Generalization of Novel Object Names in Comparison Contexts in a yes-no paradigm by young children. When the rate of stimulus presentation matters.

Eleanor Stansbury (eleanor.stansbury@u-bourgogne.fr)
Arnaud Witt (arnaud.witt@u-bourgogne.fr)
Jean-Pierre Thibaut (jean-pierre.thibaut@u-bourgogne.fr)
LEAD-CNRS, UMR 5022, Université de Bourgogne Franche-Comté,
Pôle AAFE – Esplanade Erasme, 21065 Dijon, France

Abstract

A common result in novel word generalization tasks is that comparison settings (i.e., several stimuli introduced simultaneously) favor conceptualization and generalization. We hypothesized that typical comparison forced-choice designs between a lure and a target conceptual dimension might have constrained children's choices. Here we used a "yes-no" free choice design with 3- and 4-year-old children, and manipulated the presentation mode of the stimuli, either simultaneous or sequential. We manipulated the semantic distance between training and transfer items. Results showed that simultaneous, rather than sequential, presentations in the transfer phase led to more taxonomic generalizations in four-year olds. Results are discussed in terms of the constraints that both types of presentation bring into the task.

Keywords: novel name; comparisons; generalization; forced-choice; free-choice.

Introduction

When they learn to categorize and name novel objects, children have to capture which dimensions are important to define the corresponding concept (Murphy, 2002). One difficulty is that, in some cases, perceptual similarities (e.g., objects from different categories displaying the same texture and/or the same color) or differences are more salient than variations along the relevant features. Semantic similarities (e.g., thematic similarities) can also be misleading. It can therefore be challenging for young children to ignore salient but irrelevant perceptual or semantic similarities and generalize according to less salient but deeper, conceptually based properties (Augier & Thibaut, 2013, Gentner & Namy, 1999). In this context, understanding which presentation format(s) and which strategies lead to conceptually driven generalization is an important topic for cognitive sciences.

There is now considerable evidence that the opportunity to compare stimuli during learning highlights nonobvious shared properties and favors conceptually-based categorization and novel word generalization more than the classical single learning exemplar situations.

However, little is known of the dynamics of comparisons in word generalization tasks. Which items are compared? In which order? If children benefit from comparisons between learning items, do they also benefit from comparisons between learning-items and test-items? This study aims to assess the impact of comparisons made between learning-items and transfer-items in a traditional name generalization task by manipulating the transfer items' presentation mode, either favoring one-by-one comparisons between the learning items and each transfer item (*sequential* test), or allowing to compare learning items to the whole set of transfer-items presented together (*simultaneous* test).

Comparisons favor taxonomic generalization

Most of the existing comparison studies with children manipulate familiar objects, relations or situations and to the best of our knowledge, in all previous studies, children were asked to extend the novel name in a forced-choice design (Christie & Gentner, 2010). In a typical design, the learning items are perceptually similar (i.e. they display the same shape). The child has to generalize the learning items name to one of the transfer items. One of the transfer items, the taxonomic item, is taxonomically related to the learning items and is rated as less perceptually similar to them. Another transfer item is a perceptually similar lure that is conceptually unrelated to the learning items but perceptually similar to them, or to one of them (e.g., Gentner & Namy, 1999). The lure can also be thematically-related to the learning items (e.g., a fork for two food items). Many studies have shown that comparison situations lead to more conceptually-based generalizations than no-comparison situations.

Many studies have investigated which conditions help children extract a taxonomic relation during the learning phase and generalize it to the correct transfer item. Overall, we know that the presence of a common name invites comparison (Gentner & Namy, 1999) and contributes to conceptually-based generalization. We also know that increasing the number of compared items does not automatically lead to more conceptually-based transfer, especially in younger children, most likely because of the cognitive costs induced by multiple comparisons (Augier & Thibaut, 2013; Thibaut & Witt, 2015) and that semantic distance might also matter. Thibaut and Witt (2017) manipulated the semantic distance between learning items (e.g., two bracelets versus a bracelet and a watch), and the semantic distance between the learning items and the transfer items (e.g., a jewel, near distance, versus a bow tie, far distance). Six-year olds made more distant generalization in the far learning condition than in the close learning condition. Children also made less taxonomic choices in the distant generalization condition compared to the near generalization condition, confirming that increasing the generalization distance between learning and transfer items makes the task harder for young children, especially when the compared learning items were very close (e.g. two apples).

