

Children's Pathways in Concepts Acquisition: Prototypical Vs. Exemplar Categorization

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Abstract

This study focused on the prototypical-exemplar categorization dichotomy in pre-school and school-aged children considering 4-11 years old children: categorization at 4 to 5 years of age mainly relied on Perceptual /Descriptive features, and conceptual features were used appropriately only at 8 to 11 years.

Keywords: childhood; concepts development; categorization; prototypicality-exemplarity.

Introduction

Concepts lie at the very core of our thinking; they represent a way of mentally grouping and organizing objects, and create long-term memory contents thereby. They are hierarchically related to one other as to understand external reality the same object needs to be identified at different hierarchical levels (Hammer, Diesendruck, Weinshall, Hochstein, 2009). The process of categorization allows us to organize the world distinguishing between super-ordinate and subordinate classes (i.e., between wooden objects and wooden furniture). In turn, this process leads to comprehension of the relations that exist among various objects within a specific class (i.e., between wooden chairs and non-wooden chairs). Furthermore, categorization processes require the use of inferential mechanisms that allow knowledge related to a specific part of reality to be transferred to other elements of the same "kind" (i.e., to wooden chairs vs. my wooden chair).

Although many studies have focused on analyzing the development of concepts in general, little investigation has focused on the pathways children follow to acquire concepts. The current debate on categorization processes is between authors who maintain that the basic (or exemplar) level, classic Rosch, Mervis, Gray., Johnson, & Boyes-Braem (1976) position, is children's earliest way of categorizing conceptual acquisition and argue that development of categorization proceeds at a different pace in different domains of knowledge (Mervis & Crisafi, 1982); and other authors, such as Mandler (2008), who believe that a concept's core structure is present early on in children.

A relatively new line of thinking, however, proposes that category representations are unstable even within, and not only among, individuals of different ages, and that they depend greatly on the context in which they are applied (Barsalou, 1991). In contrast with their position, Sloutsky (2003) argued that categorization is grounded in perceptual

and attentional mechanisms. He theorizes the existence of a concrete to an abstract shift as other recent studies do (Tallandini & Roia's, 2005; Perraudin & Mounoud, 2009).

The purpose of the present study was to examine children's artifacts (church¹ and bank) categorization at the two different levels of proto-typicality (a church or a bank) and exemplarity (the church/bank you know about)² considering the existence of a developmental process that might account for the categorization of artifacts in prototypical and exemplar tasks. In particular, children would rely on different types of information (Perceptual/Descriptive, Conceptual, or Functional) to make categorizing decisions in function of their ages. The starting assumption was that prototypical concepts are identified by conceptual features, and exemplar concepts are identified by perceptual/ descriptive features (Keil, 1989).

To the best of our knowledge, research using the same object considered at two different abstraction levels (exemplar and prototypical) has been conducted only with adults (Archambault, O'Donnell, & Schyns, 1999).

Predictions

The theories outlined above suggest three apparently contrasting accounts for the development of children's categorizing capacity: one refers to the existence of a nearly inborn categorizing capacity (Mandler, 2008), the second to the importance of perceptual cues and to a radical change occurring during development (Sloutsky, 2003), the third points out to the relevance of the context (Barsalou, 1991). The predicted outcomes, in agreement with Sloutsky's (2003) theoretical position, are based on the view that concepts are composed of different types of information (theoretical, perceptual, and functional), which are differently acquired and organized at different rates during development. Specifically, the provisions are that the youngest participants (4 to 5 year olds) would be unable to distinguish between the prototypical and the exemplar request; they would consider the aspect in which they were idiosyncratically most interested as being the most relevant for denoting the object under consideration, regardless of

¹ A church is generally a very familiar building for Italian children--most probably because they typically attend church at a very young age, and many play- and social activities take place on church playgrounds and in parishes.

