SYNTACTIC AND INTENTIONAL CUES AS GUIDES TO WORD LEARNING IN NONOSTENSIVE CONTEXTS

by

JANE M. PROCTOR

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Department of Psychology

The University of British Columbia
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Abstract

This research examined preschoolers' ($\underline{N}$ = 96) and adults' ($\underline{N}$ = 96) use of syntactic and intentional information to learn new words. Participants took part in a two-item forced-choice task, in which they had to choose either a solid entity or a nonsolid entity as the referent of a novel word (e.g., "dax"). We varied two factors between subjects. One was the syntactic information that accompanied the word – whether the word was modeled as a count noun (e.g., "Which is <u>a</u> dax?") or a mass noun (e.g., "Which is <u>some</u> dax?"). Consistent with previous findings, participants tended to choose solid entities as the referents of count nouns and nonsolid entities as the referents of mass nouns. Unlike past research, we also manipulated the intentional information provided for the two entities – which item was said to be made on purpose and which was said to be made by accident. This intentional information also affected participants' choices. When the solids were described as purposefully made and the nonsolids as made by accident, participants again tended to choose solids as the referents of count nouns and nonsolids as the referents of mass nouns. However, when the solids were described as accidentally made and the nonsolids as made on purpose, these choices changed – participants were more likely to choose nonsolids as the referents of count nouns. The results offer new insight into early lexical development by revealing that preschoolers exploit intentional cues, in addition to syntactic cues, in determining the referents of new words.

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Acknowledgements

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Syntactic and Intentional Cues As Guides to Word Learning in Nonostensive Contexts

It is a well-documented fact that young children are proficient word learners; one estimate of their rate of lexical acquisition is one word per waking hour between the ages of 18 months and approximately 5 years (Carey, 1978). This is an amazing figure when one considers the ambiguous learning environment within which children demonstrate these achievements. Much research has addressed the ambiguity of ostensive labeling situations (e.g., "dog" uttered while the speaker points at a dog; see Quine, 1960, for a detailed description of the problem) and has investigated children's mechanisms for word learning in these contexts (e.g., Dickinson, 1988; Markman, 1994; Soja, Carey, & Spelke, 1991). In contrast, little research has examined children's word learning in the even more ambiguous contexts of nonostensive or indirect labeling.

Nonostensive Contexts

In nonostensive word learning contexts, children must map a novel word onto a referent that may be, for example, hidden from view (Tomasello & Barton, 1994), or included in a pair or array of items (Hall, Quantz, & Persoage, 2000). Consider, for example, a situation in which a young child is presented with two entities: a metal whisk and a pile of flour. As is obvious to the reader, if the child were asked to retrieve the "whisk," he or she should choose the whisk, and if asked to retrieve the "flour" he or she should choose the flour. Suppose, however, that these two words - "whisk" and "flour" - are novel to the child, that they offer no more meaning to the child than words like "daxy" or "fep" offer to the reader. Given these circumstances, how could the child succeed at choosing the correct referent for each of these novel words? What information could the child exploit in order to disambiguate this situation, and thereby, to learn a novel word presented in a nonostensive context?

Form Class Information

One type of information that is often available to word learners is information about a novel word's form class. Form class information is any indicator of the part-of-speech to which a word belongs. Consider the novel word "daxy." Presented bare, in a context such as "This is Daxy" the word would be construed as a proper name. However, if preceded by "very," as in "This doll is very daxy," the novel word would belong to the form class, adjective. Similarly, if preceded by "a," as in "This is a daxy," or "some," as in "This is some daxy," the word would be construed as a count noun or a mass noun, respectively. This form class information (e.g., "very," "a," "some") is important to word-learners because it provides them with clues to the meanings of novel words; there is a link between the form class of a word and the type of meaning it expresses (Bloom, 1994, 2000; Macnamara, 1986).[1] For example, proper names refer to individual (most often animate) entities (e.g. "Sally"), adjectives refer to properties (e.g. very "tall"), count nouns refer to categories of objects (e.g. a "ball"), while mass nouns refer to categories of materials (e.g. some "rubber").[2]

The current investigation will focus on the final two form classes outlined above: count nouns and mass nouns. The distinction between count nouns and mass nouns can be characterized in terms of their potential for indicating individuals, and their forms of quantification. Count, but not mass, nouns can be applied as a means of indicating individual entities. The count noun "table" can be used to pick out a single, bounded entity in a way that the mass noun "snow" cannot. Quantification for count nouns is discrete and involves the use of numerals or quantifiers such as "many" (e.g., "five tables," "many tables"), whereas quantification for mass nouns is continuous, and mass quantifiers are not numerals (e.g., "five snows") but portion indicators (e.g., "much snow," "five centimeters of snow").

Consider again the example of the child asked to retrieve the "whisk" or the "flour." In this situation, the child would benefit from the addition of form class information to the sentential context of the request; that is, for example, asking the child to retrieve "a whisk" would be less ambiguous than asking him or her to retrieve "whisk." The form class information provided by "a" would allow the child to identify "whisk" as an object category label (i.e., a count noun). However, the child must then decide if either (or both) of the entities on the counter (i.e., the flour or the whisk) is an instance of an object category. Thus, form class information alone is limited in that it provides a link from syntax (e.g., "a") that extends only as far as semantics (e.g., instance of an object category). Additional information is required for the child to make the link from semantics (e.g., instance of an object category) to an entity or entities in his/her environment (e.g., the whisk).

Solids and Nonsolids: The Construal Biases

One source of additional information is properties of the entities themselves. Much research and discussion has addressed the role of an entity's properties, specifically its solidity or nonsolidity, in children's tendencies to construe it as an object or a material (e.g., Akiyama & Wilcox, 1993; Dickinson, 1988; Gordon, 1985; Imai & Gentner, 1997; Macnamara, 1982; McPherson, 1991; Samuelson, & Smith, 1999; Soja, 1992; Soja, et al., 1991; Subrahmanyam, Landau, & Gelman, 1999). General findings indicate that, even without having the benefit of hearing the syntactic context for count nouns (e.g., "a," "another," "each," the plural morpheme) and mass nouns (e.g., "some," "a bit of," no plural morpheme), children interpret novel words for solids and nonsolids as labels for object categories and material categories, respectively. Evidence for this link in mapping comes from the patterns children demonstrate in their extensions of words for solids and nonsolids (e.g., Imai & Gentner, 1997; Lavin & Hall, 1999; McPherson, 1991; Soja, 1992; Soja, et al., 1991). For example, Soja, et al. (1991) tested children between the ages of 2 and 2.5 years, who were not demonstrating a mastery of count/mass syntax, for their generalization of novel labels applied to novel solids and nonsolids. Results of an extension task demonstrated that children generalized a novel label applied to a solid (e.g., a copper plumbing fixture) to entities in the same object category as the exemplar (e.g., a plastic plumbing fixture), whereas they generalized a novel label applied to a nonsolid (e.g., some hair gel in the shape of a backward "c") to entities in the same material category as the exemplar (e.g., some hair gel in the shape of a pancake). These generalization patterns illustrate young children's tendency to construe solid entities and nonsolid entities as objects and materials, respectively. For the purposes of this discussion, this tendency will be referred to as a pair of biases: the Solid-Object Construal Bias and the Nonsolid-Material Construal Bias.

Form Class and the Construal Biases

The Solid-Object and Nonsolid-Material Construal Biases could be of great importance to our whisk-seeking child, in that these biases would provide the semantics-entity link that information about form class could not provide. Guided by the Construal Biases, the young child would construe the whisk as an instance of an object category on the basis of its solidity, and the flour as an instance of a material category on the basis of its nonsolidity. The child could then combine this entity-semantics link (i.e., solid = instance of object category) with the syntax-semantics link provided by form class information (i.e., "a whisk" = count noun = object category label) to identify the whisk, and not the flour (nonsolid = instance of material category), as the referent of "whisk." From this example one can see how children might use form class information in conjunction with the Construal Bias described above to disambiguate a nonostensive word learning context involving solids and nonsolids.

Indeed, there is evidence that children are able to disambiguate nonostensive labeling situations involving solids and nonsolids when novel labels are presented in sentential contexts (i.e., form class information is provided). Brown (1957) presented children with a picture depicting an action (hands manipulating a nonsolid in a bowl), an object (a bowl), and a material. The picture was described using either a verb, a count noun, or mass noun (i.e., "sibbing," "a sib," "some sib"). Children were then shown three pictures: one of the action, one of the object, and one of the material. When asked to choose the referent of the novel word from these three pictures, children who heard the verb chose the action; those who heard the count noun chose the object; and those who heard the mass noun chose the material. In doing so, the children combined their understanding of the link between form class information and categories of labels (i.e., "a" indicates an object category label or count noun, whereas "some" indicates a material category label or mass noun), with their Biases to construe solids (i.e., the bowl) as objects and nonsolids (i.e., the entity in the bowl) as materials. As a result of this combination, the children were able to limit their hypotheses concerning the possible referents of a novel word presented in a nonostensive context.

Limitations

Although children tend to map count nouns to solids and mass nouns to nonsolids, these mapping patterns are not consistent across the English language. Many researchers (e.g., Dickinson, 1988; Samuelson & Smith, 1999; Soja, Carey, & Spelke, 1992) have noted that category labels for solid materials (e.g., "wood") and nonsolid objects (e.g., "lake") cannot be learned through the use of the Construal Biases. To build on the example presented earlier, suppose the young child had been asked to retrieve "some metal" rather than "a whisk." The word "some" would indicate to the child that "metal" is a mass noun, a material category label. The child would then examine the two entities (i.e., the whisk and the pile of flour) to determine if one or both of them might belong to the material category. Lacking any clarifying information to aid him/her in this task, the child would have to depend upon the Solid-Object and Nonsolid-Material Construal Biases and, consequently, determine that materials are nonsolid rather than solid. The child would then overlook the whisk and choose the pile of flour as the referent of "some metal." Similarly (i.e., by means of the same associations), if the child were seeking "a pile," he or she would be prompted to choose an instance of an object category and mistakenly select the whisk instead of the pile of flour. What additional information would help this child to override the Construal Biases in order to properly map "some metal" to the material of which the whisk is made, and "a pile" to the structure of the flour?