Comparison Strategies

As mentioned above, most comparison designs are forced-choice designs, in which children first see the learning items together with their name. Immediately after, they are shown two (or more) options, one being a correct conceptually-based transfer item, the other being incorrect (a perceptual or a thematic lure).

Forced-choice tasks are reasoning tasks in the sense that children have to choose the most plausible answer given the available evidence. However, children could choose an item that is plausibly related to the standards but that they would not select as an item of the same category if they were not forced to choose one. Moreover, a selection of a most plausible option does not entail that participants would not accept the other option as a member of the category if they were given the opportunity to select it. In a forced-choice Smiley and Brown (1979) showed that young children could select and justify a taxonomic choice even when their first choice was a thematic choice. Forced-choice designs are well suited to study what commonalities children are able to transfer. Free-choice designs give other insights on the items children would *really* generalize as members of a category.

Goals of the present experiment

In the following experiment, we use a comparison design and contrast two theories of generalization. The first derives from most comparison studies and suggests that the main determinants of conceptualization are the comparisons between learning items, during the learning phase. This view conceives learning as the product of the comparisons taking place with the learning items and gives no status to comparison during transfer. Another possibility is that conceptualization is also determined by other comparisons between other available items, for example items available in the noun generalization phase.

In contrast with forced-choice designs, we used a free-choice task in which we asked participants to select the items they thought would also hold the same name, with no additional constraint. Our main goal was to contrast a simultaneous with a sequential transfer mode. In real life, children often see transfer items one by one, in a sequential transfer mode, in which they encounter transfer items on successive occasions. Thus, it is difficult to make systematic comparisons between learning items and different transfer items or to compare transfer items one with the others. In comparison, in the simultaneous transfer mode children saw all the transfer items simultaneously, a mode which is more similar to presentations of various stimuli in books. The simultaneous condition, compared with the sequential condition, allow for additional types of comparisons, that is comparisons between learning items and all the transfer items and, second, between transfer items themselves, so that children might decide which stimuli are the most adequate transfer items. How would these additional comparisons contribute to generalization? One possibility would be that comparisons in the simultaneous mode would allow children to align distant transfer items with near transfer items and extend their generalization to more distant items. Both comparisons between learning items and transfer items, and between transfer items themselves also contribute to highlight the irrelevance of the distractor thematic relation and should contribute to exclude these thematically related objects from the chosen transfer items.

Along this latter theoretical perspective, our first prediction is that the simultaneous mode may lead to better taxonomic generalization performance because these comparisons will contribute to highlight the relevant properties. This means that participants should select more taxonomic choices but also less non taxonomic lures in the simultaneous condition.

However, this factor, transfer mode, might interact with the semantic distance and age. As for the semantic distance between learning and transfer items, we mentioned above that it influences the scope of children's conceptual generalization. We predict more near transfer item (i.e., items that belong to the close categories) choices than distant transfer item (i.e. items from remote categories) choices in both the simultaneous and the sequential modes, because it is easier to understand that near items are of the same kind as the learning items. However, we also predict that transfer mode and semantic distance might interact. Our conceptual framework predicts that difference between near and distant transfer items should be smaller in the simultaneous mode because participants will be able to compare near transfer items to distant transfer items in this mode. These comparisons between near and distant transfer items may help participants to extend their generalization whereas such an alignment process is impossible in the sequential mode.

We also predict, for the same alignment reasons, that a learning condition including both semantically close and far learning items should lead to better results in both conditions than learning conditions made up with either of close learning items or of far learning items. A mixture of both might contribute to better conceptualize the scope of the category.

We also make predictions regarding interactions between age and the other factors. Generalization is a cognitively demanding task and previous studies have shown that young children can be overwhelmed by excessive quantities of information in generalization tasks (Augier & Thibaut, 2013; Stansbury, Witt, & Thibaut, 2018; Thibaut & Witt, 2015). We hypothesize that the sequential mode should be more cognitively demanding and thus predicts that the difference between younger and older children should be larger in the sequential than in the simultaneous conditions.

By contrast, if conceptualization and generalization is mainly a matter of comparisons involving the learning items, then later comparisons between transfer items should not influence children's generalization. This predicts equivalent generalization results between *simultaneous* and *sequential* Transfer Modes. This view does not make any specific view regarding the transfer items semantic distance, or between transfer and age.

