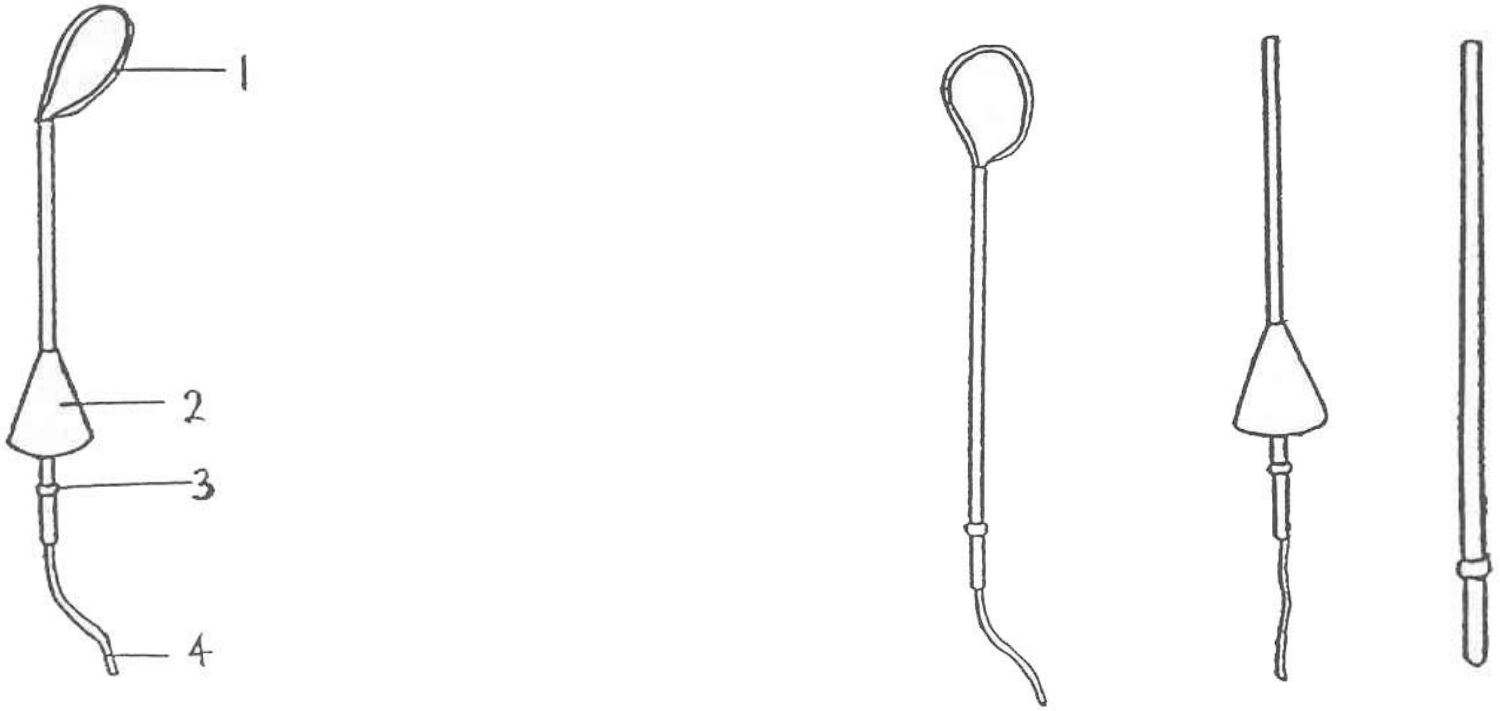
- Young children have sophisticated conceptual structures that have been studied extensively by scholars.
  - Naïve theories and their development: naïve physics, theory of mind, biological world vs. artifacts (Spelke, Carey, Keil)
  - Studies on the development of theory-based inferences: how deep are principles that govern children's inferences? (Gelman).

- Young children learn sophisticated concepts about the world, especially artifacts.
  - In the case of artifacts, they learn to associate the function of objects with their structure.
  - If a novel name is provided, they associate this novel name with the particular structure-function association (i.e., structures that can perform the function).