A partial answer to this question, as Subramanyam, Landau, and Gelman (1999) have shown, is that, in ostensive contexts, children appear to rely on form class information to learn object category labels for nonsolids (e.g., "lake") and material category labels for solids (e.g., "wood"). Subrahmanyam et al. (1999) demonstrated that beginning around the age of 4 years, children extend novel count nouns on the basis of object categories, and novel mass nouns on the basis of material categories regardless of whether they are paired, in an ostensive context, with solids or with nonsolids. The Construal Biases, therefore, may be viewed as default assumptions that the child depends upon in ambiguous situations, but ones he or she overrides in situations that provide additional, clarifying information (e.g., an ostensive mapping of word to referent).[3] The conclusion to be drawn from this result is that it may not be solidity or nonsolidity, per se, that determines an entity's construal as an object or material; rather that, in nonostensive, ambiguous situations, this property (i.e., solidity/nonsolidity) serves as a probabilistic cue to an entity's "objecthood" or "materialhood." If this is so, then it remains to be determined what really underlies the construal of an entity as an object or a material.

Perceived Arbitrariness of Structure[4]

Solidity/Nonsolidity as Cues

One recent proposal in the literature is that solidity serves as a cue that an entity's structure should be thought of as nonarbitrary, and that it is this conceptualization of the structure as nonarbitrary (and not the perception of its solidity, per se) that guides a person to construe the entity as an object (Burger & Prasada, 1997; Prasada, 1999; Prasada, Ferenz, & Haskell, 2000). Specifically, the cohesiveness of a solid entity provides it with a structure that is definite and persistent across time and space. The definiteness and persistence of this structure indicate to the observer that the structure is an important feature of this entity; that the structure could not be just any other way. The observer, therefore, is prompted to think of the structure of a solid entity as nonarbitrary, and, consequently, to construe the entity as an object.

Similarly but conversely, it is possible that nonsolidity serves as a cue that an entity's structure should be thought of as arbitrary, and that it is this understood arbitrariness (rather than the perception of nonsolidity, per se) which determines the entity's construal as a material. Specifically, the noncohesiveness of a nonsolid entity provides it with a structure that is not definite in that it is subject to change across time and space. This structure's susceptibility to change indicates to the observer that the structure is <u>not</u> an important feature of this entity; that the structure <u>could</u> be just any other way. The observer, therefore, is prompted to think of the structure of a nonsolid entity as arbitrary and, consequently, to construe the entity as a material.

There is an important distinction, therefore, between a person's <u>perception</u> of a particular <u>property</u> of an entity (i.e., solidity/nonsolidity), and the way he or she <u>conceptualizes</u> the entity (i.e., as having a structure that is arbitrary or nonarbitrary) based on this perceived property. Support for this distinction comes from the fact that the same entity can be construed as either an object or a material (e.g., as either "a table" or "some wood"); the property (i.e., solidity/nonsolidity) of the entity remains constant while the way the perceiver thinks about the entity is subject to change (Burger & Prasada, 1997).

Intention/Accident as Cues

Thus, since it is possible to consider the structure of a solid as arbitrary (e.g., a table as some wood) and the structure of a nonsolid as nonarbitrary (e.g., some water as a lake), it seems that the properties of solidity and nonsolidity must <u>not</u> be the <u>only</u> cues to whether an entity's structure should be thought of as nonarbitrary or arbitrary, respectively. Indeed, Prasada and his colleagues have proposed the existence of several other cues, one of which is information about the nature of the processes that lead to an entity's creation. That is, if there is evidence that an entity's structure has arisen as the result of a process aimed at producing that structure, it should be treated as nonarbitrary, and the entity construed as an object -- regardless of its solidity or nonsolidity. On the other hand, if there is no evidence that an entity's structure is the result of such a directed process, the structure should be treated as arbitrary, and the entity construed as an amount of material -- again regardless of its solidity or nonsolidity (Burger & Prasada, 1997; Prasada, 1999; Prasada, et al., 2000).

In support of these hypotheses, (but without addressing the issues in these terms), recent research has shown that information about the circumstances surrounding an entity's creation (specifically, whether or not the entity's structure is the result of some purposeful creational process) can affect whether or not an entity is labeled in object or material terms. For example, Gelman and Ebeling (1998) have shown that children between the ages of 2.5 and 3.5 years will name a drawing for its shape (a count noun, or object construal) if told that it represents something that has been made on purpose, and for its material (a mass noun, or material construal) if told it represents something that has been made by accident. Similar results were revealed by Gelman and Bloom (2000) through tests using actual artifacts; 3-year-olds, 5-year-olds, and adults named an entity for its object category (e.g., "a knife") when told it was intentionally created and for its substance/material category (e.g., "plastic") when told it was the result of an accident (for a related investigation see Bloom & Markson, 1998).

These results suggest that perceived arbitrariness of structure (as cued by information about the accidental or intentional creation of an entity) is the underlying determinant of an entity's construal in either discrete (i.e., object) or continuous (i.e., material) terms. Further, the results of these studies can be taken as a strong indication that the property of solidity is merely a cue to the decision to think about an entity's structure as nonarbitrary and, as such, information about solidity is of only heuristic value; it is unnecessary and may be completely disregarded in situations where other cues (i.e., information about intentional or accidental processes of creation) are available.

Two Accounts of Word Learning

The preceding discussion is consistent with Prasada's (1999) notion that cues to the arbitrariness of an entity's structure are of primary relevance to an entity's construal as an object or a material. What remains to be explored is how the different cues to this understanding of arbitrariness (e.g., solidity/nonsolidity of entity, intentional/accidental processes of creation) interact in nonostensive contexts of word learning. There seem to be two differing accounts of how children identify the referents of novel words in nonostensive contexts. The first few steps of the process, establishing the links between syntax and semantics, are the same in both accounts: a novel label (e.g., '"a whisk," "some flour") is, through the use of form class information (e.g., "a," "some"), recognized as a count noun/object category label or as a mass noun/material category label. The child then searches his environment for an instance of an object category, or a material category, depending on the count or mass status of the word.

The two accounts differ, however, in their conceptualization of the links between semantics (i.e., object/material categories) and entities in the child's environment (i.e., instances of these categories). According to an account based on the Solid-Object and Nonsolid-Material Construal Biases (henceforth referred to as the Construal Biases account), a child in search of an instance of an object category would know that solid, but not nonsolid, entities are instances of object categories and would, therefore, seek a solid entity to be the referent of the novel count noun (i.e., object category label). Similarly, this child would know that nonsolid, but not solid entities, are instances of material categories, and he or she would choose a nonsolid entity as the referent of a mass noun (i.e., material category label). According to this Construal Biases account, it is the solidity or nonsolidity of the referent, per se, that determines whether it gets selected as the referent for a count or mass noun. In contrast, according to the Perceived Arbitrariness of Structure account, a child seeking an instance of an object category would know that entities whose structures appear to be nonarbitrary, but not those whose structures appear to be arbitrary, are instances of object categories. Therefore, he or she would seek an entity whose structure appears to be nonarbitrary to be the referent of a novel count noun (i.e., object category label). Similarly, the child would know that entities whose structures appear to be arbitrary are instances of material categories, and he or she would seek such an entity as the referent of a novel mass noun (i.e., material category label).

According to both accounts, count nouns and mass nouns can be mapped to referents solely on the basis of their solidity and nonsolidity, respectively. However, unlike the first account, the second purports that count nouns <u>can</u> also be mapped to nonsolids and mass nouns to solids, depending on the child's perception of their structures as nonarbitrary and arbitrary, respectively. The critical difference is that under the Construal Biases account it is solidity or nonsolidity, per se, that is guiding the mappings, whereas under the Perceived Arbitrariness of Structure account solidity or nonsolidity act as mere probabilistic cues to the child to conceptualize the entity's structure as arbitrary or nonarbitrary, and the chosen conceptualization ultimately determines the mappings.

Current Studies

Which account describes the actual state of affairs? This is precisely what I endeavoured to investigate in the current set of studies. In forced-choice (disambiguation) tasks, adults and children were asked to choose one of two novel items as the referent of either a novel count noun or a novel mass noun. The two options differed in solidity such that one item was solid (i.e., a cue that structure should be considered nonabitrary) and the other was nonsolid (i.e., a cue that structure should be considered arbitrary). The first study examined the choices of adults and children when they were provided with this solidity/nonsolidity information alone. It was predicted that results would replicate those reported by Brown (1957), and illustrate the Solid-Object and Nonsolid-Material Construal Biases such that novel count nouns would be mapped to solid entities while novel mass nouns would be mapped to nonsolid entities.

Indeed, this first study may be thought of as a modified replication of Brown's (1957) disambiguation study. The major modifications included the use of real entities instead of pictures, the exclusion of the verb syntax condition, the varying of count/mass syntax between rather than within subjects, and the inclusion of adults as participants. An additional minor modification was the limiting of the age range of the child participants; although Brown studied children between the ages of 3 and 5 years, the children involved in the current studies ranged in age from 4.5 to 5 years. My primary reason for focusing on this older subgroup of preschoolers was the complexity of the information to be presented to the participants in the second study. Some previous studies have demonstrated that children as young as 3 years of age are able to exploit form class information in word learning tasks (e.g., Brown, 1957; Soja, 1992). Other studies have demonstrated that children that young are able to exploit information about the intentional or accidental circumstances surrounding an entity's creation when naming items in a free-naming task (e.g., Gelman & Bloom, 2000). However, no previous study has investigated at what age children are able to combine these two types of information. In the second study I was requiring children to integrate form class information and information about intention/accident in order to disambiguate a nonostensive word learning situation. It was thought that older preschoolers, rather than younger children, would be better suited to cope with these demands of the task.

