Novel Noun Generalization in a Free-Choice Design : Investigating Generalization Constraints.

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Abstract

A common result in novel word generalization is that comparison settings (i.e., several stimuli introduced simultaneously) favor taxonomically-based generalization. Most generalization studies on comparison have been done with forced-choice designs. We investigated which type of items five-year-old children would choose as referents in a free-choice novel noun generalization task. Options were items from the same basic level category, from a near superordinate category, a distant superordinate category, and also perceptual lures, thematic lures, and unrelated lures. We manipulated the generalization items availability at test (i.e., generalization stimuli introduced sequentially or simultaneously). Results show that items from the same basic level category were more chosen than other taxonomically related items. Interestingly, perceptual lures and near superordinate items did not differ, suggesting that children did not arbitrate between perception and taxonomy. Results are discussed in terms of the respective role of taxonomic relations and perception but also mode of presentation (availability).

Keywords: Categorization, generalization, novel noun, forced-choice, free-choice, conceptual distance, stimuli availability

Introduction

Comparisons and novel word generalization

Given the importance of language learning, identifying which word learning situation promote concept construction and novel word generalization is an important topic for cognitive sciences. The available evidence during learning constrains children's later generalization. For example, being introduced to one learning stimulus or to several stimuli does not provide the same amount of evidence and thus do not allow to test hypotheses regarding a novel noun extension with the same amount of certainty (e.g., Markman, 1989). One prevailing view is to consider that novel noun generalization is biased towards a limited number of dimensions (Markman, 1990). In experimental design involving one single stimulus, various biases have been described. They show that children tend to give the same name to objects that are holistically similar, or to objects that display the same shape or to objects of the same basic level category (Emberson et al., 2019; Imai et al., 1994; Jones & Smith, 1993; Landau et al., 1988b; Markman, 1989a; Markman & Hutchinson, 1984; Waxman, 1990; Waxman et al., 1991).

One way to reduce these so-called biases might be to introduce several learning instances. Indeed, the opportunity to compare several learning exemplars for a novel word would favor conceptually based categorization, compared to the classical one-single exemplar learning design (Childers, 2020; Gentner & Christie, 2010). This is the case because, introducing several items decreases the number of possible dimensions to which the noun may be generalized. Thus, the comparison process constrains which dimensions are more plausible. In a novel word learning by comparison design, two or more learning items are displayed (e.g., two apples, or two fruits) and belong to the same taxonomic category. In the generalization phase, the child has to choose between an item that is taxonomically-related to the learning items but rated as perceptually dissimilar to them (e.g., a banana) and a perceptually similar lure that is conceptually unrelated to the learning items but perceptually similar (e.g., a red Christmas ball) to them (Gentner & Namy, 1999). Whatever the variations and particulars of the design, studies have shown that comparison situations and the presence of a unifying name (i.e. label effect) lead to more conceptually-based generalizations than no-comparison (single stimulus) situations.

However, when one compares the available studies using the comparison design, depending on the comparison condition implemented in the experiment, the percentage of taxonomic choices varies across studies (from 50% to 80% and beyond). These differences suggest that various factors might modulate the effectiveness of comparison learning situations.

One factor might be the format of the experiment. Most existing studies on novel object noun learning and generalization use forced-choice designs (Alfieri et al., 2013) This format has been used to study which commonalities children spontaneously prefer in novel noun learning (e.g., biases in novel word generalization). A limited set of options that are hypothetically potential targets for generalization (e.g., same shape, versus same texture, versus same color) (Landau et al., 1988a; Markman, 1989b). Children have to choose "one that shares the same name" among the options.

As a result, they might select an item that they would not have selected as an item of the same category if they considered that none belong to the same category. Conversely, selecting one option does not mean that participants would not accept the other options as members of the category, as shown by Smiley and Brown (1979) In order to allow children to choose as many (or as little) items

In M. Goldwater, F. K. Anggoro, B. K. Hayes, & D. C. Ong (Eds.), *Proceedings of the 45th Annual Conference of the Cognitive Science Society.*

when generalizing nouns we use a free choice design. We also used a comparison design (see hereafter).