- In many cases, generalizing a novel word correctly is
  - to use it to for objects that have the same functional affordance as the training object but that might differ perceptually,
  - or to reject objects that cannot perform the function but that might be similar to the training object.

- Purpose: create a task in which young children have to learn a micro-theory about an object and relate it with the perceptual structure of the object.
- Paradigm: Lin and Murphy (1997): subjects are presented with an unknown object composed of two important parts. A group of subjects learn a theory associated with one part, a second group learn a theory associated with the other part.

Lin and Murphy's stimuli



- Smith and Colleagues: young children tend to generalize new concepts (and thus novel words) on the basis of perceptual similarity (⇔ with adults). Thus, they might also fail to learn the connection between a theory and a specific feature because of a failure to analyze the stimulus accurately.
- Other authors (Kemler Nelson): even young children generalize novel words on the basis of function rather than shape.

- To test children, DS and MA-matched, ability to implement a taught function on a training stimulus, as a function of the training device.
- Generalization: Do children rely on the perceptual structure of the stimuli or on function to generalize the learning stimulus?
- i.e., assess how they categorize the transfer items as a function of the type of transformation performed on the items.
  - We introduce a set of transfer items that differ structurally (i.e., perceptually) from the training item object.

Main point

- Comparison between DS children and MA-matched, in a generalization task.
- DS children generalization capacities
  - Perceptually based or functionally based generalization ?
  - How do they deal with structurally transformed but functional stimuli ?
  - Are they as efficient as MA-matched children in mapping structure on function ?
  - What is the influence of context on structure-function mapping (i.e., training with pictures vs; training with real objects and manipulation)?
  - DS children are supposed to have poor abstraction or generalization capacities. However, what does it mean in the present context?

Methods

Participants

- Fifty normally developing children (MA matched): mean mental age = 4 (range 3-5;9); mean chronological age =11;7 (7;9 to 16;7).

  Fifty DS children: mean mental age: 4 (range 3 to 5;8); chronological age= 4;3 (3;1 to 5;3).

(Matching with three subtests of the K ABC)

Condition		Type of presentation		
		Pictures	Real object	Real object + Pictures
Groups	SD	N = 16	N = 17	N = 17
	MA-Matched	N = 16	N = 17	N = 17