In the second study, adults and children were presented with the same solid-nonsolid pairs used in the first study. In this study, however, they were also provided with information about the accidental or intentional processes by which each item came to be (i.e., conceptual cues to perceived arbitrariness of structure). The conceptual cues were manipulated such that one of the items in each pair was described as the result of careful craft-making (i.e., a purposeful process of creation and cue that structure should be thought of as nonarbitrary), whereas the other was described as resulting from an entity's fall to the floor (i.e, an accidental process of change and cue that the structure should be thought of as arbitrary). In this way, cues to how to think about an entity's structure (i.e., as arbitrary or nonarbitrary) were either convergent (i.e., solid and intentionally created; nonsolid and accidentally created) or divergent (i.e., solid and accidentally created; nonsolid and intentionally created).

It was predicted that the results of the convergent-cue condition would be similar to those expected for Experiment 1: novel count nouns would be mapped to solid (intentional) entities and novel mass nouns would be mapped to nonsolid (accidental) entities. This pattern of results would be consistent with predictions stemming from both accounts of word learning. The Construal Biases account predicts that count nouns would be mapped to solids and mass nouns to nonsolids; the Perceived Arbitrariness of Structure account predicts that count nouns would be mapped to items made intentionally (i.e., the solids) and mass nouns to items made by accident (i.e., the nonsolids).

It was expected that, in contrast to the results of the convergent-cue condition, the results of the divergent-cue condition would provide support for only one of the two word learning accounts. In this condition, the solidity/nonsolidity information cued participants to map count nouns onto solid items and mass nouns onto nonsolid items. The intentional/accidental information, on the other hand, cued participants to map count nouns onto nonsolid items (because they were intentionally created) and mass nouns onto solid items (because they were accidentally created). What would participants do when faced with these conflicting messages in the divergent-cue condition? If the Construal Biases account is accurate, then adults and children should consistently map count and mass nouns to solids and nonsolids, respectively, regardless of the intentional or accidental nature of each entity's creation. If the Perceived Arbitrariness of Structure account is correct, information about the intentional or accidental circumstances surrounding an entity's creation should attenuate, and even override, the effects of the solidity/nonsolidity cues such that adults and children should map count nouns onto referents created intentionally (i.e., a cue that structure should be seen as nonarbitrary) and mass nouns onto referents created accidentally (i.e., a cue that structure should be seen as arbitrary), regardless of their solidity or nonsolidity.

As discussed earlier, previous research has indicated that these intention/accident cues have significant effects on participants' behaviour in free-naming tasks; adults and children use object category labels to refer to entities made intentionally, and material category labels to refer to entities made accidentally (Gelman & Ebeling, 1998; Gelman & Bloom, 2000). It seemed justifiable, therefore, to predict that, in the divergent-cue condition, the intention/accident cues would override the solidity/nonsolidity cues such that participants would demonstrate a complete reversal of the mapping patterns expected in both Experiment 1 and the convergent-cue condition of Experiment 2.

In sum, the following studies investigated the mapping patterns that adults and children demonstrate when faced with the ambiguous task of choosing the referent of a novel count noun or mass noun presented in a nonostensive context. In Experiment 1, I examined participants' reliance on the Solid-Object and Nonsolid-Material Construal Biases. In Experiment 2, I explored how these Biases might be maintained or overridden by cues to how an entity's structure should be perceived (i.e., as arbitrary or nonarbitrary). The inclusion of both children and adults as participants in this investigation allowed for an assessment of how use of the Biases and of cues to perceived arbitrariness of structure develops between the age of five and adulthood.

Experiment 1

Method

Participants

Participants in this study were 32 adults (age range: 17-63 years) and 32 preschoolers (age range: 54-70 months). One additional adult and one additional child were tested but were excluded from the analyses on the basis of experimental error. The adults were psychology undergraduates who were awarded course credit for their time, as well as parents or grandparents of children visiting the laboratory who were paid $5 for their participation and parking expenses. All adult participants were tested either individually or in small groups (2-4 people).

The majority of the children were recruited from local preschools and daycares where they were tested individually in the classroom or in a separate room during regular school hours. Other children were recruited through the use of public notices and were tested individually in the laboratory during a scheduled visit. Children were given either stickers or Play-do for their participation.

All children were native speakers of English according to information provided by parents and/or daycare staff. Adults provided self-ratings of English proficiency indicating that they were native English speakers and/or demonstrated a native-speaker level of fluency.

Children and adults were randomly assigned to one of two Syntax conditions (count noun, mass noun), such that there were 16 adults and 16 children in each group.

Stimuli

Eight items served as stimuli for this study. Four of the items were constructed out of solid materials and four were constructed out of nonsolid materials. Each solid was paired and matched for color with a non-solid. The pairs of solid and non-solid materials were as follows (color in parentheses): floral foam and chocolate pudding (brown); floor tiling and facial cleanser (beige); corrugated plastic and petroleum jelly tinted with oil paint (green); and (dried) plaster of paris and icing (white). Each solid item was in a different random shape formed through the breaking of a 10 cm by 10 cm square of the material. Each non-solid item was in a different random shape designed by the experimenter. In order that these same stimulus items could be used in Experiment 2, all items were designed such that they could be accepted as either accidentally created or the result of an intentional craft-making process (see Figure 1).

Additional apparatus for this study included a small cardboard stage covered in yellow construction paper, and two similarly covered paper plates. Also, four small, stuffed toy monsters, similar in size and shape but differing in color, were used as characters in the story.

Procedure

The task was introduced as a game, the purpose of which was to help each of four little monsters find what he was seeking. The participants were informed that they were going to hear a story about the monsters making crafts for their monster-moms and that, following the story, the participants would be asked to help each of the monsters. It was explained that the monsters spoke a different language than did the participants, and that the participants would be hearing some monster words. The experimenter explained that the participants would be asked to choose one of two items in response to each monster's request. Adults were asked to record their choices on a provided answer sheet; children were asked to point to their choices.

Participants were presented with four trials. In an individual trial the participant was introduced to one of the monsters and told what he was seeking (e.g., "Here's Vince. Vince is looking for ____ dax"). Participants in the count noun condition heard the novel word presented as a count noun (e.g., "a dax") while participants in the mass noun condition heard the novel word presented as a mass noun (e.g., "some dax"). The experimenter then repeated the novel word twice; in the first repetition the syntactic information was altered slightly (i.e., a second form class cue was provided) and in the second the information was identical to the original. For example, in the count noun condition the experimenter said "I don't know what daxes are, so listen to Vince's story and see if you can help him find a dax"; in the mass noun condition the experimenter said "I don't know what dax is, so listen to Vince's story and see if you can help him find some dax."

All participants were then shown one of the items ("When Vince was making crafts he had this") and given perceptual information about its solidity or nonsolidity (i.e., if the material was solid, the experimenter tapped it against a hard surface; if the material was nonsolid, the experimenter stuck her finger in it and showed it to the participant). The experimenter then placed the item on the left-hand plate on the table in front of the participant(s). Then, the experimenter showed the second item to the participants ("And Vince had this") and demonstrated its solidity or nonsolidity in the manner described above. The second item was placed on the right-hand plate in front of the participants. The participants were then asked to help the monster, and the monster told the participants what he was seeking (e.g., "I am looking for the plate that has a/some dax on it"). The experimenter repeated the monster's request and rephrased it in the form of a question such that the novel word was repeated twice and a third cue to form class was provided. For example, in the count noun condition the experimenter said "Vince is looking for the plate that has a dax on it. Can you show him the plate that has one dax on it?"; in the mass noun condition the experimenter said "Vince is looking for the plate that has some dax on it. Can you show him the plate that has a bit of dax on it?" Adult participants recorded their choice on the answer form; child participants pointed to the item of their choice and the selection was recorded by either the experimenter or an observer. On the final trial, adult participants were asked to write a brief explanation for their choice, and child participants were asked to express what made one item different from the other.

Each novel word was invariably assigned to a stimulus pair. The novel words were as follows: dax (brown), lif (beige), zav (green), and fep (white). The side of presentation of the solid and nonsolid was counterbalanced across trials for each participant. The order of presentation of the stimulus pairs was counterbalanced across participants (at each level of Syntax within each level of Age).

Results and Discussion

The mean percentage of solid choices was the focus of the first set of analyses. Based on the findings of Brown (1957), I predicted that there would be more solid choices in the Count Noun than in the Mass Noun conditions, for both adults and children. The mean percentages of solid choices are shown in Figure 2. These means were submitted to a 2 (Syntax: Count Noun, Mass Noun) by 2 (Age: Adult, Child) between-subjects ANOVA. As predicted, there was a main effect of Syntax, F (1, 60) = 32.6, $p < .001$, indicating more solid choices in the Count Noun conditions than in the Mass Noun conditions. There was no main effect of Age, indicating that the percentage of solid choices did not differ between adults and children.

However, the ANOVA revealed a significant interaction between Age and Syntax, F (1, 60) = 5.5, $p < .05$. This interaction reflected differences in the strength of the Syntax effect at the two levels of Age. Tests of simple effects showed there was a significant effect of Syntax for both the Adults and the Children (i.e., both Adults and Children were more likely to choose the solid item as the referent of a count noun than as the referent of a mass noun), but the effect was less pronounced for the Children, F (1, 60) = 5.7, $p < .05$, than for the Adults, F (1, 60) = 32.5, $p < .001$.

In order to explore the observed Syntax effect further and, specifically, to determine whether participants were demonstrating clear preferences for the solid items in the Count Noun condition and for the nonsolid items in the Mass Noun condition (i.e., in line with the Construal Biases), I used t-tests to compare the mean percentage of solid choices to levels expected by chance (i.e., 50%) within each of the four conditions (Adults – Count Noun, Adults – Mass Noun, Children – Count Noun, Children – Mass Noun). For the Adults, the mean percentage of solid choices was above chance in the Count Noun condition, t (15) = 5.1, $p < .001$, and below chance in the Mass Noun condition, t (15) = -3.1, $p < .01$. These results indicate that adults demonstrated a clear preference for solids as the referents of count nouns and for nonsolids as the referents of mass nouns. For the children, the percentage of solid choices was above 50% in the Count Noun condition, but not significantly, t (15) = 1.1, p = .289; it was below chance in the Mass Noun condition, t (15) = -2.3, $p < .05$. These results indicate that children demonstrated a clear preference for neither the solids nor the nonsolids as the referents of count nouns, but demonstrated a clear preference for the nonsolids as the referents of mass nouns.