Methods

Participants

Ninety-six French speaking children were tested individually in a quiet room at their school. Two age groups were tested, 47 three-year olds (mean age: 3.1; range: 2.4 – 3.5) and 49 four-year olds (mean age, 4.0; range: 3.6 - 4.9). Informed consent was obtained from their school and their parents.

Materials

Color pictures of real objects were used as stimuli. The pictures were organized into fifteen stimulus sets, each associated with a semantic category (e.g., accessories, foods, clothing, tools see Table 1), each set being constructed around learning stimuli and six transfer stimuli. The list of stimuli is given in Table 1.

The design worked as follows. Each participant saw fifteen trials which were divided into three learning conditions (close, far, and close-and-far). Each trial was constructed around a semantic category (e.g., foods, tools, see Table 1). 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 stimuli from the same basic level category (e.g. a pear and a cut pear). In the far learning condition, the two learning items were pictures of stimuli from the same superordinate category (e.g., a pear and a raspberry). Finally, in the close-and-far learning condition, there were three learning stimuli, two from the same basic level category and one from the same superordinate category (e.g., a pear, a cut pair and a raspberry). As can be seen, the latter condition, was the accretion of the first two conditions. Note that each participant saw the three learning conditions but the semantic categories that composed them differed from one learning condition to the other. In fact, each participant saw only one learning condition from each the 15 semantic categories given in Table 1 (e.g. if he/she saw the pear and the cut pear in the close learning condition, he/she did not see the pear and the raspberry).

There were also six transfer items which were two pictures of stimuli from the same superordinate level category as the learning-items (near transfer items, e.g., apricots and pineapple, in the pear and/or raspberry case), two pictures from a more remote superordinate category as the learning-items (distant transfer items, e.g., chips and pasta, i.e., from the superordinate category of foods), and two pictures thematically but not taxonomically related with the learning-items (thematically related distractors, e.g., a fruit basket and person eating).

The trials' order during the task was counterbalanced, as was the order in which were presented the different learning conditions. All 15 trials in a task were presented with the same transfer mode. Half of the participants saw the trials in the sequential transfer mode and half in the simultaneous transfer mode. In the sequential transfer mode, the transfer-items' order was randomized between trials.

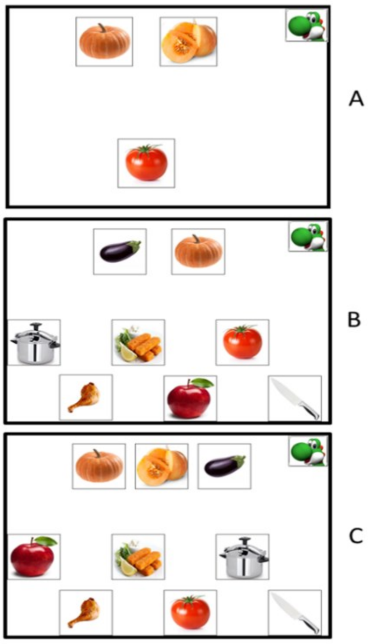

Figure 1: Trial examples built for the food category crossing the three experimental conditions (learning, generalization, transfer mode).

Note: A = close learning - sequential transfer mode, B = far learning - simultaneous transfer mode, C = close-and-far learning – simultaneous transfer mode.

In the simultaneous transfer mode, the order in which each transfer item appeared was randomized. Figure 1 shows 3 examples of trials built using the stimuli from the food category. The pictures were displayed on a 13inch touchscreen laptop. Apicture of Yoshi appeared for six seconds on the right-hand side of the screen after all the stimuli pictures had appeared.

We forged 15 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).

Perceptual similarity and semantic similarity ratings were obtained from eighty university undergraduate students (forty students evaluated the perceived similarity and forty others the semantic proximity). For each of the fifteen categories, we assessed the perceptual and semantic similarities between each of the three learning-items and each transfer item, and the three learning items between each other. As expected, close learning items were rated as perceptually more similar and semantically closer to each other than the far learning items to each other ($ps < .05$). The near transfer items were also rated as perceptually and semantically more similar to the three learning items than the distant transfer items ($ps < .05$).