No significant difference in MA between groups

Materials

Learning object /
Old test item

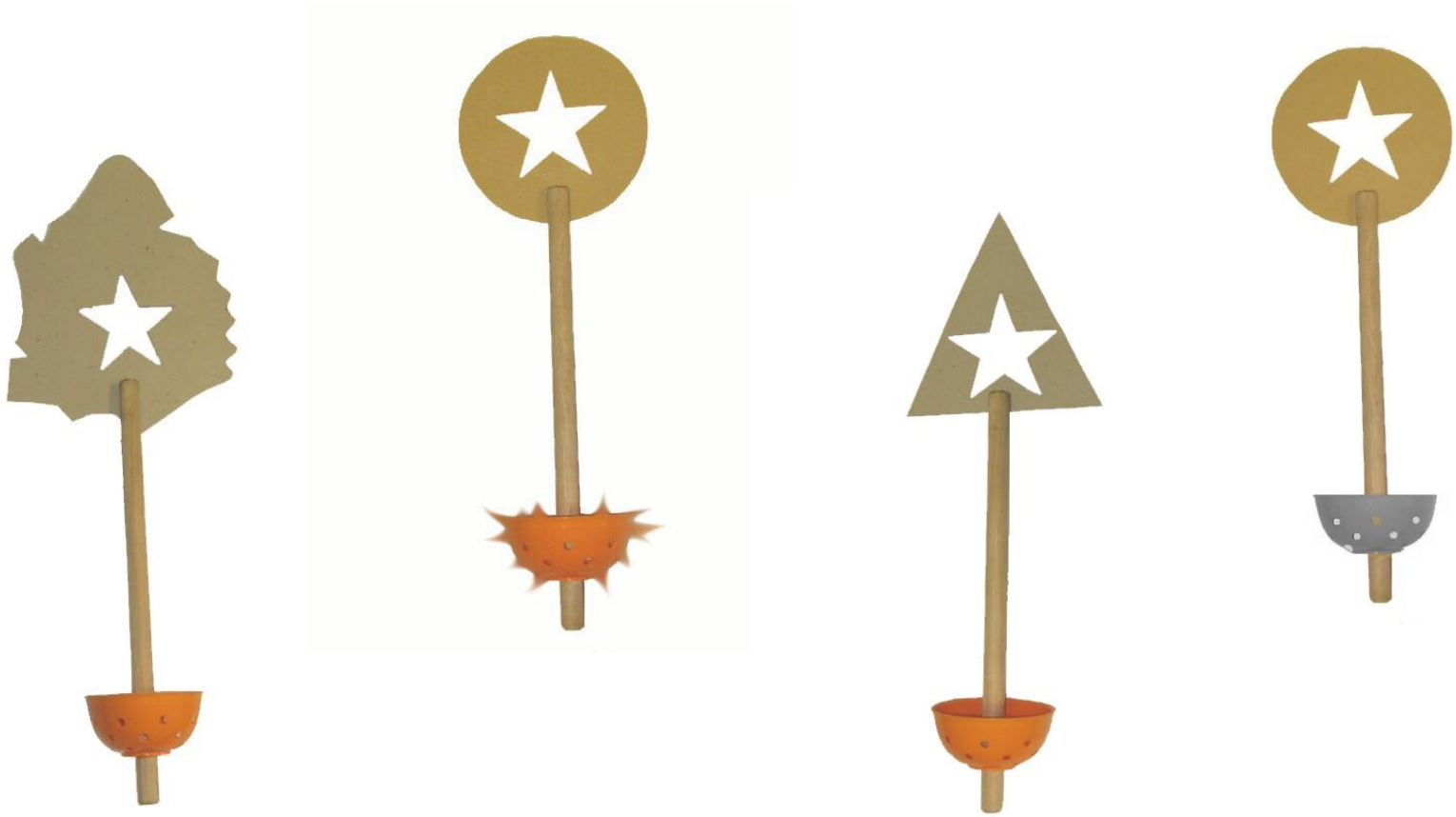
Two functions (theories): shell and drawing.
draw with the star.
Filter shells with the container

Materials: test items

Test item inconsistent with both theories

One part test items consistent with one function; no transformation of the functional part

Complete test items that are consistent with both functions, but with a transformed part



Functional test items consistent with one theory and perceptually modified

Functional test items consistent with one theory and perceptually transformed: “larger transformation”