² We refrain from referring to the levels examined in our study as "basic" and "subordinate", because the terms do not always have the same meaning in the object recognition- and object categorization literature (Schyns, 1998).

the hierarchical level of the request. The middle aged participants (6 to 7 year olds) will not show any particularly distinctive choice as they are no longer at an idiosyncratic level nor they have yet achieved the capacity of distinguishing the hierarchical level of the concept categorization. Conversely, the oldest participants (8 to 11 year olds), would use a conceptual feature to categorize the prototypical building, and a descriptive/perceptual feature for the exemplar building, distinguishing the two levels of categorization thereby. Finally, considering Barsalou's (1991) context relevance theory, as the concepts examined belong to the same domain, the expectation was that a highly familiar concept, such as "church", would show differentiation in categorization at an earlier age than the less familiar concept of "bank" would, due to the greater amount of information that the concept "church" has available.

Method

Participants

Participants were non-referred, 4- to 11-year-old children divided into the following four age groups: 4-5, 6-7, 8-9, and 10-11 years. All the groups presented nearly equal distributions in terms of gender. Participants refusing to perform the task were excluded from the research. Participants were from middle- and lower middle class and were recruited at public kindergardens and elementary schools. Three-hundred and seventy-six (376) participants were assigned the bank task, and 349 were administered the church task.

Procedure

We verified the children's degree of familiarity with the concepts of church and bank. In an effort to avoid the influence that is typically generated by pre-composed verbal descriptions or visual presentations (Deak & Bauer, 1996), a procedure that has participants produce their own stimuli by drawing them was developed.

Hence, a task requiring the hierarchical identification of stimuli was developed that have the same content but which is related to two levels of categorization (prototypical and exemplar) for the same object to avoid confounding effects that might derive from using different stimuli for different conditions. The procedure therefore had the participants to draw an object and allowed the children themselves to specify the object's key features, avoiding the influence of any adult intervention thereby. No similar procedure was found in literature.

Children were randomly assigned to two groups and were asked, either to draw a bank (prototypical condition) / "draw the bank you know about" (exemplar condition), and "draw a church" (prototypical condition) / "the church you know about" (exemplar condition) on a blank A4 sheet of paper for each drawing. After they had drawn their pictures, the experimenter asked the focus questions, "How do you know that this is a bank/the bank you know about (or a church/the

church you know about?)" and then wrote down their verbal responses. To avoid the risk of contamination by further reasoning (Shallice & Warrington, 1975), only the first mentioned feature was considered. A classification system to group children's answers was obtained in terms of Conceptual Features (CF), Functional Features (FF), and Perceptual / Descriptive Features (P/DF). CFs, indicating the core of a concept, yield only one or two utterances per stimulus, as also theoretically substantiated by Keil (1989), conversely P/DF and FF were represented by numerous elements.

Results

Although the task had been administered following a Latin square distribution, the eventual order effect was first checked: an ANOVA for repeated measures was conducted, with task type and presentation order as IV and responses as DV. No effects related to presentation order emerged.

Given that all measures were at the nominal level, a non-parametric statistical approach was used. A two-way, log-linear saturated model was computed for each stimulus (church/bank) and for each of the two conditions (prototypical/exemplar), with age and features as factors; the aim was to check for any systematic differences in the ways different-aged children mentioned properties. Then a three-way, log-linear saturated model, was applied with features, age, and stimuli (prototypical and exemplar) as factors to examine the influence, if any, of the two conditions (prototypical/exemplar). A second three-way log-linear model was then computed to verify the familiarity effect, by using the two levels of familiarity (church/bank), type of features, and age group for each of the stimuli conditions (prototypical and exemplar). Lastly, log-linear parameter values and their standardizations were calculated for all statistically significant two- or three- dimensional effects.

