Infants’ Integration of Information from Different Sources in Object Segregation

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The present research investigated 9.5-month-old infants’ use of spatial and featural information when determining the locations of object boundaries. Infants were shown displays for which spatial information (the relative positions of the boxes) and featural information (the colours and patterns of the boxes) led to either the same or different interpretations of the display. Infants’ interpretations of the displays were assessed by measuring their looking time at an event in which a screen passed either between or behind the objects. The results indicated that when the spatial information provided a clear interpretation of the display, infants used this interpretation even when featural information conflicted. In contrast, featural information was only used to interpret the display when spatial information did not allow a clear interpretation (1997a). These results are similar to those of Needham and Baillargeon in their indication that infants use multiple sources of information to segregate displays and that their strategies for determining which information to use are sensitive to characteristics of each source of information such as its likelihood of providing a veridical interpretation of a display.

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Consider a situation faced by an infant as she visits the home of another infant for the first time. Soon after they arrive, her father places her in front of her new friend’s toy box where she is confronted with a collection of unfamiliar toys. Delighted as she may be by this sight, the tangle of brightly coloured shapes presents a number of challenges to her perceptual and cognitive systems. One task that could be quite difficult is segregating the jumble of surfaces into units that correspond to objects in the toy box, a process we will refer to as object segregation. A long, multicoloured snake (itself composed of different coloured and patterned segments that could be separate or connected) is partially hidden by a teddy bear: she pulls one segment of the snake and observes that all of its segments come along, but the bear does not move. Two bright red foam blocks are arranged in depth and might or might not be connected: she pulls out the closer block and finds that the back block does not come along. A white truck has large wheels which are each a...
different colour: she grabs one wheel and finds that the rest of the wheels and the truck body come as well.

As this example demonstrates, an object part’s motion is a more accurate indicator of which unit it belongs to than its shape, colour or pattern (for demonstrations and discussions of infants’ use of motion in object segregation, see Kellman, 1993, 1996; Kellman et al., 1987; Kellman and Spelke, 1983; Kellman et al., 1986; Spelke et al., 1989). Although exploration such as that described above clearly leads to learning about the relation between surface features and boundaries of objects (as she notes the similarities and dissimilarities of the surfaces and which surfaces move as a single object when she pulls and which do not), one might ask how infants come to form veridical interpretations of such complex displays in a predictive rather than a post hoc manner. Being able to predict which surfaces belong together as a single unit and which do not before they are moved must depend on analysing information in the display such as spatial information based on the relative positions of the objects in space, or featural information based on the shapes, colours and patterns of the objects. Analysing and interpreting this information must depend on the observer’s knowledge about the visual information, such as the knowledge that spatially distinct surfaces belong to separate objects (for interpreting spatial information) or the knowledge that object boundaries are likely to be located where there are abrupt changes in surface features (for interpreting featural information) (see Needham et al., in press, for a detailed version of this claim). The present research investigates infants’ use of spatial and featural information when predicting the locations of object boundaries.

The segregation of surfaces into objects is one of the most important and intriguing tasks of visual perception. Whether infants segment object displays in the same way as adults do has been a question of considerable interest even before there were sensitive methods for studying this ability in infants. For example, Piaget (1954) observed his son Laurent (at 6 months 22 days) reaching for an object (e.g., a matchbox, eraser, penknife or goblet) that was resting on a support (i.e., a book). Piaget noted that Laurent seemed to reach for the object (an indication that he saw it as separate from its support) only when it was moving across the surface of the support or when it protruded quite noticeably from the support (i.e., a book). Piaget believed that Laurent’s failure to reach for a small stationary object on a support, which occurred until about 10 months of age, was a consequence of his perception of the object and its support as a single unit.

Whether infants perceive adjacent and partly occluded objects in an adult-like fashion is a question that has motivated extensive research over the past 15 years or so, primarily by Spelke, Kellman and their colleagues (for reviews, see Kellman, 1993, 1996; Spelke, 1990; Spelke and Van de Walle, 1993). This area has seen a resurgence of interest in recent years (Craton, 1996; Johnson, 1997; Needham, in press; Needham et al., in press). These experiments have investigated infants’ ability to segregate two adjacent objects or to group together the visible portions of a partly occluded object using a number of kinds of information that could be grouped into the following categories: physical information, regarding the relations between surfaces; featural information, such as the colours, patterns and shapes of surfaces; and experiential information, in which an object’s boundaries are known as a result of our prior experiences with that object or that kind of object.

This body of research has supported the conclusion that infants can use physical, featural and experiential information to find object boundaries. Specifically, studies have shown that infants can use many kinds of physical information to determine whether surfaces belong as part of the same unit: the motions of the surfaces (Johnson and Aslin, 1995; Kellman and Spelke, 1983; Kellman et al., 1986, 1987; Slater et al., 1990; Spelke et al., 1989), the spatial layout of the surfaces (Kestenbaum et al., 1987; Spelke et al., 1989) and the apparent support or solidity relations between the surfaces (Craton, 1994; Needham and Baillargeon, 1997a). Evidence for infants’ use of featural information (such as the shape, colour and pattern of surfaces) as indications of object boundaries has also been found (Craton, 1996; Needham, in press; Needham et al., in press; Needham and Baillargeon, 1997a). Finally, infants’ use of prior experiences with objects to find object boundaries has been reported by Schwartz (1982) and Needham and Baillargeon (in press).