Dysfunctional test items: to be rejected

Procedure

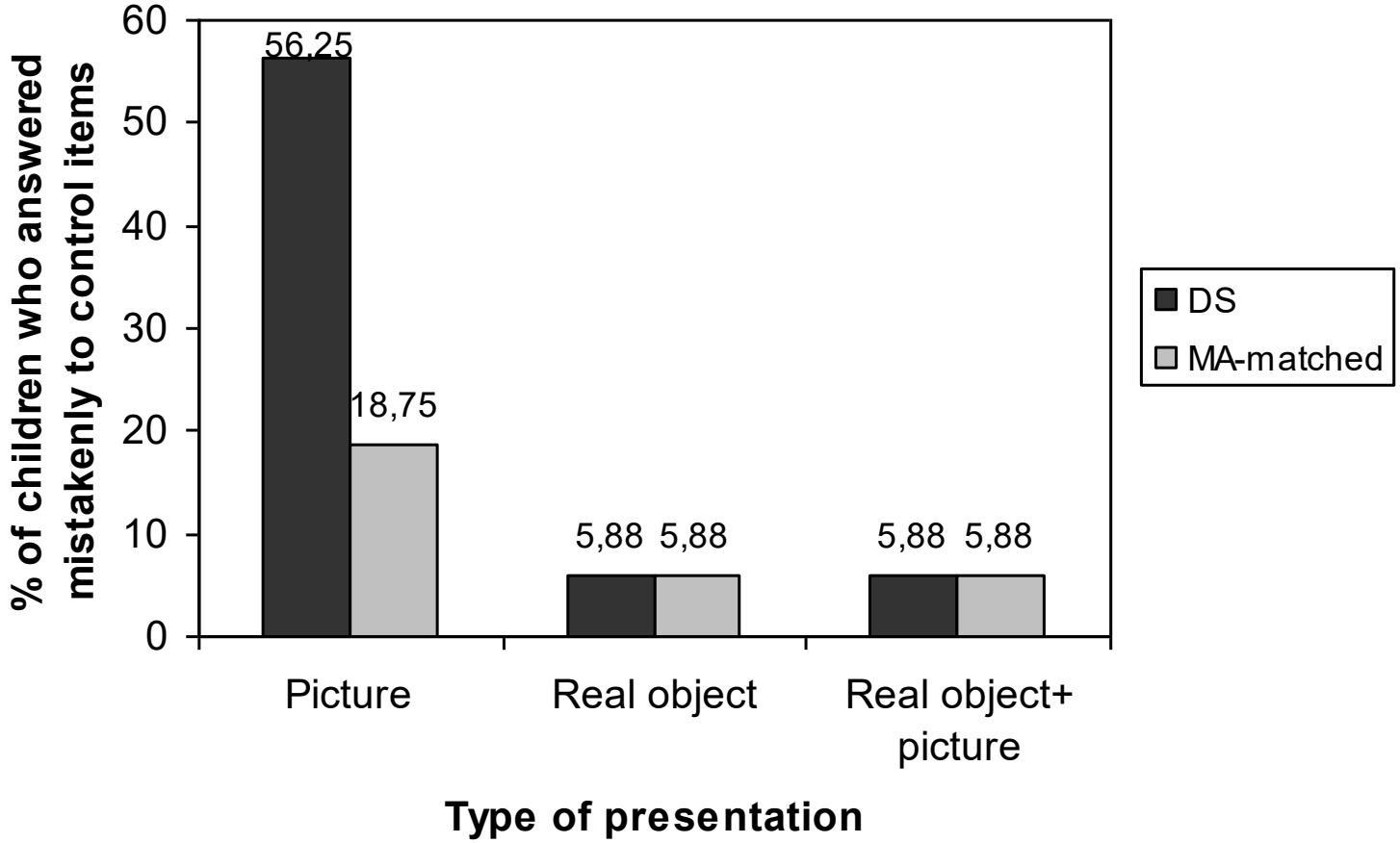
- **Training phase (structure-function + novel name)**
  - One function was taught about a novel object and a novel name was given, “moupa”.
  - Participants were randomly assigned to one of the two functions, “drawing” or “filtering”.
  - Participants in both functions saw the same learning object and were given the same description of its parts (before the function was explained).

Procedure

- **Training phase**: Three conditions:
  - "picture condition": the function was taught through verbal descriptions of a picture of the training object.
  - Real object condition: demonstration with a real 3D object
  - Real object + picture.
- **Transfer Phase**
- For each test item, S. had to say whether it was a "moupa" or not.

Results

- First analysis: proportion of children who understood the task as a function of condition.
  - Accept the training object and reject the item inconsistent with both theories.