To expand the examination of participants' preferences, in my second set of analyses I examined participants' choice patterns across the four trials. Participants were considered to have demonstrated a solid choice pattern if they chose the solid item three or four times (out of four). It was predicted that there would be more participants demonstrating solid choice patterns in the Count Noun condition than in the Mass Noun condition. Figure 3 shows the number of participants classified as demonstrating solid choice patterns in each Age and Syntax condition. These numbers illustrate the consistency (or inconsistency) of the individual participants' selections across the four trials. Chi-square analyses were performed, separately for Adults and Children, on the numbers of solid choice patterns. For Adults, the number of solid choice patterns was significantly higher in the Count Noun condition than in the Mass Noun condition, χ^2 (1, $\underline{N}$=32) =15.2, $\underline{p} < .001$. For Children, there was no difference between the Count Noun and Mass Noun conditions in number of solid choice patterns, χ^2 (1, $\underline{N}$=32) = 1.4, $\underline{p}$ = .238. These results show that the within-participant choice patterns are consistent with the Age by Syntax interaction revealed in the first set of analyses; that is, the effect of Syntax was not as pronounced for the children as it was for the adults.

Taken together, the results suggest that both adults and children tended to choose solid entities (over nonsolid entities) more frequently as the referents of count nouns than as the referents of mass nouns. The effect of the novel word's form class was more pronounced for the adults than it was for the children. These findings support my hypothesis that children (and adults) can use information about a novel word's form class (e.g., "a" as a clue to count noun status; "some" as a cue to mass noun status), to help them select the referent of a novel word presented in a nonostensive context. Thus, the results of this study replicate Brown's (1957) classic finding that preschoolers exploited form class information in nonostensive contexts of word learning. In addition, the current results extend Brown's pattern of findings (i.e., count nouns mapped to solid entities, mass nouns mapped to nonsolid entities) to adults.

Importantly, like Brown's (1957) study, the current modified replication provides support for the notion of Construal Biases; in the absence of any clarifying information, solid entities are more likely to be construed as objects (i.e., chosen as the referents of count nouns, or object category labels) than are nonsolid entities, which are more likely to be construed as materials (i.e., chosen as the referents of mass nouns, or material category labels). In this way, the current study can be seen as providing evidence from a nonostensive word learning context of the solid-object and nonsolid-material construal patterns previously demonstrated by children in ostensive word learning scenarios (e.g., Imai & Gentner, 1997; Lavin & Hall, 1999; McPherson, 1991; Soja, 1992; Soja, et al., 1991).

As I hypothesized, both preschoolers and adults appear to use information about a novel word's form class (e.g., cues to the word's status as a count noun or a mass noun), in conjunction with their biases to construe solids as objects and nonsolids as materials, to help them choose the referent of a novel word presented in a nonostensive context. Nonetheless, it is important to note that children appear to use form class information less consistently than do adults; children demonstrated an effect of Syntax that was less pronounced than that demonstrated by the adults. Why did adults demonstrate a clearer differentiation between count nouns and mass nouns than did children?

A possible answer to this question is that the adults, in their eagerness to provide the "proper" responses in the context of a rather ambiguous psychological study, noted the repetitive nature of the task (i.e., it was a within-subjects design) and devised a rule for responding based on the two types of information that were consistently emphasized across trials: the syntax of the novel word, and the solidity and nonsolidity of the novel items. The children, on the other hand, accepting the disambiguation task as a game, may have been less likely to notice the repetition and, consequently, approached each trial as a unique problem to solve, perhaps basing their choices on different factors each time (e.g., solidity/nonsolidity, shape, texture). An important implication of this interpretation of the differences between adults and children in their response patterns is the inadequacy of solidity/nonsolidity information, in and of itself, in guiding either adults or children to choose the referent of novel count nouns and mass nouns in nonostensive contexts. Children were relatively inconsistent in their use of solidity/nonsolidity information and adults may have evidenced greater consistency simply through a reliance on the repetition of solidity/nonsolidity information across trials, and not by a consistent reliance on the information itself.

If this possibility is correct, then a further conclusion to be drawn is that, in nonostensive contexts of word learning, both children and adults require information other than, or perhaps in addition to, information about the solidity/nonsolidity of the potential referents, in order to demonstrate consistency in their mappings of novel count nouns and mass nouns. It may be the case that information about solidity/nonsolidity serves as only one of several types of cues to some underlying determinant of whether an entity is construed as an object or a material and, subsequently, labeled with a count noun or a mass noun, respectively. As described earlier, one conceptualization of this underlying determinant is the notion of perceived arbitrariness of structure; an entity whose structure is perceived to be nonarbitrary is construed as an object (i.e., labeled with a count noun), while an entity whose structure is perceived to be arbitrary is construed as a material (i.e., labeled with a mass noun). It is possible that, on some trials, the participants in the current study based their perceptions of the arbitrariness of the structures of the stimulus items on information other than the solidity/nonsolidity of the items (e.g., shape).

In an attempt to test the validity of the preceding hypothesis, in the second study I added to the solidity/nonsolidity information provided in the first experiment. I included and systematically manipulated a second, previously studied (e.g., Gelman & Bloom, 2000) cue to arbitrariness of structure: information about the intentional or accidental processes that led to a structure's creation. I then monitored the interaction of these two cues in their effects on participants' mapping of novel count nouns and mass nouns to the stimulus items.

Experiment 2

Method

Participants

Participants in this study were 64 adults (age range: 17-45 years) and 64 preschoolers (age range: 53-70 months). Twelve additional adults were tested and then excluded from the analyses; three on the basis of experimental error, and nine others based on a criterion of first-language English proficiency (see Experiment 1). Sixteen additional children were tested and then excluded; three based on experimental error, eight on the basis of the first-language English criterion, and five others based on incorrect responses to a control question (see below). All participants were drawn from the same population as the participants in Experiment 1 and compensated in the same manners (i.e., course credit or money for the adults; stickers or Play-do for the children). Adults and children were randomly assigned to one of two Syntax conditions (Count Noun, Mass Noun), such that there were 32 adults and 32 children in each group. Within each Syntax condition, 16 adults and 16 children were assigned to each of two Cue conditions: Convergent, Divergent. As in Experiment 1, adults were tested either individually or in small groups (2-4 participants), and children were tested individually.

Stimuli

The four solid-nonsolid pairs used in Experiment 1 were used in the second study as the "end products." As stated in the description of Experiment 1, all end products were designed such that they could be accepted as either accidentally created or as the result of an intentional craft-making process. In addition to these four solid-nonsolid pairs, for each material (solid as well as non-solid) there was an original, or "raw exemplar." For the solids, the four raw exemplars were squares, 10 cm by 10 cm and 1 cm or under in height (varied with material). The four non-solid raw exemplars were single round globs, approximately 5 cm in diameter and 5 mm in height, formed on 10 cm by 10 cm squares of waxed paper.

Additional apparatus was identical to that used in Experiment 1.

Procedure

The procedure was the same as that of Experiment 1, with the exception of the following modifications that were applied to both Syntax conditions (i.e., Count Noun; Mass Noun).

In Experiment 1, after they were asked to listen to the monster's story in order to help him find what he was looking for, participants were immediately presented with one of the solid-nonsolid pairs of stimulus items. In Experiment 2, these pairs served as the end products of a craft-making process, so participants did not see them until the end of each trial. Participants were now first shown one of the raw exemplars ("When Vince was making crafts he had this") and given perceptual information about its solidity or nonsolidity (i.e., if the exemplar was solid, the experimenter tapped it against a hard surface; if the exemplar was nonsolid, the experimenter stuck her finger in it and showed it to the participant). The experimenter then explained that the raw exemplar was either manipulated intentionally – "Vince took this and worked on it very carefully" – or involved in an accident – "By mistake, Vince dropped this on the floor." In the Convergent Cue condition, solids were described as "worked on very carefully" while nonsolids were described as "dropped by mistake." Conversely, in the Divergent Cue condition, solids were described as "dropped by mistake" while nonsolids were described as "worked on very carefully."

In both the Convergent and Divergent Cue conditions, to make the intentional/accident information more salient, the experimenter mimed the sequence of events using the stuffed monster and the stage; the raw exemplar was presented on top of the stage and then brought behind the stage (out of the participant's view) to be manipulated or dropped by the monster. Further information about the intentional or accidental circumstances surrounding the creation of the end product was given in the form of the monster's verbal reaction to the events: "When he finished, Vince said 'There!'" (intentional) versus "When this happened, Vince said 'Oops!'" (accidental). Next, the experimenter said "Then it looked like this" and brought the end product from behind the stage and placed it on the plate on the participant's left. The experimenter then re-stated the intention/accident information: (pointing to the end product) "See this? Vince worked on it very carefully (intentional)/ dropped it by mistake (accidental), and it looked like this."

Then, the experimenter presented the other raw exemplar and the associated end product to the participant such that the circumstances surrounding the product's creation were opposite to those involving the first member of the pair (i.e., if the first item had been described as "worked on very carefully" the second was described as "dropped by mistake"). The second end product was placed on the plate on the participant's right. Once both end products had been presented, the experimenter again repeated the intentional/accidental status of each one: "Now remember, Vince worked on this very carefully (intentional)/ dropped this by mistake (accidental), and it looked like this."

The experiment ended with the same forced-choice task that ended Experiment 1. The final change from Experiment 1 was that, on the final trial, instead of being asked to indicate a difference between the two items, children were asked to indicate which of the items had been made by mistake. The purpose of this question was to assess whether the child had attended to, and had understood, the story. Data obtained from children who gave incorrect responses to this question were excluded from the analyses.