Comparison as alignment

It has been claimed that showing two or more stimuli simultaneously invites comparison of the stimuli and would contribute to elicit a different, more relevant, conceptual encoding. Comparing the learning items promotes the alignment of their common features (Gentner et Namy, 1999) and labels (Namy & Gentner, 2002). The first output of a comparison process would be composed of common salient perceptual features. These common features would promote more comparisons that would elicit further alignments based on less salient conceptual commonalities (Namy & Gentner, 2002). The representation of both objects resulting from this stimulus mapping process is more conceptually based than the one that would have been built without the possibility to compare stimuli, that is in a single object design.

Here we focus on several factors which might potentially influence comparison. Semantic distance is one such potential factor, as it has been shown that children have more difficulties conceptualizing superordinate categories than basic level categories (Rosch et al., 1976). On the other hand, data that asses the role of distance between items in comparison designs is scarce (Liu et al., 2001). Thibaut and Witt (2017) manipulated the semantic distance between learning items and showed that comparing learning pairs from more distant domains led to better taxonomic generalization for children from both age groups.

No comparison designs tell us that there is a basic level bias, according to which young children spontaneously extend a novel object to items from the same basic level of categorization rather than to other levels of categorization (e.g., *apple* from one apple to any other apple rather than *Cox apple* or *fruit*) (Markman, 1989; Waxman et al., 1991; Waxman & Hatch, 1992). This bias can also explain children's difficulties with superordinate categories in the comparison case.

Goals of the present experiment

In two experiments, we studied 5-year-old children in a comparison design. The difference with previous studies is that we use a free-choice design rather than a forced-choice design, in which we will introduce two learning exemplars and different categories of options.

We manipulate semantic distance at learning and between learning items and options, and the type of lures. The taxonomically related options will belong to the same basic level category or the same immediate superordinate category (e.g. banana, for two learning apples) or the same distant taxonomic category (e.g., meat for the two apples). The lures will be perceptually related or thematically related or unrelated with the learning items. Contrasting different taxonomic distance is important, and assess whether children will choose all the taxonomically related items or choose them less as the semantic distance decrease. Another question is whether choosing taxonomically related items will eliminate perceptual and/or thematic choices. In forced-choice tasks, they are handled as incompatible options.

Testing the role of semantic distance between learning items is important in order to assess breadth of the category representation. Based on existing studies, we hypothesized that basic level categories would be selected more often than other taxonomically related items (see Thibaut & Witt 2017; submitted).

We also manipulated what we called item's availability at test. Are all options introduced simultaneously at test, or are they introduced one by one? In daily life, children might see new (generalization) items simultaneously (e.g., a fruit with other target fruits, or a fruit in a kitchen with other fruit-related objects, all on a table, or any display). They might also see the same generalization items one by one, sequentially, in a book, or introduced one by one. Those two modes of presentation might have different consequences. For example, children might compare the taxonomic options in the simultaneous case and include more distant taxonomic choices, by progressive alignment, than in the sequential case.

One important and open question is whether children will choose perceptual lures. Their selection might be modulated by the mode of presentation of the options: for example, perceptual lures could be chosen more often when stimuli are introduced one by one (sequential) because they cannot compare them with the taxonomic choices.

The second experiment is a replication of the first experiment except that we removed the two options from the same basic level category. We conjectured that children in Experiment 1 might select less same superordinate items as a default strategy, or because they already selected the basic level item. Given that the instructions are to find items that share the same name, children might select the basic level options first and might be more reluctant to select less similar items or simply stop because they did the job.

Experiment 1

Methods

Participants

Seventy-nine French speaking children (forty-five boys) were tested individually in a quiet room at their school. Children were from middle class town center schools and were five-years-old (mean age: 54 months; 45 – 66). Children were randomly assigned to one of the two availability conditions (sequential: 40 children; simultaneous: 39 children).