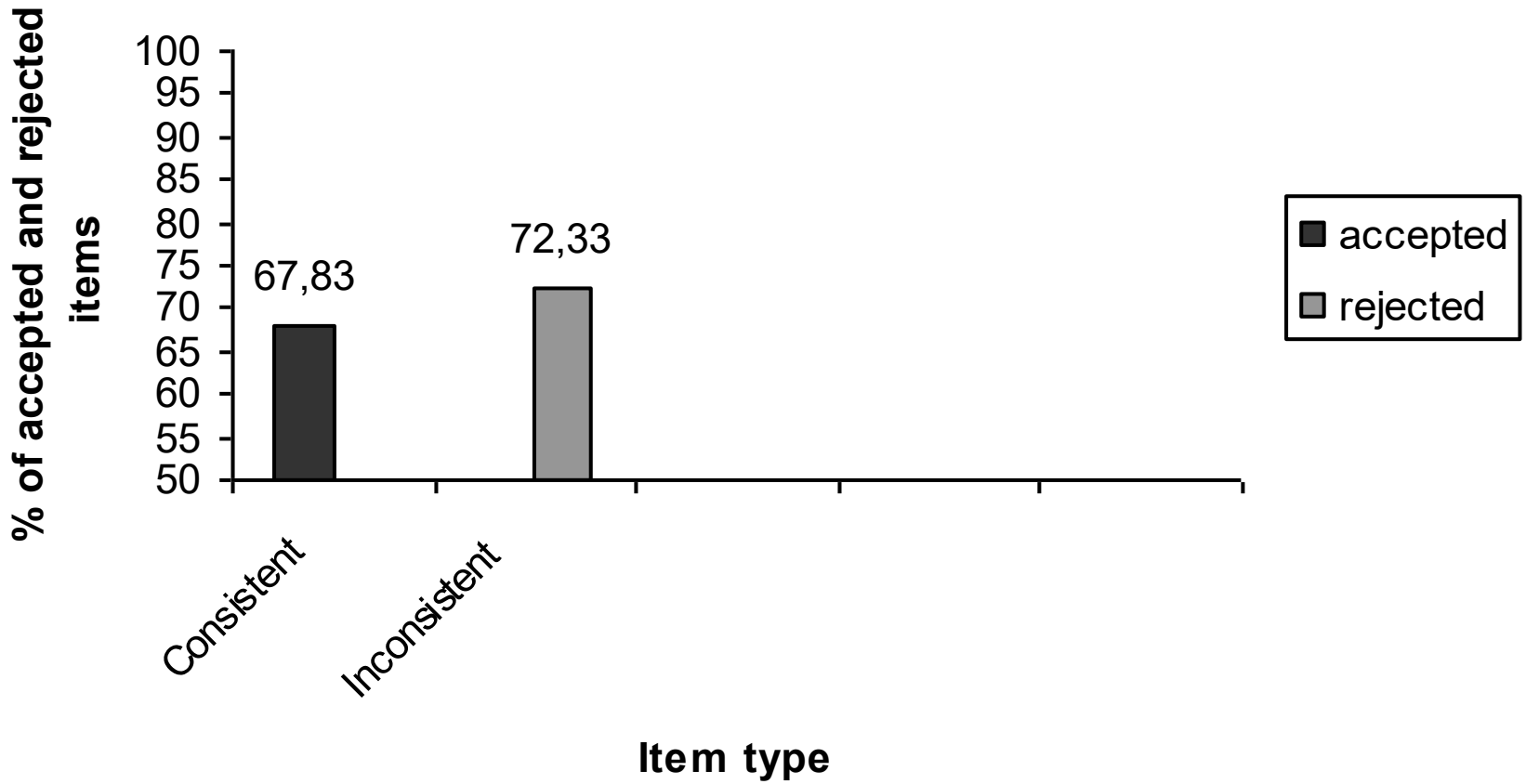


Percentage of errors for control items as a function of group (DS and MA-matched) of type of presentation (Picture, Real object, Real + Picture).

One part test items: results

- Did children associate the function of an object with the relevant part and do they generalize on the basis of this association (⇔ contrast with other studies)?
  - No difference between groups, or between conditions (Picture, real, etc.).
  - A main effect of type of stimulus (consistent with the function vs. inconsistent).