The remaining three pairs of stimuli were presented in the manner just described. The pairing of intention/accident and solidity/nonsolidity information remained constant across trials for each participant but was counterbalanced across participants at each level of Syntax within each level of Age. All other counterbalancing was the same as in Experiment 1.

Results and Discussion

The Perceived Arbitrariness of Structure account of word learning (Burger & Prasada, 1997; Prasada, 1999; Prasada, et al., 2000) contends that properties of an entity, such as its solidity (as opposed to its nonsolidity) and the intention (as opposed to the accident) that led to its creation serve as cues to perceive that entity's structure as nonarbitrary (as opposed to arbitrary). According to this account, an entity whose structure is perceived to be nonarbitrary is construed as an object and, consequently, labeled with a count noun; an entity whose structure is perceived to be arbitrary is construed as a material and, consequently, labeled with a mass noun. Based on this account of word learning, I predicted that the effect of Syntax (i.e., differences in the mean percentage of solid choices in the Count Noun condition as compared to the Mass Noun condition) would differ depending on whether the two sets of cues (i.e., solidity/nonsolidity, intention/accident) converged or diverged. Specifically, I predicted that in the Convergent Cue condition (i.e., solid items created intentionally; nonsolid items created accidentally) the Syntax effect would be similar to that obtained in Experiment 1; that is, participants would tend to choose the solid (intentional) items as the referents of count nouns (Count Noun condition) and the nonsolid (accidental) items as the referents of mass nouns (Mass Noun condition). Predictions for the Divergent

Cue condition (i.e., solid items created accidentally; nonsolid items created intentionally) were the converse; I anticipated that the solidity/nonsolidity cues would be overridden such that participants would tend to choose the intentional (nonsolid) items as the referents of count nouns and the accidental (solid) items as the referents of mass nouns.

As in Experiment 1, the first set of analyses focused on the mean percentage of solid choices. The percentages for each condition of Syntax within levels of Age are shown in Figure 4, for the Convergent Cue condition, and Figure 5, for The Divergent Cue condition. These numbers were submitted to a 2 (Age: Adult, Child) by 2 (Syntax: Count Noun, Mass Noun) by 2 (Cue: Convergent, Divergent) between-subjects ANOVA. As in Experiment 1, there was a main effect of Syntax, $F(1, 120) = 7.6$, $p < .01$, indicating more solid choices in the Count Noun than in the Mass Noun condition. There was also a main effect of Cue, $F(1, 120) = 7.0$, $p < .01$, indicating more solid choices in the Convergent than in the Divergent Cue condition; participants were more likely to choose the solid as the novel word's referent when the solid item was made intentionally than when it was made accidentally. There was no main effect of Age, $F(1, 120) = 2.3$, $p = .134$. Further, none of the interactions involving Age were significant. These nonsignificant results are interesting because they signify the absence of the Age by Syntax effect that was present in Experiment 1; in this second study, children and adults display similar patterns of mapping novel words to novel items.

There was a significant interaction between Syntax and Cue, $F(1, 120) = 14.2$, $p < .001$, indicating that, as I predicted, the effect of Syntax was different in the Convergent Cue than in the Divergent Cue condition. Simple main effects analyses revealed a significant Syntax effect in the Convergent Cue condition, $F(1, 120) = 21.3$, $p < .001$, indicating, again as I predicted, and as in Experiment 1, more solid choices in the Count Noun condition than in the Mass Noun condition; participants were more likely to choose the solid (intentional) item as the referent of a count noun than as the referent of a mass noun. In contrast, simple main effects analyses revealed no significant effect of Syntax in the Divergent Cue condition, $F(1, 120) = .50$, $p = .48$, indicating that the percentage of solid choices was equivalent in the

Count Noun and Mass Noun conditions; participants were not more likely to choose the solid (accidental) item as the referent of a mass noun than as the referent of a count noun. Although the results of the Divergent Cue condition did not indicate a complete reversal of the Syntax effect observed in both Experiment 1 and in the current Convergent Cue condition, these findings were, nonetheless, in line with my predictions in that they demonstrated a significant attenuation of this effect.

Although I found no Age effects (discussed above), I maintained an interest in examining the responses of the children separately from those of the adults in order to gain a clearer understanding of the mapping patterns each population displayed. To this end, I broke down the analyses further, by Age, and examined the interaction of Syntax and Cue separately for Adults and Children. For Adults in the Convergent Cue condition, there was a significant effect of Syntax, F (1, 120) = 22.4, $p < .001$, indicating more solid choices in the Count Noun condition than in the Mass Noun condition; there was no effect of Syntax for Adults in the Divergent Cue condition, F (1, 120) = .39, $p = .53$. Similarly, Children demonstrated a Syntax effect in the Convergent Cue condition, F (1, 120) = 4.04, $p < .05$, but not in the Divergent Cue condition, F (1, 120) = .14, $p = .71$. Again, unlike in Experiment 1, children and adults displayed similar patterns of mapping count nouns and mass nouns to solids and nonsolids both when the Perceived Arbitrariness of Structure cues converged (solid intentional; nonsolid accidental) and when the cues diverged (solid accidental; nonsolid intentional).

In order to explore further the interaction between Syntax and Cue I used t-tests to compare the mean percentage of solid choices to levels expected by chance (i.e., 50%) within each of the eight conditions defined by Age, Syntax, and Cue. My goal in this group of tests was to determine whether participants demonstrated clear preferences for the solid or the nonsolid items as a function of their experimental condition. Specifically, I predicted that participants (both Adults and Children) in the Convergent Cue - Count Noun condition would demonstrate a preference for the solid (intentional) items while those in the

Convergent Cue - Mass Noun condition would demonstrate a preference for the nonsolid (accidental) items. Further, I predicted that participants in the Divergent Cue - Count Noun condition would demonstrate a preference for the nonsolid (intentional) items while participants in the Divergent Cue - Mass Noun condition would demonstrate a preference for the solid (accidental) items.

For Adults in the Convergent Cue condition, the mean percentage of solid choices was above chance in the Count Noun condition, t (15) = 3.2, $p < .01$, and below chance in the Mass Noun condition, t (15) = -3.6, $p < .01$. These results indicate that, as I predicted, Adults demonstrated a clear preference for the solid (intentional) item as the referent of a count noun, and a preference for the nonsolid (accidental) item as the referent of a mass noun. For Children in the Convergent Cue condition, the mean percentage of solid choices was above chance in the Count Noun condition, t (15) = 2.9, $p < .05$, but precisely at chance in the Mass Noun condition, t (15) = .00, p = 1.0. Like Adults, and as I predicted, Children demonstrated a clear preference for the solid (intentional) item as the referent of a count noun. However, unlike Adults, and contrary to my predictions, Children did not demonstrate a clear preference for the nonsolid (accidental) item as the referent of a mass noun; they demonstrated no clear preference for the solid or the nonsolid in the Convergent Cue - Mass Noun condition.

For Adults in the Divergent Cue condition, the mean percentage of solid choices was below chance in the Count Noun condition, t (15) = -2.6, $p < .05$, and below 50%, but not significantly, in the Mass Noun condition, t (15) = -.95, p = .359. In line with my predictions, these results indicate a clear preference, on the part of the Adults, for the nonsolid (intentional) item as the referent of a count noun. Contrary to my predictions, these results indicate that Adults demonstrated no preference for the solid (accidental) item as the referent of a mass noun; Adults demonstrated no clear preference for either the solid or the nonsolid in the Divergent Cue - Mass Noun condition. For Children in the Divergent Cue condition, the mean percentage of solid choices was below 50%, but not significantly, in both the Count Noun, t (15) = -.791, p = .441, and the Mass Noun, t (15) = -.32, p = .757, conditions. These results indicate that unlike adults, and contrary to my predictions, Children demonstrated no clear preference for the nonsolid (intentional) item as the referent of a count noun. These results also indicate that, like Adults, but no less contrary to my predictions, Children demonstrated no clear preference for the solid (accidental) item as the referent of a mass noun. Children demonstrated a clear preference for neither the solid nor the nonsolid in both the Divergent Cue - Count Noun and the Divergent Cue - Mass Noun conditions.

Again as in Experiment 1, in my second set of analyses I examined the participants' choice patterns across the four trials. The purpose of this set of analyses was to determine whether participants were more or less consistent in their choice of the solid items as a function of the experimental condition. Participants were considered to have demonstrated a solid choice pattern if they chose the solid item three or four times (out of four). I predicted that, within the Convergent Cue condition (solid-intentional; nonsolid-accidental), the number of participants (both Adults and Children) demonstrating a solid choice pattern would be greater in the Count Noun condition than in the Mass Noun condition. Conversely, for the Divergent Cue condition (nonsolid-intentional; solid-accidental) I predicted that the number of participants demonstrating a solid choice pattern would be greater in the Mass Noun condition than in the Count Noun condition.

Figure 6, for the Convergent Cue condition, and Figure 7, for the Divergent Cue condition, show the number of participants classified as demonstrating solid choice patterns within each Age group at both levels of Syntax. Chi-square analyses were performed, separately for Adults and Children within each of the Cue conditions, on the numbers of solid choice patterns. For Adults in the Convergent Cue condition, the number of solid choice patterns was significantly higher in the Count Noun condition than in the Mass Noun condition, χ^2 (1, N=32) =15.2, p < .001. Similarly, for Children in the Convergent Cue condition, the number of solid choice patterns was significantly higher in the Count Noun condition than in the Mass Noun condition, χ^2 (1, N=32) = 4.6, p < .05. These results indicate that, as predicted, both Children and Adults in the Convergent Cue condition were more likely to be consistent in their choice of the solid item as the referent of a Count Noun than as the referent of a Mass Noun. In the Divergent Cue condition, the number of solid choice patterns was not significantly different in the Mass Noun condition compared to the Count Noun condition for either Adults, χ^2 (1, $\underline{N}$=32) = 1.6, $\underline{p}$ = .200, or Children, χ^2 (1, $\underline{N}$=32) = .00, $\underline{p}$ = 1.0. These results are contrary to my specific predictions in that they indicate that participants in the Divergent Cue condition were not more likely to demonstrate a consistent pattern of solid choices in the response to a mass noun as opposed to a count noun; participants in the Divergent Cue condition chose the solid with equal consistency in the Count Noun and Mass Noun conditions. Nonetheless, the results are in line with my general prediction that frequencies of solid choice patterns would differ for participants in the Divergent Cue condition compared to those in both the Convergent Cue condition and in Experiment 1.