The procedure was in accordance with the declaration of Helsinki (1964) and was ethically reviewed and approved within an Official agreement (convention n°: 2019-0679 and endorsement n°: 2020-0566) between the Academia Inspection of the French National Education Ministry, the University of Bourgogne ("Inspection Académique de Côte d'Or"). Participant's consent was assured by an information letter sent to children's parents and their returned written consent.

Materials

Color pictures of real objects were used as stimuli. The pictures were organized into sixteen stimulus sets, each associated with a semantic category (e.g., accessories, foods, clothing, tools, etc), each set was designed with three learning stimuli and twelve generalization stimuli. The sixteen trials were divided into two learning conditions (close or far learning). Each trial was constructed around a semantic category. In each learning condition, one of the two pictures was considered as the standard picture. In the close learning condition, the two learning items were two pictures of objects from the same basic level category (e.g. a pear and a cut pear). In the far learning condition, the two learning items were from the same superordinate category (e.g., a pear and a raspberry).

The twelve generalization items were: two pictures of objects from the same basic level category as the standard learning item (basic level category generalization, TaB, e.g., pears), two pictures from the same superordinate level category as the learning-items (near superordinate generalization items, TaN, e.g., apricots and pineapple), two pictures from a more distant superordinate category as the learning-items (distant superordinate generalization items, TaD, e.g., chips and pasta); two stimuli perceptually similar to the standard learning item but not taxonomically related to the learning items (perceptual distractors, P, e.g. a punching ball and a pear shaped candle); two pictures thematically but not taxonomically related to the learning-items (thematically related distractors, Th, e.g., a fruit basket and a fruit knife); two lures semantically and perceptually unrelated to the learning items (non-related distractors, NR, e.g. a car and a note book).

The trials' order during the task was balanced. All 16 trials in a task were presented in one availability level (simultaneous or sequential). In the sequential generalization availability, the generalization-items' order was balanced between trials. In the simultaneous generalization availability, the position of the generalization items on the screen was balanced between trials. Figure 1 shows an example of a trial built using the stimuli from the food/fruit/pear category. The pictures were displayed on a 13inch touchscreen laptop.

We forged 16 different bisyllabic labels (pseudo-words) which are, as shown by Gathercole and Baddeley (1993), easier to remember than monosyllabic pseudo-words (e.g., buxi, dajo, zatu, xanto, vira). Syllables were of the CV type which is the dominant word structure in French (from Lexique.org, New, Pallier, Brysbaert, & Ferrand, 2004).

Ratings for generalization items. Twenty-eight students' ratings confirmed that taxonomically related items were considered to belong to the same category as the standard learning item (average ratings: $M_{Ta} = 7.6$, $M_{Th} = 4.5$, $M_{P} = 2.1$, $M_{NR} = 1.5$, average p between Ta-Th $p < .001$). Twenty-four students rated near taxonomically related generalization items conceptually closer to the standard item compared to distant taxonomically related items.

Perceptual similarity ratings were obtained from 36 students and controlled that perceptual matches were perceptually more similar to the learning items than all other generalization items (average ratings: $M_{Ta} = 3.0$, $M_{Th} = 2.2$, $M_{P} = 6.3$, $M_{NR} = 1.7$, average p between P-Ta $p < .001$). Ratings were also obtained from 21 students for thematically related distractors. They showed that they were more thematically related to the learning items than all other generalization items (average ratings: $M_{Ta} = 6.4$, $M_{Th} = 7.5$, $M_{P} = 2.2$, $M_{NR} = 1.8$, average p between Th-Ta $p < .05$). Unrelated distractors scored significantly below all other generalization items in all ratings ($p < .01$)