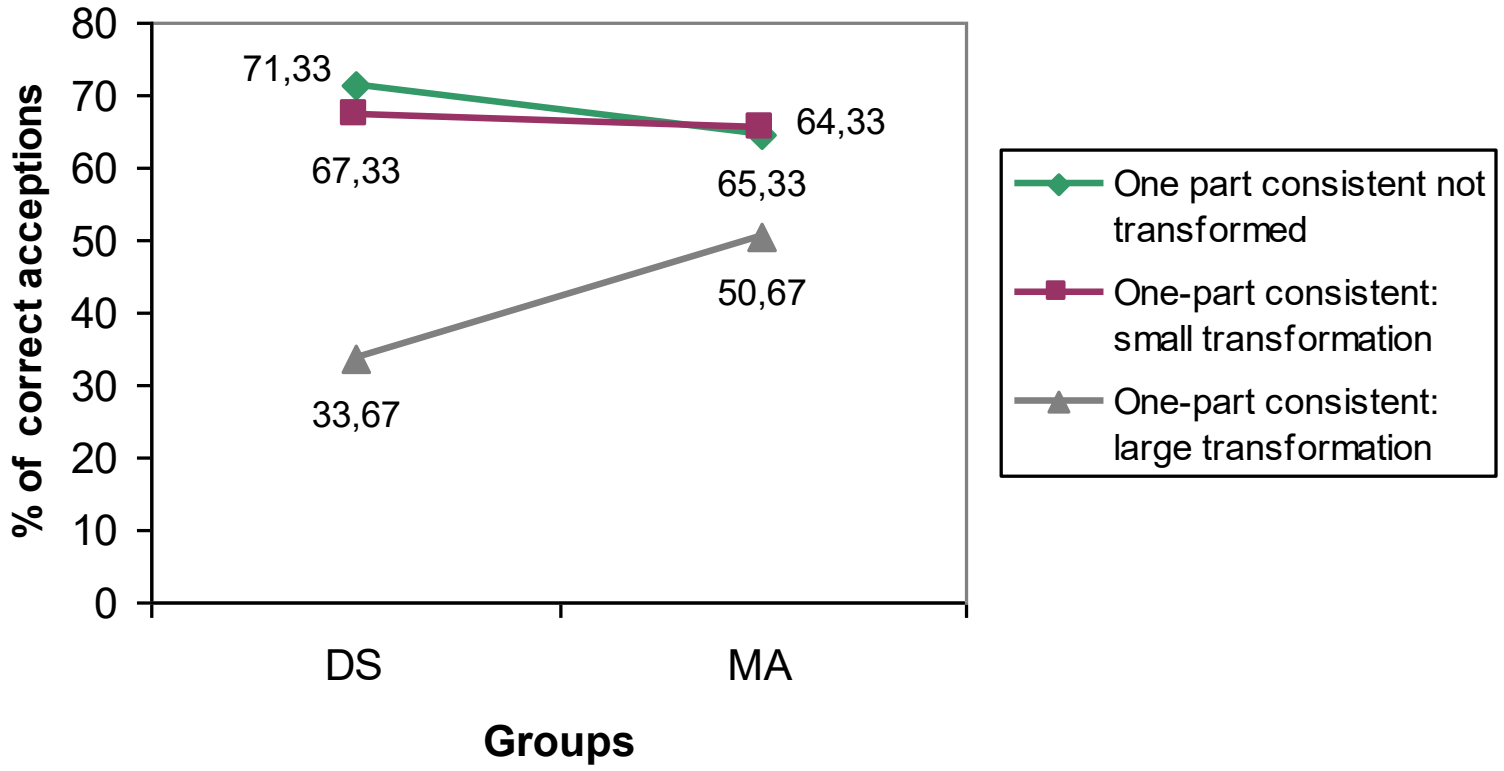
One part test items (no transformation) consistent with one function


% of accepted and rejected items
100
95
90
85
80
75
70
65
60
55
50
67,83
72,33
Consistent
Inconsistent
Item type
accepted
rejected

Results: transformed items

- Complete but transformed items: No difference between groups and between conditions (86% correct, overall).

- One part test items, comparison between untransformed one-part items not transformed, one-part items with small transformations and one-part items with large transformation.
  - Group x type of item interaction.


80
70
60
50
40
30
20
10
0
% of correct acceptions
71,33
64,33
67,33
65,33
50,67
33,67
DS
MA
Groups
One part consistent not transformed
One-part consistent: small transformation
One-part consistent: large transformation

One-part dysfunctional items (to be rejected)

- Anova group x presentation:
  - Main effect of group, with DS < MA-matched, i.e., DS rejected less accurately dysfunctional items that were similar to the functional part (71% vs 87%).

Discussion

- Do DS children and MA-matched learn and generalize a novel-name-function-object-structure relation in the same way?
- The answer is no for both questions.
  - They were less able learn the association between structure and function in a less « real » context, such as the « picture » context.
  - They were more influenced by the perceptual similarity between the training object (or the functional part of the training object) and the transfer objects, in two ways:
    - They reject more often the large-transformation functional one-part items
    - They accept more dysfunctional objects

- Interestingly, DS children behaved like younger children who associate a novel name on the basis of function but fail to do so for very dissimilar stimuli (see Gelaes & Thibaut, in press).
- This might explain why their lexicon tend to remain rather poor.
- Implications for everyday training procedures.