In summary, these results indicate that participants' patterns of mapping count nouns and mass nouns onto one of two possible referents were influenced by the convergence or divergence of cues to the arbitrariness of the possible referents' structures. Specifically, when the cues converged (i.e., solid entities made intentionally, nonsolid entities made accidentally), both adults and children, like the participants of Experiment 1, chose the solids more often when the novel word was presented as a count noun than when it was presented as a mass noun. Moreover, both adults and children demonstrated a clear preference for selecting solid entities as the referents of count nouns. For children in the count noun condition, this is a more pronounced result than was obtained when only solidity/nonsolidity cues were provided (Experiment 1). In the mass noun condition only adults demonstrated a clear preference for selecting nonsolid entities as the referents. For children in the mass noun condition, this is a less pronounced result than was obtained in Experiment 1; children in the first study did demonstrate a clear preference for selecting nonsolids as the referents of mass nouns.

Despite these differences between children in Experiment 1 and those in the Convergent Cue condition of Experiment 2, it is important to note that the two groups of participants were actually quite similar in regards to the magnitude of the Syntax effects that they demonstrated. For children in Experiment 1, the mean percent solid choices for the Count Noun and Mass Noun conditions differed by 24 (see Figure 2). For children in the Convergent Cue condition of Experiment 2, these percentages differed by 25 (see Figure 4). The primary difference between the two groups, then, is that the children in the Convergent Cue condition of Experiment 2 demonstrated more solid choices, overall, than did the children in Experiment 1. This difference may reflect a general tendency of the children in Experiment 2 to choose the item described as intentionally made (in this case the solid). Nonetheless, both groups of children demonstrated a significant differentiation between Count Nouns and Mass Nouns.

When the cues diverged (i.e., solids made accidentally, nonsolids made intentionally), however, participants did not appear to differentiate between the two Syntax conditions; adults and children chose the solid equally often when the novel word was presented as a count noun and when it was presented as a mass noun. Further, adults, but not children demonstrated a clear preference for selecting the nonsolid entities as the referents of count nouns. The response patterns of these adults in the Divergent Cue - Count Noun condition are the only clear indication of a reversal of the count noun-solid and mass noun-nonsolid mapping patterns observed in the Convergent Cue condition and in Experiment 1. There are, however, several other indications of an <u>attenuation</u> of these mapping patterns: adults in the Divergent Cue - Mass Noun condition did not show a preference for the nonsolid entity as they did in both the Mass Noun condition of Experiment 1 and the Convergent Cue - Mass Noun condition; children in the Divergent Cue - Count Noun condition did not show a preference for the solid entity as they did in the Convergent Cue - Count Noun condition; and children in the Divergent Cue - Mass Noun condition did not show a preference for the nonsolid entity as they did in the Mass Noun condition of Experiment 1. Specifically, this imbalance in the reversal of mapping patterns is indicative of a willingness of both children and adults (adults more than children) to map count nouns onto nonsolids made intentionally, but a relative unwillingness of both groups to map mass nouns onto solids made accidentally. I address this imbalance in more depth in the General Discussion.

In Experiment 2, both children and adults assigned novel count and mass nouns to novel referents in patterns that differed depending on how information about the intentionality or accidentality of a novel entity's structure was paired with the entity's solidity or nonsolidity. When intentionality was paired with solidity and accidentality with nonsolidity, participants chose the solids more often as the referents of count nouns than of mass nouns; when the pairs were intentionality-nonsolidity and accidentality-solidity, participants chose the solids equally often as the referents of both types of nouns. It is important to note that when solidity/nonsolidity information was paired with information about intentionality/accidentality, respectively (Convergent Cue condition), participants demonstrated similar patterns of mappings as those demonstrated by participants presented with solidity/nonsolidity information on its own (i.e., Experiment 1). When solidity/nonsolidity information was, conversely, paired with information about accidentality/intentionality, respectively (Divergent Cue condition), participants demonstrated patterns of mappings that were unlike, and even approaching a reversal of, the mapping patterns demonstrated by participants in Experiment 1.

General Discussion

The main goal of the current set of studies was to identify and explore the types of information children and adults exploit in order to identify the referents of novel words presented to them in nonostensive contexts. Previous investigations (e.g., Brown, 1957) have examined children's use of syntax, or form class information, in nonostensive word-learning and have identified mapping links between count nouns (object category labels) and solid entities on the one hand, and mass nouns (material category labels) on the other. In Experiment 1, I replicated Brown's results and extended his findings to adults. In Experiment

2, I examined the nature of the count noun-solid and mass noun-nonsolid mapping links and found evidence that adults and children can use information about the creation of entities to demonstrate a disruption of these links. There are two main conclusions to be drawn from my findings.

First, the simple fact that I was able to disrupt significantly the count noun-solid and mass noun-nonsolid mapping links by providing participants with additional information about the possible referents provides support for the claim that it cannot be solidity or nonsolidity, in and of itself, that determines how an entity is construed and, consequently, labeled. This finding is in line with the fact addressed by many researchers (e.g., Dickinson, 1988; Samuelson & Smith, 1999; Soja, et al., 1992) that the count noun-solid and mass noun-nonsolid mappings are not consistent across the English language (i.e., "wood" is a mass noun that refers to a solid entity; "lake" is a count noun that refers to a nonsolid entity), and the finding that, when provided with clarifying information (e.g., ostensive labeling of solids with mass nouns), children as young as 4 years old will map count nouns onto nonsolids and mass nouns onto solids (Subramanyam, et al., 1999). Therefore, the current study provides additional evidence against the Construal Biases account of word learning; it is not information about solidity or nonsolidity, in and of itself, that determines a person's construal of an entity as an object or material, respectively, and his or her consequent decision to label that entity with a count noun or a mass noun.

Second, the more complex fact that the disruption was evidenced when the additional information indicated that the structures of the solids were accidental and the structures of the nonsolids were intentional provides support for the notion that solidity/accidentality and nonsolidity/intentionality are pairs of opposing cues to the <u>underlying determinant</u> of an entity's construal in either discrete (i.e., object) or continuous (i.e., material) terms: the perceived nonarbitrariness or arbitrariness of that entity's structure (Burger & Prasada, 1997; Prasada, 1999; Prasada, et al., 2000). Both solid and nonsolid items were more likely to be construed as objects (i.e., labeled with count nouns) when they were described as intentionally created than when they were described as the products of accidents. Not only do these results stand in contradiction to the Construal Biases account of word learning by illustrating a disruption of the mapping between solids and count nouns, but these results also provide support for the Perceived (Non)arbitrariness of Structure account by demonstrating a link (stronger for adults than for children) between count nouns (i.e., object category labels) and entities, both solid and nonsolid, whose structures are described as intentionally created.

However, one striking detail about these results is that they do not demonstrate a strong link between mass nouns (i.e., material category labels) and entities whose structures are described as accidental. It is true that when the nonsolid entity was described as accidentally created adults demonstrated a preference for it as the referent of a mass noun (i.e., a continuous, or material, construal); they did not demonstrate this preference when the nonsolid entity was described as intentionally created. Nonetheless, this tendency to choose the accidental-nonsolid as the referent of a mass noun was not upheld by the children and, what is more, when the solid was described as accidentally created, neither the children nor the adults demonstrated a tendency to choose it as the referent of a mass noun (i.e., to construe it as a material). One might conclude, then, that adults and (to a lesser extent) children were able to construe nonsolid items made intentionally as objects but that they were unable to construe solid items made accidentally as materials. This imbalance in object and material construals is intriguing and might be interpreted in several ways. I propose two possible interpretations.

The first interpretation is that it is easier to add cues that an entity's structure is nonarbitrary than it is to subtract, or override, existing cues to this perception. For example, in the case of the nonsolid made intentionally, the clarifying information (i.e., intentionality) is the only indication that the entity's structure is nonarbitary; however, in the case of the solid made accidentally, solidity is a pre-existing cue to nonarbitrariness that the clarifying information (i.e., accidentality) must override. It is easy, then, to accept the structure of a nonsolid made intentionally as nonarbitrary, but it is difficult to disregard the solidity of a solid entity, even a solid entity that is made by accident, in order to think of its structure as arbitrary. Expressed in different terms, it is easier to think of a portion of nonsolid as an individuated entity (i.e., an object) and label it with a count noun (e.g., "a lake"), than it is to think of a portion of solid as a nonindividuated entity (i.e., a material) and label it with a mass noun (e.g., "some wood"). This interpretation of the observed imbalance described above is supported by evidence that children in experimental settings have difficulty learning words for solid non-individuated entities (e.g., "vinyl," "metal," "plastic") (e.g., Dickinson, 1988), but they are relatively proficient at learning words for nonsolid individuated entities (e.g., "puddle") (Soja, 1992).

An alternate interpretation of the finding that adults and children were unwilling to map mass nouns onto solid entities concerns the particular structures of my solid stimulus items. In previous research, it has been demonstrated that the regularity of an entity's structure can influence whether the entity is labeled with a count noun or a mass noun. Specifically, Prasada and his colleagues found that adults assigned count noun labels to entities whose structures had been judged to be regular, and mass noun labels to entities whose structures had been judged to be irregular (Prasada, et al., 2000). Regularity/irregularity of form, therefore, can be viewed as a third cue to the arbitrariness of an entity's structure (the first two being solidity/nonsolidity and intentionality/accidentality). It is possible, then, that in the current study participants judged the solid stimulus items as being regular in form. If this were the case, for an individual solid item, participants would have had two cues to think of the entity's structure as nonarbitrary (i.e., solidity and regularity of form), but only one cue to think of the structure as arbitrary (i.e., accidentality). As a result, participants may have thought of the solid items as having nonarbitrary structures, construed the items as instances of object categories and, therefore, judged them unsuitable as the referents of the novel mass nouns.