The church

The prototypical church yielded a statistically significant two-dimensional effect ($L2 = 14.71$, $df = 6$, $p < 0.05$). The values of the log-linear parameters and their standardization indicated that within age group, 4- to 5-year-old children mentioned Perceptual/Descriptive features (PD) ($z = 3.04$; $p < 0.001$) significantly more frequently than the other features. A radical difference emerged for ages 8-9 and for age 10-11 yrs, in that PDF became the significantly least-used feature ($z = -2.20$ and $z = -1.57$, respectively). The two-dimensional effect was not statistically significant for the exemplar church ($L2 = 5.30$, $df = 6$, n.s.).

The bank

For the prototypical task, the two-way, saturated model, log-linear analysis yielded a statistically significant two-dimensional effect ($L2 = 35.04$, $df = 6$, $p < 0.001$).

In the within age group analysis, 4 to 5 year olds used CF for the prototypical bank significantly less frequently ($z = -2.82$; $p < 0.005$) than they mentioned PDF ($z = 2.48$; $p <$

0.01) or FF ($z = 2.15$; $p < 0.01$). At 8-9 years, an opposite trend was observed, with a statistically significant CF use ($z = 3.54$; $p < 0.001$) and a lower frequency in PDF use ($z = -2.41$; $p < 0.01$). At 10-11 years, we once more observed an increased use of CF ($z = 3.54$; $p < 0.001$), and again a less frequent use of PDF ($z = -2.06$, $p < 0.01$) and of FF ($z = -2.01$, $p < 0.05$).

The two-ways log-linear analysis conducted on the exemplar bank responses yielded a statistically significant two-dimensional effect ($L2 = 45.43$, $df = 6$, $p < .001$).

The within age group analyses showed that 4- to 5-year-old children used significantly more FF ($z = 3.12$; $p < 0.001$) and significantly less CF (CF: $z = -2.72$; $p < 0.005$) than the older groups did, when asked to indicate the distinctive properties of the exemplar bank. At the age of 8-9 years, there was a lower frequency in PDF use ($z = -3.80$, $p < 0.001$) versus a higher frequency in CF use ($z = 3.36$, $p < 0.001$). At the age of 10-11 years, children used with higher frequency CF ($z = 3.26$; $p < 0.001$) and lower frequency FF ($z = -4.26$; $p < 0.001$).

Discussion

The questions the study aimed to answer were how and at what age children differentially identify the same concept at the two hierarchical levels of exemplarity and prototypicality. The predictions stemmed from the consideration that the capacity for expressing hierarchical categorization is gradually constructed during development (Sloutsky & Fisher, 2004), hence only older children would be able to identify the different taxonomic levels and a developmental shift should be observed produced by the conceptual change in older children (Sloutsky, 2003; Keil, 1989). Moreover, a concomitant hypothesis, based on Barsalou (1991) theoretical position, would be supported by the influence of the degree of concepts familiarity (Barsalou, 1991). In general the results showed a clear difference between the responses obtained with the two stimuli (church and bank) first of all providing support to the hypothesis of the influence of familiarity in acquiring a hierarchical organization of categories (ib.). Moreover, only the older children identified the different taxonomic levels correctly, giving ground to the shift hypothesis in the acquisition of hierarchical categorization (Keil, 1989; Rosch et al., 1976; Sloutsky, 2003). However, this finding was clearly supported by the data only for the more familiar stimulus, the church. In fact, more perceptual /descriptive features were mentioned for the exemplar church and more conceptual features were presented for the prototypical church in a shift from the 8-9 year level upward. A different pattern emerged for the bank, the less familiar stimulus, where there was indeed a different use of cues through ages but not a clear differentiation for the two stimuli. However, these data do not give support to the core category theory (Mandler 2008), as children at the first age level use almost at the same rate PDF, FF and CF.

Overall, these data lend support to Sloutsky's (2003), Tallandini & Roia's (2005), and Perraudin & Mounoud's

(2009) positions. They argued that the perceptual aspects have a fundamental role in early categorization. Moreover, the existence of a concrete to an abstract shift has been confirmed.

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