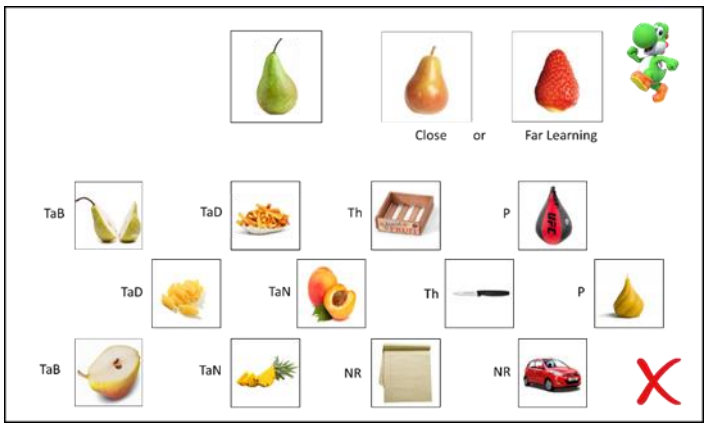

Figure 1: Trial built for the food category

Note: Participant saw either the close or the far learning item
TaB : same basic taxonomic category, TaN : near superordiante category, TaD: distant superordiante, Th: thematically related, P: perceptually related, NR : non related generalization items.

Procedure

Participants were seated at a low table, in a quiet room at their school, facing the laptop, next to the experimenter. They were randomly assigned to one of the generalization availability conditions (sequential, or simultaneous). In both conditions, children were introduced to a puppet named "This is Yoshi, we are going to play with him. But he lives far away from here and speaks a different language. In the game we are going to learn his language." The experimenter then showed the fifteen trials. In all two learning conditions learning items appeared one by one near the top of the screen and the experimenter announced their name as they appeared using the instruction: "Yoshi's mummy says that this is a *buxi*, and this one is also a *buxi*; Yoshi must find other *buxis* for his mummy….". Then, the generalization items appeared on the lower part of the screen, generalization availability one by one in the sequential condition, the experimenter said "is this a "*buxi…?*"for each of the 10 generalization items. In the simultaneous condition, they were displayed simultaneously: "which ones of these are also *buxis*, show me the *buxis* but not the other things". The experimenter finished the instructions by "Take your time, don't give me your answer before Yoshi appears on the screen".

Design

Availability (sequential, simultaneous) a between-subject factor was crossed with learning distance (close, far) and generalization item (basic, near super, distant super, theme, perceptual, non-related) within-subject factors.

Results

We recorded the number items chosen by children in each trial for each category of generalization item (i.e., basic category level, near superordinate, distant superordinate, perceptually related, thematically related, non-related) and the order in which items were chosen. The proportion of answers for each type of generalization item was calculated out of the total number of items of each type across all 16 trials (i.e., 32 items). This means that all or no items could be chosen in a trial, and that any type of generalization item could be chosen at any order in the sequence of choices.

Children's proportion of answers analysis

We ran a three-way repeated measures ANOVA on the proportion of answers with availability (sequential, simultaneous) as a between factor and learning distance (close, far) and generalization items (basic level, near superordinate, distant superordinate, theme related, perceptual match, non-related) as between factors.

Results reveal significant differences in children's proportion of choices of generalization items $F(5,385) = 155.39$, $p < .001$, $\eta^2_P = .67$ (Figure 2). Student t test contrasts show that children choose more basic level category items than all other items ($p < .001$, Bonferroni corrected significance level at $p = 0.005$). They also selected more near superordinate items than thematically related and unrelated items ($M_{Near} = 0.40$; $M_{Theme} = 0.18$; $M_{Unrelated} = 0.16$; $p < .001$). The number of selections of near superordinate items did not differ from the selections of perceptual matches ($M_{\text{Perceptual}} = 0.42$: $p =$).

This analysis also revealed two interactions, between learning distance and generalization items $F(5,385) = 2.89$, $p < .05$, $\eta^2_P = .04$, and between availability, learning distance, and generalization items $F(5,385) = 3.15$, $p < .01$, $\eta^2_P = .04$. In this latter interaction, we were mostly interested in difference between the two availability levels across the other levels of the two other variables. Student t test contrasts with a Bonferroni corrected significance level set at $p = .0011$, surprisingly, revealed no difference between the two availability levels across all the levels of the two other variables ($p > 0.05$).