As a means of testing the plausibility of this second interpretation of participants' unwillingness to map mass nouns onto solid items, I am currently conducting a pair of follow-up investigations. In the first study I am obtaining "regularity of form" ratings for all of the stimulus items used in the current set of experiments as well as for a second set of items that I have designed to systematically differ from the original set in regards to regularity of form. Specifically, I am attempting to create a second set of stimuli in which the solid items are judged to be quite irregular in form while the nonsolid items are judged to be quite regular in form. This dichotomized stimulus set will then be used in a second study, a replication of the Divergent Cue conditions (Count Noun and Mass Noun) described above. The main goal of this set of studies will be to examine the role of regularity/irregularity of form as a cue to the nonarbitrariness/arbitrariness of an entity's structure.

Of primary interest in these follow-up studies will be whether the findings support the prediction that, when presented with the additional cue of irregularity of form, participants will be willing to accept an accidentally created solid entity as the referent of a mass noun. If participants do, indeed, demonstrate a pattern of mapping mass nouns onto accidental-solids under these conditions, then the results will be taken as an indication that, in the current study, participants were held back from making these mappings by the regular forms of the original solid items. On the other hand, if, even under these circumstances (i.e., solid-accidental items having irregular forms; nonsolid-intentional items having regular forms), participants do not demonstrate a tendency to choose the solid items as the referents of mass nouns, the results will be taken as support for the first interpretation, discussed above, that solidity is a very strong cue to the nonarbitrariness of an entity's structure; one that is extremely difficult to override.

In conclusion, I return to the whisk-seeking child whose dilemma provided the impetus for this entire investigation. What are the implications of the current findings for him or her? Recall that this child was faced with the ambiguous task of choosing between a metal whisk and a pile of flour as the referent of a novel word. Based on the findings of the current studies, one can predict that, with no additional information provided, this child would be more likely to choose the solid, metal whisk as the referent of "a whisk" (a count noun, or object label) than as the referent of "some flour" (a mass noun, or category label), and that he or she would be likely to select the pile of flour, rather than the metal whisk, as the referent of "some flour." In making such mappings, the child would be exploiting information about the novel word's form class in conjunction with information about the solidity or nonsolidity of the possible referents. It is important to note, however, that the links that the child would demonstrate between object category labels (e.g., "a whisk") and solids (e.g., the whisk) on the one hand, and material category labels (e.g., "some flour") and nonsolids (e.g., the flour) on the other, are not direct; rather, these links are mediated by the child's perception of the metal whisk's structure as nonarbitrary, and his or her perception of the flour pile's structure as arbitrary. The child maps count nouns, or object category labels, onto entities whose structures he or she perceives to be nonarbitrary, and mass nouns, or material category labels, onto entities he or she perceives to arbitrary. Solidity and nonsolidity serve as cues to this nonarbitrariness and arbitrariness, respectively.

The child is able, also, to exploit other cues to a structure's (non)arbitrariness. For example, if this child were told that the flour pile was intentionally created, he or she could override the information provided by the nonsolidity of the flour, view the pile's structure as nonarbitrary and, subsequently, choose the pile of flour as the referent of an object category label (e.g., "a pile," or even "a whisk"). The child accepts intentionality of creation (which cues nonarbitrariness) as a stronger cue than nonsolidity (which cues arbitrariness) to how an entity's structure should be perceived. However, it appears (so far) that the converse is not true; the child does not accept accidentality of creation (which cues arbitrariness) as a stronger cue than solidity (which cues nonarbitrariness). Therefore, even if he or she were told that the structure of the whisk was the result of an accident, the child would still only be equally likely to perceive the whisk's structure as nonarbitrary as he or she would be to perceive it as arbitrary. In fact, in this example, because the regularity of the whisk's structure may, like solidity, also serve as a cue to nonarbitrariness, the child may be more likely to perceive nonarbitrariness. As a result, the child would be unwilling to accept a material category label (e.g., "some metal") for the metal whisk. Further investigation is required to determine what types of additional information the child would need in order to succeed at making this mass noun-solid mapping.

Taken together, the results of the current investigation indicate that children and adults construe a novel entity as either an object or as a material depending on their perception of the entity's structure as either nonarbitrary or arbitrary, respectively. In the absence of additional, clarifying information, the mere solidity or nonsolidity of an entity serves as a default, perceptual cue to children and adults that the entity's structure should be perceived as nonarbitrary or arbitrary, respectively. However, these defaults can be affected, though not completely reversed, when conceptual information about the intention or accident that led to a structure's creation is presented in conflict with the perceptual cue of solidity/nonsolidity. The stronger cue determines a person's understanding of the structure as arbitrary or nonarbitrary, which, in turn, determines his or her construal of the entity as either an object or as a material. Ultimately, it is this construal that determines whether an entity is accepted as the referent of a count noun (i.e., object category label) or of a mass noun (i.e., material category label). The results of this research, therefore, add to the growing body of knowledge about the strategies children use to identify the referents of novel words presented to them in nonostensive, and therefore highly ambiguous, contexts.

Endnotes

[1]Because form class information is conveyed by different words in different languages (e.g., "a" in English is equivalent to "un/une" in French), it is evident that children must learn the syntax-semantics links of their respective languages. It is generally agreed that the learning of these links is an important aspect of the beginnings of language acquisition, but there is ongoing debate as to the exact processes through which this learning takes place. Further discussion of this debate referred to as "the bootstrapping problem" is beyond the scope of the current investigation. See Bloom (1999), Gleitman (1990), Grimshaw (1981), Macnamara (1982), and Pinker (1984, 1992) for a detailed exploration of the issue.

[2] More generally, count nouns refer to categories of individuals and mass nouns refer to categories of non-individuated entities. Thus, words like "idea", and "purpose" are count nouns and words like "advice" and "sadness" are mass nouns. The current investigation, however, will focus on the use of count and mass nouns in reference to physical entities only; therefore, they are narrowly defined here as "object category labels" and "material category labels", respectively.

[3] Viewed as defaults in this way, the Construal Biases can be likened to the Word Meaning Assumptions (e.g., Mutual Exclusivity, Whole Object). For review, see Woodward and Markman (1998).

[4] The term "perceived arbitrariness of structure" requires some qualification. When used in the context of this term, "perceived" is to be interpreted as "understood; apprehended", and "arbitrariness" is to be interpreted as an inclusive noun, describing the associated property of structures that are nonarbitrary, as well as the associated property of structures that are arbitrary. Despite its potential to cause confusion, this term is used in the current discussion because it is the term used in the writings of Prasada and his colleagues to refer to the idea presently under investigation (see Burger & Prasada, 1997; Prasada, 1999; Prasada, Ferenz & Haskell, 2000).

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Figure Captions

<u>Figure 1.</u> Stimulus sets.

<u>Figure 2.</u> Experiment 1: Mean Percent Solid Choices.

<u>Figure 3.</u> Experiment 1: Number of Solid Choice Patterns.

<u>Figure 4.</u> Experiment 2: Mean Percent Solid Choices, Convergent Cue Condition and Divergent Cue Condition.

<u>Figure 5.</u> Experiment 2: Number of Solid Choice Patterns, Convergent Cue Condition and Divergent Cue Condition.

