



# When is a path not a path?

## Spatial relationships account for infants' processing of path and manner

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### INTRODUCTION

- Dynamic event components, such as *path* and *manner*, are central to learning relational terms (e.g., verbs and prepositions).
- Path** is the extrinsic movement of one object relative to another (e.g., *running* over a reference object). **Manner** is intrinsic movement delimited by movement of properties relative to the object (e.g., *in running*, legs move relative to the body).
- Adult research suggests that *path* and *manner* are fundamentally spatial and processed in different areas of the brain (Chatterjee, Hirsh-Pasek & Golinkoff, 2006; Wu, Morganti & Chatterjee, 2008).
- Although infants are able to discriminate and categorize both *paths* and *manners*, research suggests that *paths* are more salient than *manners* (Pruden et al., 2004; Pruden, 2006; Pulverman, Golinkoff, Hirsh-Pasek, & Buresh, 2008). For example, Pruden et al. (2004) found that infants form categories of *path* and *manner* by 11 and 14 months of age, respectively.
- Here, we test the linguistic definition of path: If path requires an extrinsic relationship, removing the reference object should disrupt path detection, but should not affect manner detection.

### RESEARCH QUESTIONS

- Can infants form a category of path when the reference object is removed?
- Can infants form a category of manner in the absence of a reference object?
- Is path and manner categorization without a reference object (current study) comparable to path and manner categorization with a reference object (Pruden et al., 2004)?

### METHOD

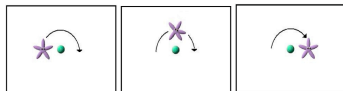
#### Participants

- Path Categorization**
  - 16 infants aged 10 to 12 months (M= 11.35 mo., SD= .87 mo.)
  - 17 infants aged 13 to 15 months (M= 14.11 mo., SD= .85 mo.)
- Manner Categorization**
  - 19 infants aged 10 to 12 months (M= 11.42 mo., SD= .74 mo.)
  - 16 infants aged 13 to 15 months (M= 14.56 mo., SD= 1.05 mo.)
- All participants were raised in monolingual, English-speaking households.

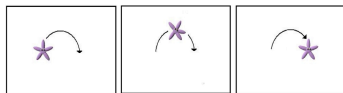
#### Stimuli

- Previous studies of path and manner used an animated starfish, Starry, moving in a variety of *manners* (e.g., spinning) in different *paths* (e.g., over) relative to a reference object "green ball" (e.g., Pruden, 2006; Pulverman et al., 2008).
- The current study used the Starry animations, but removed the ball in the center of the screen to investigate categorization in the absence of a reference object.

Original Starry  
with a reference object  
(see Pruden et al. 2004; Pruden, 2006)

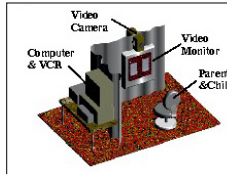


No Ball Starry  
without a reference object



**Figure 1.** Original Starry (see Pruden et al. 2004; Pruden, 2006) stimuli from previous studies and No Ball Starry stimuli for the current study.

### Paradigm and Procedure



#### The Preferential Looking Paradigm:

- The child was seated on their parent's lap watching the video
- Measure: Looking time

**Figure 2.** The Preferential Looking Paradigm (see Hirsh-Pasek & Golinkoff, 1996).

#### Path Categorization

- Familiarization Trials (4 trials):**
  - Starry moved around the center of the screen (without the ball) in the same path (e.g., over) across a variety of manners (e.g., spinning, bending, toe-touching, jumping jacks).
- Test Trials (2 identical trials shown on a split screen):**
  - On one side, Starry moved in the Old Path (over) with a Novel Manner (twist).
  - On the other side of the screen, Starry moved in a Novel Path (under) with the same Novel Manner (twist).
  - The novel paths and manners were counterbalanced for test trials

	Visual Stimuli	Duration
Familiarization (4 trials)	spin over	12 sec. for each trial
	bend over	
	toe-touch over	
	jumping jacks over	
Test Trials (2 identical trials)	twist over	12 sec. for each trial
	twist under	

**Table 1.** Example video sequence for Path Categorization.

#### Manner Categorization

- Familiarization Trials (4 trials):**
  - Starry moves around the center of the screen (without the ball) in the same manner (e.g., spin) across a variety of paths (e.g., over, under, past, in front).
- Test Trials (2 identical trials shown on a split-screen):**
  - On one side, Starry moved in the Old Manner (spin) with a Novel Path (around).
  - On the other side of the screen, Starry moved in a Novel Manner (twist) with the same Novel Path (around).
  - The novel paths and manners were counterbalanced for test trials

	Visual Stimuli	Duration
Familiarization (4 trials)	spin over	12 sec. for each trial
	spin under	
	spin past	
	spin in front	
Test Trials (2 identical trials)	spin around	12 sec. for each trial
	twist around	

**Table 2.** Example video sequence for Manner Categorization.

#### Coding:

- Offline coding of gaze duration
- DV: Proportion of looking time toward the left and right sides on split-screen, IV: Age
- Chance = 50%, reliability between coders (for looking time) = .994

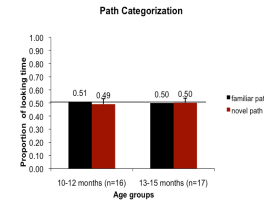
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### RESULTS

#### Can infants form a category of path when the reference object is removed? NO!

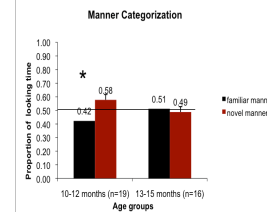
- Both 10- to 12- and 13- to 15-month-old infants looked similarly to *old* and *novel* paths in test trials ( $ps > .05$ ).
- Thus, neither age group formed a category of *path*, confirming the logic that attention to path was disrupted when the ground object was removed.



**Figure 3.** Proportion of looking time to *familiar* path and *novel* path by 10- to 12- and 13- to 15-month-olds

#### Can infants form a category of manner in the absence of a reference object? MIXED!

- 10- to 12-month-old infants looked longer toward the *novel* manner at test ( $p = .044$ ). In contrast, 13- to 15-month-olds looked similarly to *old* and *novel* manners in test trials ( $p > .05$ ).
- Thus, manner categorization was enhanced in the absence of reference object: 10- to 12-month-olds can form a category of *manner*.



**Figure 4.** Proportion of looking time to *familiar* manner and *novel* manner by 10- to 12- and 13- to 15-month-olds

#### Is path and manner categorization without a reference object (current study) comparable to path and manner categorization with a reference object (Pruden et al., 2004)? MIXED!

- Comparisons of **path** change is *different*: Infants form a category of path at both age groups when the reference object is present in Pruden et al. (2004) study
- Comparisons of **manner** change: Although infants formed a category of manner at an earlier age in the absence of a reference object (10-12 months), the trend of manner categorization is similar across studies (Pruden et al., 2004).

### DISCUSSION

- Discrimination and categorization of paths and manners provide foundation for learning verbs and prepositions in one's native language. Research suggests infants can discriminate (Pulverman et al., 2008) and categorize these elements (Pruden, 2006). We can now begin to ask what elements are necessary for **path** and **manner** relations.
- This study indicates that **path** categorization disappears without the presence of a reference object. In contrast, removing the reference object heightens **manner** categorization.
- As Talmy (1985) suggested the processing of paths is dependent upon an extrinsic spatial relationship between two objects and that manner is reliant on intrinsic properties of the agent (Chatterjee, Hirsh-Pasek, & Golinkoff, 2006).