The role of semantic distance in learning and generalization of novel names in typically developing and atypically developing children

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1 CONTEXT

In typically developing (TD) children, comparisons of exemplars from the same category improves learning and generalization performance (Augier & Thibaut, 2013; Gentner & Namy, 1999; Namy & Gentner, 2002). Comparisons of conceptually distant exemplars (e.g., an apple and an orange), rather than close exemplars (e.g., two apples) lead to higher performance (Thibaut & Witt, 2015).

However, comparisons involve cognitive costs (Augier & Thibaut, 2013). Because cognitive costs are associated with executive functions which have been described to be impaired in Intellectual Deficiency (ID) (e.g., Lanfranchi, Jerman, Pont, Alberti, & Vianello, 2010), we aimed to contrast ID children and TD MA-matched children in two concept (object or relations), 2 learning comparison (close v. far) and 2 test generalization (near v. distant) conditions. Because cognitive costs might be less associated with the "intellectual status" (TD or ID) than to cognitive functioning, we divided the two groups into high- and low-functioning people on the basis of their Raven scores.

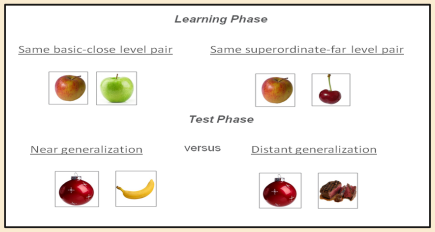
ID children should have lower results than TD children, especially in the far learning and distant generalization conditions, because items are more difficult to unify in these conditions, in both conceptual categories.

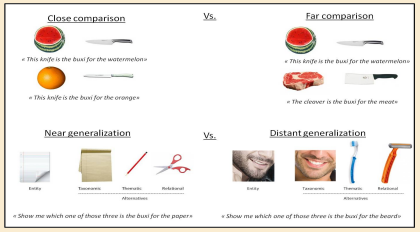
However, given that our experimental categories are familiar to all the children and that ID children have more experience with the world, they might more easily grasp the underlying concepts of the compared items.

2 METHOD

Participants: 92 children with ID (N = 46; MA = 11 years, 6 months) and without ID (N = 46; MA = 5,6) participated in this study. Each group was divided into two sub-groups regarding their cognitive functioning assessed with Raven's Progressive Coloured Matrice (with ID: RPCM = 15 & N = 23; RPCM = 26 & N = 23 - without ID: RPCM = 17 & N = 23; RPCM = 26 & N= 23). The participants with ID were attending Medical Educational Institutes or looked after by Special Education and Home Care Services (PEP21).

Material and Procedure:





Figures 1 (left) and 2 (right). Illustration of the four experimental conditions: 2 learning (close versus far) x 2 test (near versus distant) conditions for object (Figure1) and relational (Figure 2) categories.

The participant had to help a puppet, who spoke a different language (pseudo-words like "buxy"), to understand the reference of non-words in the learning phase in a comparison setting situation, and then to identify at test which object is also a "buxy" (or which object is the "buxy" for…, in the case of relations).

The variables of interests are (1) conceptual distance between the learning items (*close* –two different apples, or *far* – 1 apple and 1 cherry), (2) conceptual distance between the learning domain and the taxonomically related target (*near* - banana, or *distant*: meat) for object categories (see Figure 1). For relational categories, the same reasoning was applied (see Figure 2).

3 RESULTS

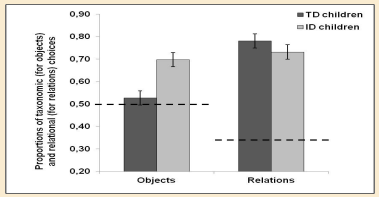


Figure 3. Mean proportions of taxonomic (for objects) and relational (for relations) choices as a function of Group (*TD* vs. *ID* children) and Category to learn and generalize (*Objects* vs. *Relations*). The error bars correspond to one standard error and the dashed lines represent chance levels (50% or 33.33%).

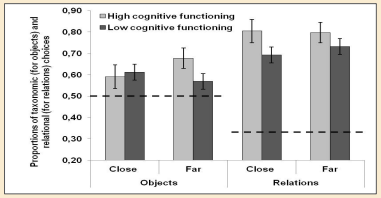


Figure 4. Mean proportions of taxonomic and relational choices as a function of Learning type (*close* vs. *far*), Cognitive functioning level (*low* vs. *high*) and the Category to learn and generalize (*Objects* vs. *Relations*).

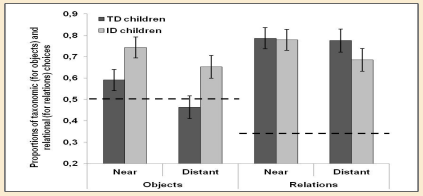


Figure 5. Mean proportions of taxonomic and relational choices as a function of Group (TD vs. ID children), Test distance (near vs. distant), and the Category to learn and generalize (Objects vs. Relations).

A 2 (Group: *ID* or *TD* x 2 (Cognitive functioning: *low* or *high*) x 2 (Categories: *objects* vs. *relations*) x 2 (Learning: *close* or *far*) x 2 (Test distance: *near* or *distant*) analysis of variance (ANOVA) was carried out on the taxonomic (for objects) and relational (for relations) choices.

- **Figure 3 : Group*Category, $F(1, 176) = 5.8$, $p = .017$.**
  - **Object : *ID children* > *TD children* ($p < .0001$).**
  - **Relations: *ID children* = *TD children* ($p = .28$).**

- **Figure 4 : Cognitive functioning*Category*Learning, $F(1, 88) = 5.23$, $p < .05$.**
  - **Objects: *Close* learning, *high functioning children = low high functioning children* ($F < 1$).**
    ***Far learning, high functioning children > low high functioning children* ($p < .05$).**
  - **Relations: *Close* learning, *high functioning children > low functioning children* ($p < .05$).**
    ***Far learning, high functioning children = low high functioning children* ($p = .18$).**

- **Figure 5 : Group*Category*Test distance, $F(1, 176) = 2.80$, $p = .096$.**
  - **Objects: *Near* generalization, *ID = TD* ($F < 1$).**
  - **Relations: *Distant* generalization, *ID < TD* ($p = .90$).**

4 DISCUSSION

If we consider MA matching, we did not observe any deficit due to ID in relational categories learning and even a better performance in ID than in TD children in object categories learning. This suggests that conceptual and lexical learning mechanisms are preserved in ID individuals.

Children with and without ID learned and generalized novel relational names. This suggests that lexical learning mechanisms are functional for relational concepts in children with ID.

Interestingly, the interaction between learning distance and level of cognitive functioning for objects suggests that a high level of cognitive functioning is crucial to compensate for conceptual deficits and to allow learning concepts in ID children as efficiently as in TD children.

However, interaction between test distance and group (TD or ID) for relational concepts suggests that generalization were more difficult in ID for concepts (like relations) that apply to very different objects.

Further investigations should integrate a mental age matched typically developing children group, matched with the Peabody Picture Vocabulary Test (PPVT; Dunn, Thériault-Whalen, & Dunn, 1993), for instance.

5 REFERENCES

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