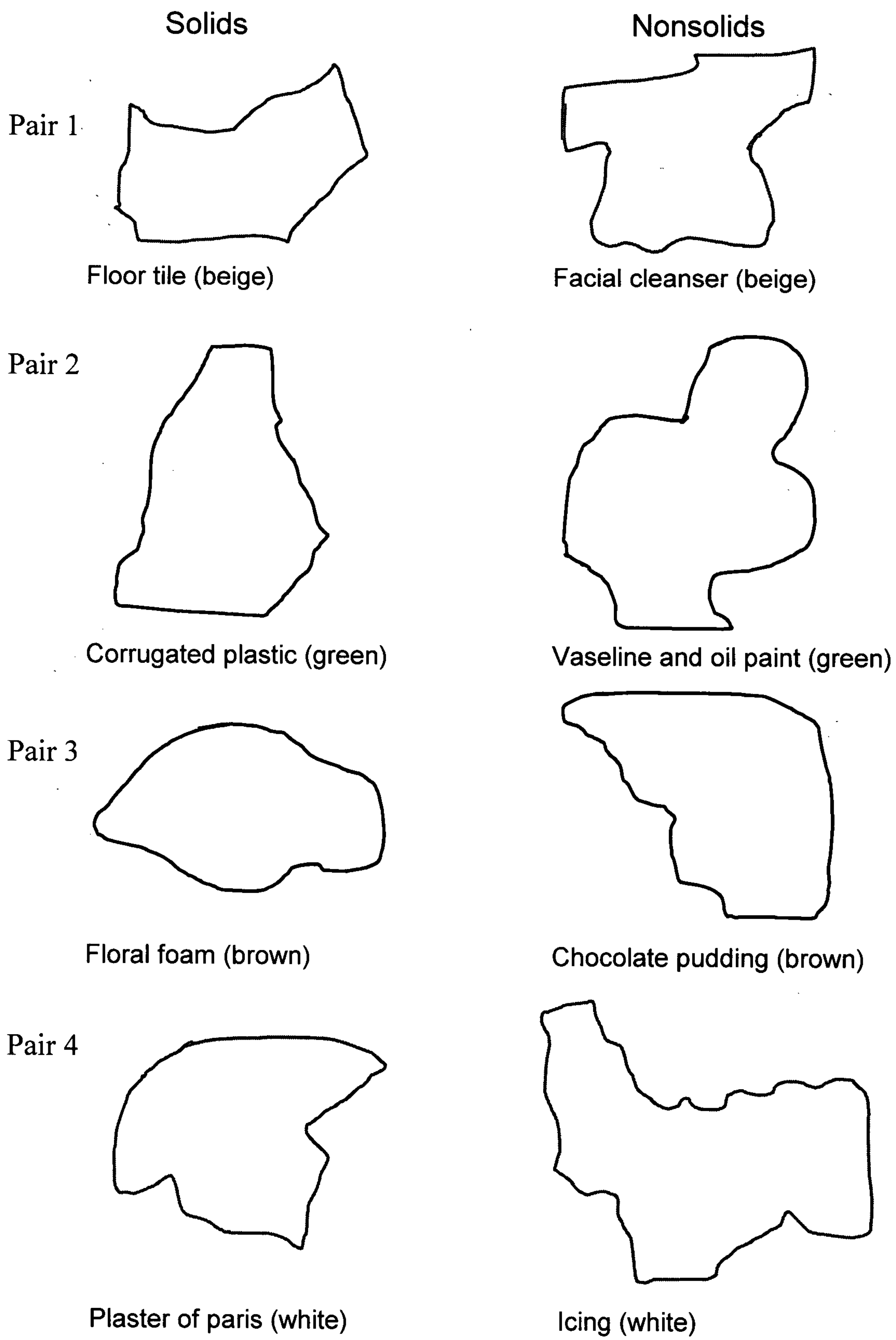

Solids
Nonsolids
Pair 1
Floor tile (beige)
Facial cleanser (beige)
Pair 2
Corrugated plastic (green)
Vaseline and oil paint (green)
Pair 3
Floral foam (brown)
Chocolate pudding (brown)
Pair 4
Plaster of paris (white)
Icing (white)

Figure 1

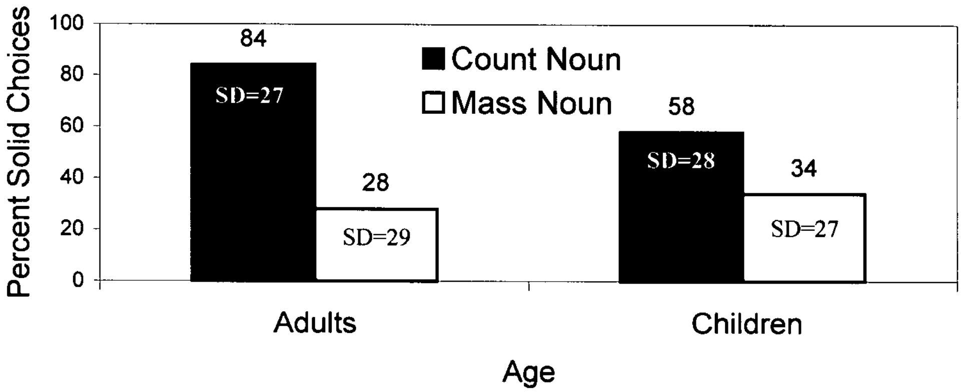
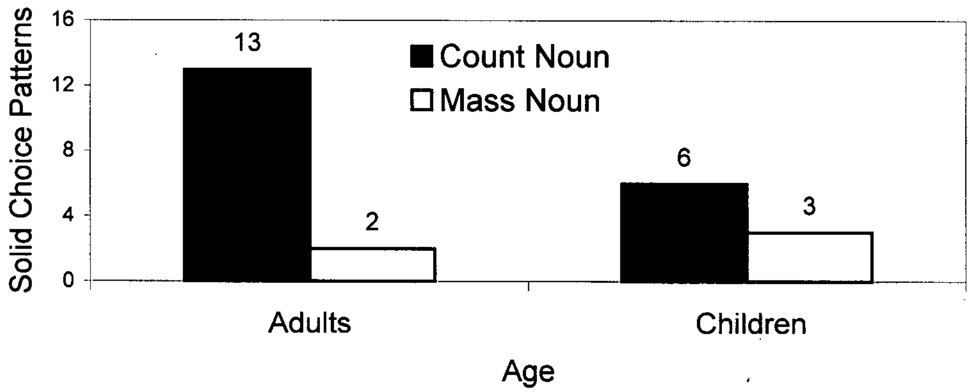

Percent Solid Choices
100
80
60
40
20
0
84
SD=27
28
SD=29
58
SD=28
34
SD=27
Count Noun
Mass Noun
Adults
Children
Age

Figure 2


Solid Choice Patterns
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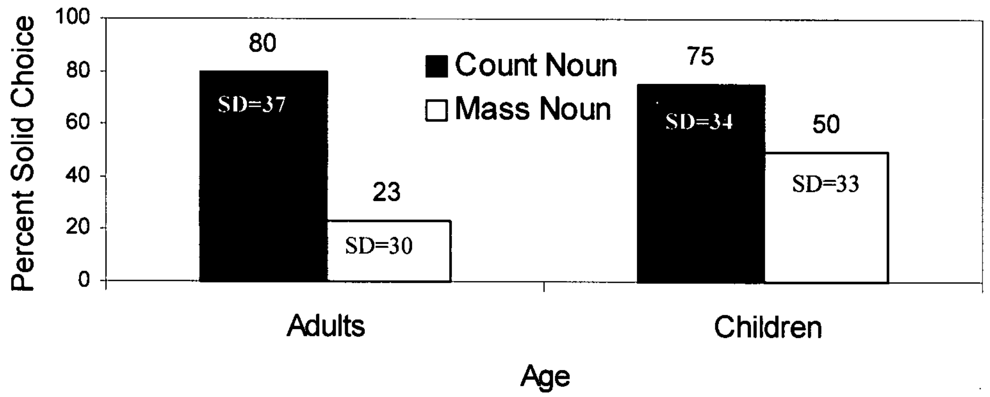
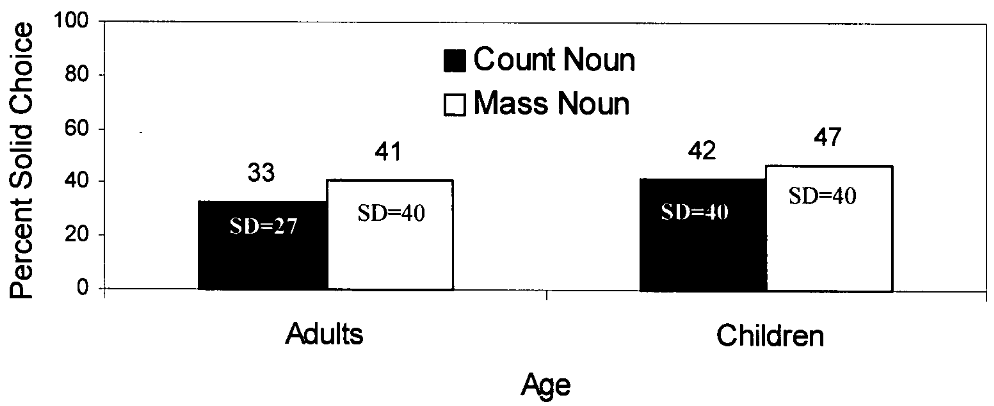
12
8
4
0
13
2
6
3
Count Noun
Mass Noun
Adults
Children
Age

Figure 3

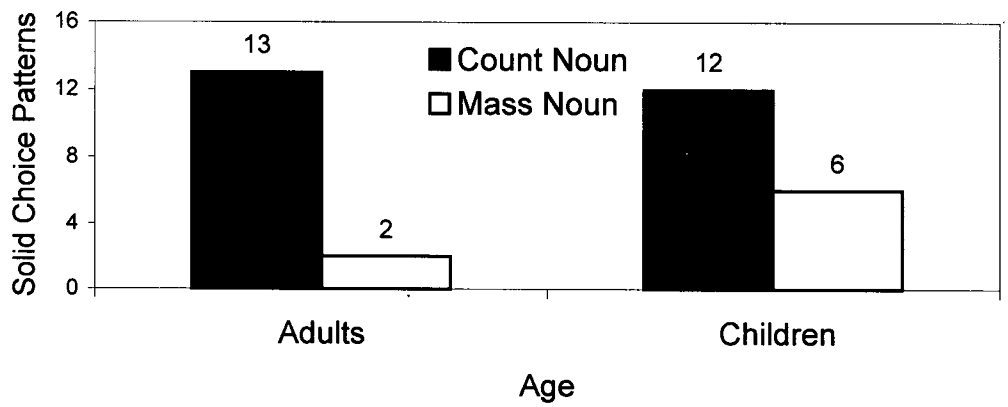


Convergent Cue Condition

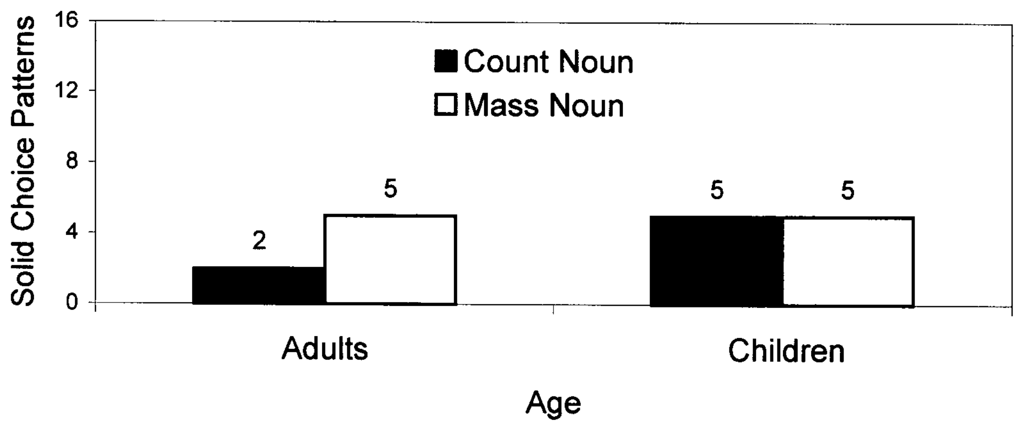


Divergent Cue Condition

Figure 4



Convergent Cue Condition



Divergent Cue Condition

Figure 5