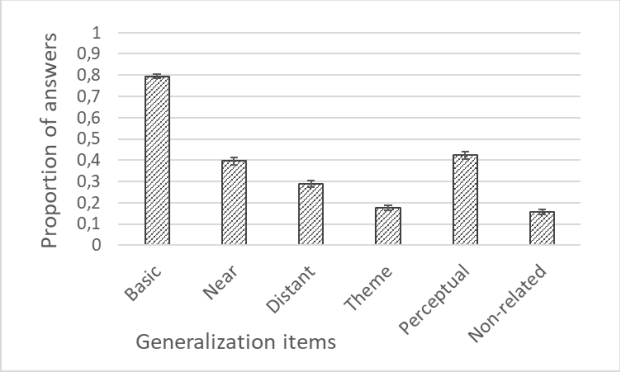

Figure 2: Proportion of answers in a 12 item task as a function of generalization item (basic level, near superordinate, distant superordinate, thematically related, perceptual match, non-related). Error bars a SEM.

Children's answers order analysis

We ran a two-way repeated measures ANOVA on average order in which items had been chosen with learning distance (close, far) and generalization items (basic level, near superordinate, distant superordinate, theme related, perceptual match, non-related) as between factors.

Results revealed an effect of generalization item $F(5,95) = 12.40$, $p < .001$, $\eta^2_P = .22$ ($M_{Basic} = 2.83$: $N_{Near} = 4.19$; $M_{Distant} = 4.50$; $M_{Theme} = 3.66$; $M_{Perceptual} = 4.02$; $M_{Non\text{-}related} = 5.31$). Children chose basic category level items before the other generalization items except for thematically related items ($p < .01$) which confirms children's tendency to choose the basic category level items with certainty and to find the other taxonomically related items and perceptual lures more ambiguous.

Discussion

This experiments' main aim was to compare the number of different types of stimuli in a comparison format, as a function of stimulus availability and semantic distance between learning items. The main results were that children chose more items from the same basic level category than any other types of available generalization options. However interestingly, in both availability conditions, they chose a significant number of stimuli from the near superordinate category and also perceptual lures at the same level. This means that beyond basic level objects, they also accept items that are taxonomically related at a higher category level and items that are perceptually related. They do not arbitrate between taxonomic relations and perception. We will come back to this in the general discussion. Also of interest, availability played no role while generalization performances' were affected by this factor in previous studies (Stansbury et al., 2022).

Experiment 2

Methods

Participants

Fifty French speaking children (twenty-nine boys) were tested. Children (mean age: 16 months; 50 – 62) were from middle class town center schools. Children were randomly assigned to one of the two availability conditions (sequential: 18 children; simultaneous: 32 children). The ethical procedures were identical to experiment 1.

Materials

The same material as in experiment was used except that the same basic level options were removed, for a total of 10 options. All other aspects of materials were identical to experiment 1.

Procedure

The procedure was identical to the one followed in Experiment 1.

Results

We ran a three-way repeated measures ANOVA on the proportion of answers with availability (sequential, simultaneous) as a between factor and learning distance (close, far) and generalization item (near superordinate, distant superordinate, theme related, perceptual match, non-related) as within factors.

Results revealed that children choose a higher proportion of items in the simultaneous settings rather than the sequential settings $F(1,55) = 6.63$, $p < .05$, $\eta_P^2 = .11$($M_{\text{sequential}} = 0.18$; $M_{\text{simultaneous}} = 0.37$). Children also choose more items in far rather than close learning settings $F(1,55) = 11.2$, $p < .001$, $\eta_P^2 = .17$ ($M_{\text{close}} = 0.27$; $M_{\text{far}} = 0.29$). . There was also a significant effect of generalization items $F(4,220) = 24.46$, $p < .001$, $\eta_P^2 = .32$: children choose more near superordinate items than distant superordinate items, thematically related lures and non-related items ($p < .001$, Student t tests, with Bonferroni corrected significance level at $p = 0.005$), however they choose as many near superordinate items as perceptual lures.