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 transfer mode conditions (sequential, or simultaneous). In both conditions, children were shown a soft Yoshi toy and were told a story about him to introduce the experiment as a game using the following

Table 1: List of stimuli for each category

	Learning Items			Transfer Items					
	Standard	Close	Far	Near		Distant		Thematically related	
Accessories	Bracelet	Curb-chain	Watch	Pendant	Earring	Bow tie	Hair band	Hand	Girl
Fruits	Pear	Cut pear	Raspberry	Apricots	Pineapple	Chips	Pasta	Basket	Person eating
Tools	Hammer	Hammer 2	Axe	Screw-driver	Pliers	Chain saw	Drill	Building site	Worker
Food	Pumpkin	Pumpkin 2	Eggplant	Tomato	Apple	Chicken	Fish fingers	Knife	Saucepan
Clothing	Sock	Sock 2	Jeans	T-shirt	Jumper	Hat	Tie	Washing machine	Man
Cleaning tools	Broom	Broom 2	Mop	Dustpan	Vacuum cleaner	Washing machine	Dish washer	Cleaning lady	Floor
Fruits 2	Apple	Apple 2	Pineapple	Banana	Orange	Fish fingers	Meat	Knife	Fruit bole
Animals	Snake	Snake 2	Lizard	Turtle	Chameleon	Rabbit	Cow	Aquarium	Land-scape
Food 2	Potato	Potato 2	Salad	Cucumber	Carotte	Piece of tart	Sweets	Bole	Fork
Food 3	Ice cream	Ice cream 2	Cake	Yogurt	Fruit salad	Egg	Sausage	Fridge	Baby eating
Insects	Ladybird	Ladybird2	Beetle	Butterfly	Ant	Goldfish	Duck	Garden	Sun-flower
Transport means	Bicycle	Bicycle 2	Skateboard	Scouter	Roller blades	Boat	Airplane	Helmet	Bicycle path
Stationary	Pencil	Pen	Ruler	Rubber	Scissors	Computer	Calculator	Classroom	Student
Musical instruments	Guitar	Guitar2	Drum	Flute	Trumpet	Piano	Stereo machine	Dancer	Music stand
Cuter	Knife	Knife 2	Chopper	Saw	Pincers	Lawn mower	Chain saw	Water-melon	Fork

instruction "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 three 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….". In the *close-and-far* learning condition the experimenter repeated the second part of the instruction for the close item then for the far item. Then, the generalization items appeared on the lower part of the screen. Depending on the transfer mode they appeared one by one (sequential condition) and the experimenter said "is this a "*buxi…?*"for each of the 6 generalization items, or all together (simultaneous condition) and the experimenter said : : "which ones of these are also *buxis,* show me the *buxis* but not the other things", In both conditions the experimenter finished the instruction by "…Take your time, don't make a mistake, don't give me your answer before Yoshi appears on the screen". The children were randomly assigned to one of the 6 trial orders, which were seen by the same number of children. The bisyllabic names were assigned randomly to the categories. At the end, the experimenter checked that the child knew the categories, by showing pictures from each trial and asking to name the objects or explain how they were used.

Design

Three- and four-year old children were compared. They were randomly assigned to one of the two transfer modes (sequential, 48 children or simultaneous, 48 children) that was a between subject factor. Age was crossed with transfer mode, learning distance (close, far or close-and-far) and generalization distance (near or distant) which were both within-subject factors.

Results

In this study, we assessed whether the transfer mode, simultaneous or sequential, would differentially influence children's selection of transfer items. It was hypothesized that sequential transfer would allow less comparisons between stimuli and, thus, less correct generalizations. It was also predicted that the transfer mode would interact with semantic distance, in the sense that sequential transfer would affect more negatively the distant conditions.

In the analyses, we kept participants who had chosen at least one item in more than a third of the trials (quantity criterion), and they must not have chosen all the items in more than two thirds of the trials (selectivity criterion). Under this criterion, four participants in the simultaneous transfer mode were removed from all subsequent analyses.

In the analysis, we compared proportions of correct responses to chance (objects = 50%) with t-tests, and used the

Bonferroni correction for multiple comparisons (significance set at .0028, divided by the number of comparisons).