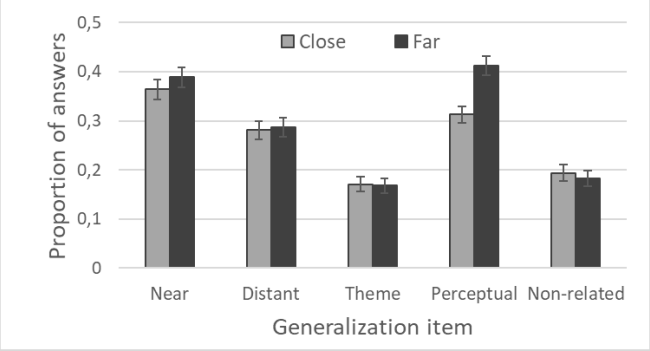

Figure 3 : Proportion of answers in a 10 item task as a function of learning distance (close, far) and generalization item (basic level, near superordinate, distant superordinate, theme related, perceptual match, non-related) in Experiment 2. Error bars a SEM.

This analysis also revealed an interaction between learning distance and generalization item $F(1,55) = 6.63$, $p < .05$, $\eta_P^2 = .11$ (Figure 3). In this interaction the differences of interest are those between close and far learning cases for same generalization item types. Interestingly, the only significant difference between the two learning conditions was observed for perceptual matches ($p < 001$, Bonferroni corrected significance level at $p = 0.005$), that are chosen more in close rather than far learning settings ($M_{\text{close}} = 31$; $M_{\text{far}} = 41$).

Comparison between the two experiments. We ran a four-way repeated measures ANOVA on the proportion of choices with generalization items (near and distant superordinate, thematically related, perceptual match, unrelated) as a within-subject factor, availability, learning distance, Experiment (1 and 2) as between-subject factors. Here only the differences between experiments or between generalization items are of interest. Results reveled an interaction between experiments (i.e., 12 or 10 item experiment) and availability $F(1,132) = 5.46$, $p < .05$, $\eta_P^2 = .04$ (Figure 4. Student t test contrasts (Bonferroni corrected significance level $p = 0.006$) reveal that children make more choices in simultaneous rather than sequential settings ($p < .001$) and this is the case in experiment 2 only.

The analysis also revealed a three way interaction between number of items, availability, learning distance and generalization $F(4,528) = 3.90$, $p < .01$, $\eta_P^2 = .03$. The differences between group were small. Indeed, a posteriori Student t test contrasts, with Bonferroni correction, revealed no significant difference between Experiments 1 and 2 for any generalization item in any experimental condition.

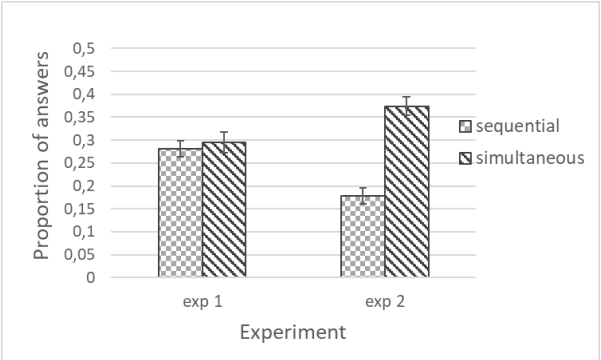

Figure 4: Proportion of answers a function of experiment (1, 2) and availability (sequential, simultaneous). Error bars are SEM.

Discussion

We studied children's word extension in a comparison setting with a free-choice design. rather than the more common forced-choice word generalization design. Indeed, a free-choice design allows children to choose different categories of stimuli, including the lures, as items bearing the same noun as the learning items. Hence, they were able to choose both taxonomically related and perceptual (or

thematic) lures. This is not possible with forced-choice designs pitting taxonomic choices and perceptual (or thematic) lures. Of central interest was the number of selections of each type of options as a function of conceptual distance and mode of presentation of these options (items' availability).

Both experiments tested which taxonomic options children would choose. They did not select the three taxonomic distances in the same way. The same was true for the lures. In Experiment 1, children selected the basic level options much more frequently than the two other taxonomically related items. This is consistent with previous research on lexical biases showing, in the case of no comparison designs that children are biased towards the basic level of categorization (Markman & Hutchinson, 1984; Rosch et al., 1976). Importantly, this result shows that despite this basic level bias, they could also accept taxonomically more distant items. In contrast, these results did not confirm an overall preference for *any* taxonomically related choice (near or distant) (Waxman, 1990).

What our data adds to the existing literature is that our free-choice comparison design led to generalizations influenced by multiple biases at the same time. What was less predicted is that distance between the learning items had no impact on these taxonomic choices. This does not seem consistent with existing results obtained with a recent Bayesian approach, hypothesizing that more distant learning items would increase the number of choices of superordinate category items (Xu & Tenenbaum, 2007a, 2007b). With learning objects from two different basic level categories, one would have expected more generalizations of the nouns beyond the basic level categories, or smaller differences between the number of basic level and superordinate level choices in the far learning condition. This was not the case.

Another important aspect of the experiment is the choice of lures. As expected unrelated lures were marginally chosen. So were the thematically related lures. This latter results confirm previous results showing that the interpretation of nouns is biased towards taxonomic relations rather than other semantic relations (Waxman & Kosowski, 1990). As for the perceptual lures, their status is more ambiguous. Single designs are correlated with same shape choices, like our perceptual lures (Jones et al., 1991; Kucker et al., 2019).

Interestingly perceptual lures were often chosen as much as near superordinate level choices and more often than distant superordinate choices. This interesting result would have been hidden in forced-choice designs as, in these designs, only one option (perceptual or taxonomic) can win. Our results suggest that taxonomic choices do not eliminate perceptual choices and are consistent with the enduring influence of perceptual similarities.

A final result is that the availability of the items (sequential or simultaneous) had no important impact in Experiment 1 but resulted in significantly less choices in Experiment 2. This is probably due to the fact that children chose a high percentage of the basic level items in both conditions in Experiment 1, which contributed to equate the two conditions. The presence of these basic level objects might have elicited a less cautious strategy in the sequential case, because, with these obvious choices, children were more eager to select stimuli. This remains to be tested. The comparison of the two experiments, on equivalent stimuli, is consistent with this analysis as there was no difference between the two conditions in Experiment 1 whereas the difference is important in Experiment 2 (as shown by the interaction between availability and Experiment).

Concluding remarks.

Our experiments showed that children could select different types of taxonomically related items in the same set of options but the proportions of these choices could vary as a function of distance. These taxonomic choices were paralleled by perceptual lures choices, a result which would have remained hidden in a classical forced choice. This suggests that the extension of the nouns incorporate different types of information in young children. It will be interesting to see whether older children or adults would no longer hesitate between these two sources of information.

Acknowledgment

We wish to thank the French Agence Nationale pour la Recherche (ANR) for their financial support for the COMPARE project (project ANR-18-CE28-0019), to the third author. The first author benefited from a scholarship of the French ministry of Higher Education and research.

References

Alfieri, L., Nokes-Malach, T. J., & Schunn, C. D. (2013). Learning Through Case Comparisons : A Meta-Analytic Review. *Educational Psychologist*, *48*(2), 87-113. https://doi.org/10.1080/00461520.2013.775712

Childers, J. B. (Éd.). (2020). *Language and Concept Acquisition from Infancy Through Childhood : Learning from Multiple Exemplars*. Springer International Publishing. https://doi.org/10.1007/978-3-030-35594-4

Emberson, L. L., Loncar, N., Mazzei, C., Treves, I., & Goldberg, A. E. (2019). The blowfish effect : Children and adults use atypical exemplars to infer more narrow categories during word learning. *Journal of child language*, *46*(5), 938-954.