We ran a four-way ANOVA on the proportion of taxonomic answers, with Age (3 and 4 years) and transfer mode (sequential and simultaneous) as a between-subjects factor, and learning distance (close, far, close-and-far) and generalization distance (near, distant) as within conditions. Since the most important results were interactions, we will report them first. One important result was the interaction between transfer mode and generalization distance, $F(1,88) = 4.72$, $p < .05$, $\eta^2_P = .051$. Figure 2 suggests that this interaction results from a larger difference between the sequential and the simultaneous conditions in the distant case than in the near condition. This is compatible with the idea that distant transfer items were more difficult when items were introduced one by one.

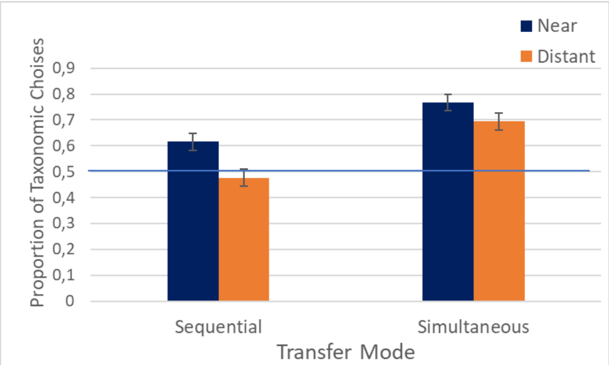

Figure 2: Proportion of taxonomic choices as a function of generalization distance and transfer mode (error bars are SEM).

A posteriori Tukey analysis revealed that in both transfer modes participants chose significantly more near transfer items than distant transfer items ($p_s < .05$), We also compared performance to chance, with a Bonferroni correction for multiple comparisons (significance at .0028). As shown by t-tests, the simultaneous mode was above chance in both near and distant conditions ($p_s < .001$), whereas in the sequential mode children scored above chance in the near condition ($p < .0025$) but were at chance in the distant condition ($p = .48$).

Second, transfer mode significantly interacted with age, $F(1,88) = 4.41$, $p < .05$, $\eta^2_P = .048$ (Figure 3). A posteriori Tukey analysis revealed that the proportion of taxonomic choices in the sequential and the simultaneous modes did not differ in the three-year olds ($p = .61$ $M_{sequential} = .56$, $M_{simultaneous} = .65$), but differed significantly at four years of age ($p < .001$, $M_{simultaneous} = .8$, $M_{sequential} = .53$). The test also revealed that there was no significant difference between the three- and four-year olds in the sequential condition ($p = .60$) but was marginally significant in the simultaneous condition ($p = .07$). One sample t-tests, with the Bonferroni correction, revealed that all groups were at chance except the four-year olds in the simultaneous condition who were significantly above chance ($p < .001$). These results show that four-year olds benefited from simultaneous transfer but three-year olds did not. This strongly suggests that the comparisons between

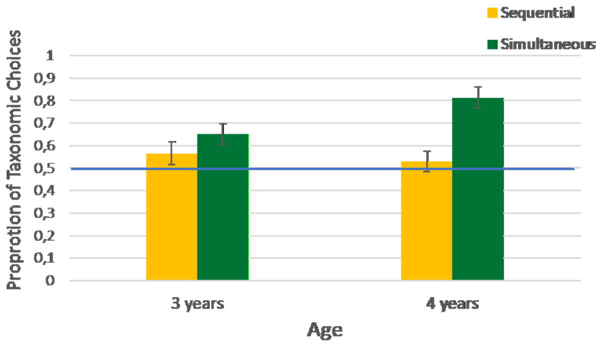

Figure 3 : Proportion of taxonomic choices as a function of transfer mode and age (error bars are SEM).

simultaneous stimuli benefited older children. By contrast, the cognitive constraints associated with a sequential presentation format were sufficient to impair comparisons between different transfer stimuli in both age groups.

There was an interaction between age and generalization distance, $F(1,88) = 6.28$, $p < .05$, $\eta^2_P = .067$. A posteriori Tukey test showed that children from each age group, 3- and 4-year olds, chose significantly more near transfer items than distant transfer items (respectively $p < .05$ and $p < .001$). Our t-tests revealed that for both age groups, participants score above chance in the near condition, ($ps < .001$), but participants score at chance in the distant condition (3-year-olds: $p = .06$; 4-year-olds: $p = .03$) (See Figure 4).