Gentner, D., & Christie, S. (2010). Mutual bootstrapping between language and analogical processing. *Language and Cognition*, *2*(2), 261-283. https://doi.org/10.1515/langcog.2010.011

Gentner, D., & Namy, L. L. (1999). Comparison in the Development of Categories. *Cognitive Development*, *14*(4), 487-513. https://doi.org/10.1016/S0885-2014(99)00016-7

Imai, M., Gentner, D., & Uchida, N. (1994). Children's theories of word meaning : The role of shape similarity in early acquisition. *Cognitive*

Development, *9*(1), 45-75. https://doi.org/10.1016/0885-2014(94)90019-1

Jones, S. S., & Smith, L. B. (1993). The place of perception in children's concepts. *Cognitive Development*, *8*(2), 113-139.

Jones, S. S., Smith, L. B., & Landau, B. (1991). Object properties and knowledge in early lexical learning. *Child development*, *62*(3), 499-516.

Kucker, S. C., Samuelson, L. K., Perry, L. K., Yoshida, H., Colunga, E., Lorenz, M. G., & Smith, L. B. (2019). Reproducibility and a unifying explanation : Lessons from the shape bias. *Infant Behavior and Development*, *54*, 156-165.

Landau, B., Smith, B., & Jones, S. (1988a). The importance of shape in early lexical learning. *Cognitive Development*, 299-321.

Landau, B., Smith, L. B., & Jones, S. S. (1988b). The importance of shape in early lexical learning. *Cognitive development*, *3*(3), 299-321.

Markman, E. M. (1989a). *Categorization and naming in children : Problems of induction*. Mit Press.

Markman, E. M. (1989b). *Categorization and Naming in Children : Problems of Induction*. MIT Press.

Markman, E. M. (1990). Constraints children place on word meanings. *Cognitive science*, *14*(1), 57-77.

Markman, E. M., & Hutchinson, J. E. (1984). Children's sensitivity to constraints on word meaning : Taxonomic versus thematic relations. *Cognitive Psychology*, *16*(1), 1-27. https://doi.org/10.1016/0010-0285(84)90002-1

Namy, L. L., & Gentner, D. (2002). Making a silk purse out of two sow's ears : Young children's use of comparison in category learning. *Journal of Experimental Psychology: General*, *131*(1), 5.

Rosch, E., Mervis, C. B., Gray, W. D., Johnson, D. M., & Boyes-Braem, P. (1976). Basic objects in natural categories. *Cognitive psychology*, *8*(3), 382-439.

Smiley, S. S., & Brown, A. L. (1979). Conceptual preference for thematic or taxonomic relations : A nonmonotonic age trend from preschool to old age. *Journal of Experimental Child Psychology*, *28*(2), 249-257.

Stansbury, E., Witt, A., & Thibaut, J.-P. (2022). How Stimuli Availability Effects Novel Noun Generalization in a Free-Choice Design. *Proceedings of the Annual Meeting of the Cognitive Science Society*, *44(44)*, 2789-2795.

Waxman, S. R. (1990). Linguistic biases and the establishment of conceptual hierarchies : Evidence from preschool children. *Cognitive Development*, *5*(2), 123-150.

Waxman, S. R., & Hatch, T. (1992). Beyond the basics : Preschool children label objects flexibly at multiple hierarchical levels. *Journal of Child Language*, *19*(1), 153-166.

Waxman, S. R., & Kosowski, T. D. (1990). Nouns mark category relations : Toddlers' and preschoolers' word-learning biases. *Child development*, *61*(5), 1461-1473.

Waxman, S. R., Shipley, E. F., & Shepperson, B. (1991). Establishing new subcategories : The role of category labels and existing knowledge. *Child Development*, *62*(1), 127-138.

Xu, F., & Tenenbaum, J. B. (2007a). Sensitivity to sampling in Bayesian word learning. *Developmental science*, *10*(3), 288-297.

Xu, F., & Tenenbaum, J. B. (2007b). Word learning as Bayesian inference. *Psychological review*, *114*(2), 245.