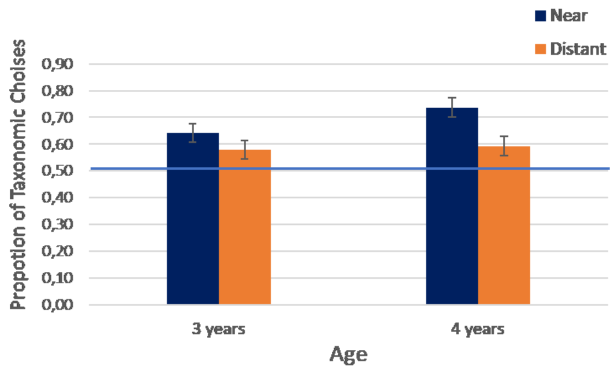

Figure 4: Proportion of taxonomic choices as a function of generalization distance and age (error bars are SEM).

Finally, there was a learning distance x generalization distance, $F(2,176) = 4{,}30$, $p < .05$, $\eta^2_P = .047$, which is interesting but is not central for our study., so we will not describe it here. We also observed a main effect of transfer mode. There were significantly more taxonomic choices in the simultaneous condition than in the sequential condition, transfer mode, $F(1,88) = 15.16$, $p < .001$ $\eta^2_P = .15$; $M_{sequential} = 0.55$, $M_{simultaneous}$ 0.73. The analysis also showed a significant main effect of learning $F(2,176) = 5.48$, $p < .01$, $\eta^2_P = .059$; $M_{close} = 0.61$ $SD_{close} = 0.28$; $M_{far} = 0.66$ $SD_{far} = 0.28$; $M_{close\text{-}and\text{-}far} = 0.64$ $SD_{close\text{-}and\text{-}far} = 0.29$. A Tukey HSD showed that children gave less taxonomic answers in close learning than in the far learning, $p < .001$ and that close and close-and-far learning did not differ significantly, $p = .15$. Last, we found a significant main effect of generalization distance, $F(2,88) = 49.05$, $p < .001$, $\eta^2_p = .36$; $M_{\text{near}} = 0.69$, $M_{\text{distant}} = 0.59$.

The difference between the near and the distant conditions is also confirmed by another dependent variable that can be derived from our hypotheses, the order of item selection. We hypothesized that children in the simultaneous condition, might continue to build their conceptual representation associated with a concept during the transfer phase and that they should start with the near transfer items. We computed the number of near and distant items in the first two items children selected. A t-test showed that near items were significantly chosen more often in the first two items than distant items ($p < .002$, $M_{near} = 15$, $M_{distant} = 11$).

We also performed a last control and checked whether the effect of transfer mode might result from a bias to select more items in the simultaneous condition than in the sequential transfer mode. This bias, if any, would result in more thematic lures in the simultaneous condition. An independent samples t-test showed that children gave as many thematically related answers in both transfer modes, ($p > .10$) which shows that the bias did not exist.

Discussion

Our main question was whether the transfer mode, sequential or simultaneous, would influence children's selection of transfer items. Related factors such as semantic distance and age were also considered. Our results suggest that transfer mode had an effect and interacted with semantic distance and age. The interaction with generalization distance shows that the difference between near item scores and distant items scores was smaller in the simultaneous case. This can be interpreted in terms of comparisons between items during the transfer view, the distant items benefiting from the former encoding of the near items.

The interaction between age and transfer mode, showed that, overall, the simultaneous transfer mode favored taxonomic answers and that the difference with the sequential mode was larger for four-year olds. Interestingly, this shows that older children benefited the most of simultaneity which means that they could compare the learning and the transfer stimuli and make sense of all these comparisons. In contrast, the sequential mode remained difficult for them, which means that the comparisons between learning items alone did not lead to better results than in younger children. For the younger children, it might be possible that both situations remained difficult and that they had difficulties also with the simultaneous case and its multiple comparisons between all the available items. Overall, these results show that simultaneous transfer mode gave better results and is consistent with the hypothesis that participants benefited from the comparison between all the stimuli. These comparisons might contribute to circumscribe the category scope.

The interaction between age and generalization distance showed that children chose less distant generalization items than near generalization items, but the difference between near and distant was larger in the older children. The distance effect is most often interpreted by saying that children find it harder to generalize to a remote item in a semantic taxonomy, or to apply the conceptual criteria to distant items. The interaction shows that our older children improved first for the near items, which is consistent with what we observed by Stansbury et al. 2018, for this age group. However, these results have a different meaning in a free-choice task. In forced-choice designs, it means that participants, given the learning input they receive, do not understand the targeted concept. In a free-choice design, this means that participants do not consider that an item belongs to the category. They might have forged a conceptual representation that does not include these items.

Another interesting result regarding semantic distance is the interaction between learning distance and generalization distance. There was a linear trend in the near generalization stimuli from close to close-and-far, whereas performance in the distant generalization declined in the close-and-far learning case, resulting in a larger difference between near and distant generalization stimuli in the latter case. This suggests that integrating a close and a far learning item during comparison might have elicited integration difficulties in children, that is difficulties to consider that a close and a far learning item belong to the same class (e.g. an apple and an apple belong to the same basic level category, whereas an apple and a banana belong to the same superordinate category). Integrating two conceptual distance levels in a single representation might be challenging.

One interpretation of these results is that comparisons between learning and generalization items help children to generalize because it enables them to build a deeper representation of the targeted relation between the learning items. Thus, the test phase also contributes to the extraction of the targeted concept and the building of the concept's representation. Children might progressively align the learning items with the transfer items (Gentner & Colhoun, 2010). These learning-item to transfer-item comparisons, starting with near transfer items, may progressively enable children to extend the scope of their representation and choose more distant items.

This interpretation implies that children may use information from multiple sources while learning and generalizing novel words. However, integrating multiple information depends on proficient executive functions which are not fully developed around three to four years of age, when children build representation to generalize novel words. Complex interactions between amount of information available to fulfill the task and the tasks executive difficulty may exist as Augier & Thibaut (2013) study show with their manipulation of multiple item comparisons. Future studies could focus on theses complex interactions that may exist between representation building rich information environments and executive functions.

Acknowledgment

We wish to thank the French Agence Nationale pour la Recherche (ANR) for their financial support in the COMPARE project which was awarded the third author. The first author benefited from a French ministry for research scholarship. We also thank Flavie Champaney and Virginie Pickel for their help in the stimulus construction and data gathering.

References

Augier, L., & Thibaut, J.-P. (2013). The benefits and costs of comparisons in a novel object categorization task : Interactions with development. *Psychonomic Bulletin & Review*, *20*(6), 1126-1132. https://doi.org/10.3758/s13423-013-0436-x

Childers, J. B., & Paik, J. H. (2009). Korean- and English-speaking children use cross-situational information to learn novel predicate terms. *Journal of child language*, *36*(1), 201-224. https://doi.org/10.1017/S0305000908008891

Christie, S., & Gentner, D. (2010). Where Hypotheses Come From : Learning New Relations by Structural Alignment. *Journal of Cognition and Development*, *11*(3), 356-373. https://doi.org/10.1080/15248371003700015

Gentner, D., Anggoro, F. K., & Klibanoff, R. S. (2011). Structure mapping and relational language support children's learning of relational categories. *Child Dev*, 1173–1188.

Gentner, D., & Colhoun, J. (2010). Analogical Processes in Human Thinking and Learning. In B. Glatzeder, V. Goel, & A. Müller (Éd.), *Towards a Theory of Thinking* (p. 35-48). Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-642-03129-8_3

Gentner, D., Loewenstein, J., & Hung, B. (2007). Comparison Facilitates Children's Learning of Names for Parts. *Journal of Cognition and Development*, *8*(3), 285-307. https://doi.org/10.1080/15248370701446434

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

Hammer, R., Diesendruck, G., Weinshall, D., & Hochstein, S. (2009). The development of category learning strategies : What makes the difference? *Cognition*, *112*(1), 105-119. https://doi.org/10.1016/j.cognition.2009.03.012

Murphy, G. L. (2002). *The big book of concepts*. MIT Press.

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.

Thibaut, J.-P., & Witt, A. (2015). Young children's learning of relational categories : Multiple comparisons and their cognitive constraints. *Frontiers in psychology*, *6*, 643.

Thibaut, J.-P., & Witt, A. (2017). Generalizing novel names in comparison settings : Role of conceptual distance during learning and at test. Proceedings of the 39th Annual Meeting of the Cognitive Science Society (pp. 3314-3319).

Waxman, S. R., & Klibanoff, R. S. (2000). The role of comparison in the extension of novel adjectives. *Developmental Psychology*, *36*(5), 571-581.