Researchers have also investigated infants’ segregation of displays that would be interpreted differently depending on which of two sources of information was used to interpret the display (Kellman and Spelke, 1983; Needham and
A question addressed in these studies is how infants determine which kind of information to base their interpretation on when multiple cues could be used to interpret the display.

For example, Needham and Baillargeon (1997a) showed in two studies that 8-month-old infants would use featural information to form an interpretation of a display consisting of two adjacent objects when the object features were the only information available. However, when physical information was also present (in these studies, the physical information concerned the solid connection between the objects or the support relations between the objects), the infants used the physical, rather than the featural information, to interpret the display.

The research described above has demonstrated that infants use featural and physical information to determine whether the portions of a fully visible display are connected and that interpretations based on physical information are given precedence over interpretations based on featural information. The present research investigates whether infants would follow similar strategies to come to similar conclusions about displays in which the point of connection between the two portions of the display was hidden.

Two specific questions were addressed. First, would infants make use of the spatial layout of the display to determine whether there was a connection between the two parts of the display? To address this question, infants' responses to two displays that were identical except for the spatial layout were compared. Secondly, would infants use the colour and pattern of the display to determine whether there was a connection between the two parts of the display? To address this question, infants' responses to two displays that were identical except for colour and pattern were compared. More generally, the research addressed how infants would integrate information from two different sources (spatial and featural) when both were available.

The displays (shown in Figures 1–3) consisted of two rectangular boxes, one in front of the other, with the right side of the back box visible to the right of the front box from the infant's perspective. Each infant was shown one of three displays: the Similar-parallel, Similar-angled, or Dissimilar-angled display. The Similar-parallel and the Similar-angled displays differed only in spatial layout, and the Similar-angled and the Dissimilar-angled displays differed only in colour and pattern.

Because the boxes could have been connected behind the front box in each of the three displays,

Figure 1. Schematic diagram of the Screen-between and Screen-behind test events, shown with the Similar-parallel display. In the Similar-parallel display, the back box is parallel to the front box and is the same colour and pattern as the front box.
the essence of the infants’ task was to determine whether the two boxes were likely to be connected. To determine whether the infants had segregated the display into a single unit or two separate units, each infant was shown one of two test events.

In the test events, the infants saw a large, thin screen slide across the apparatus floor. In the Screen-between event, the screen moved between the two boxes; in the Screen-behind event, the screen moved behind the two boxes. Unlike previous research from our lab, the boxes remained stationary throughout both events. By
responding to the movement of the screen, the infants were indirectly providing a judgement about the connection between the boxes. Our rationale was that, if the infants posited a connection between the boxes, they would not expect the screen to be able to travel through this connection (this logic is based on extensive findings regarding infants’ knowledge of the impenetrability of objects, Baillargeon, 1987, 1991; Baillargeon and DeVos, 1991; Spelke et al., 1992). Because violating infants’ expectations is typically associated with lengthened looking on their part (Bornstein, 1985; Spelke, 1985), we predicted that the infants would look reliably longer at the Screen-between than at the Screen-behind event if they had posited a connection between the boxes. In contrast, if the infants saw the boxes as comprising two separate units, they would presumably look about equally at the Screen-between and the Screen-behind events.

METHOD

Subjects

Subjects were 72 infants (38 male, 34 female) ranging in age from 8 months 21 days to 10 months 28 days (M = 9 months, 22 days). Each infant saw one of the three displays. Of the infants who saw the Similar-parallel display, half saw the Screen-between event (M = 9 months 29 days) and half saw the Screen-behind event (M = 9 months 19 days). Of the infants who saw the Similar-angled display, half saw the Screen-angled display (M = 9 months 21 days) and half saw the Screen-behind event (M = 9 months 27 days). Of the infants who saw the Dissimilar-angled display, half saw the Screen-between event (M = 9 months 14 days) and half saw the Screen-behind event (M = 9 months 20 days). Thus, the display and event variables were completely crossed, forming six separate experimen-tal groups of infants who saw six different display/event combinations. Nineteen additional infants were tested and eliminated, six due to procedural error, five due to fussiness, three due to equipment failure, two due to disagreements between the two observers as to where the infant was looking, two who were distracted by other objects or people during the experiment, and one who stood during the experiment and might have seen the tops of the boxes.

The infants’ names were obtained from the Durham County vital records office. Parents were contacted via letter and follow-up phone calls. They were offered reimbursement for their travel expenses but were not compensated for their participation.

Apparatus

The apparatus consisted of a wooden cubicle 201 cm tall, 107 cm wide, and 63.5 cm deep. The infants faced an opening 56 cm tall and 94 cm wide in the front wall of the apparatus. The floor of the apparatus was covered with dark-blue cardboard and the back wall was covered with a white speckled tan cloth.

Each display consisted of two boxes, each of which was 28 cm tall, 22.5 cm wide and 9 cm deep. Together, the two boxes subtended about 28° (horizontal) and 24° (vertical) of visual angle from the infant’s viewpoint. The front box stood 38 cm from the left wall and 16 cm from the front edge of the apparatus.

In the Similar-parallel display, the back box was placed 48.5 cm from the left wall and 38 cm from the front edge of the apparatus (13 cm behind the front box). Both the front and back boxes were oriented with their front surfaces perpendicular to the infants’ line of sight. Both boxes were covered with light-blue contact paper and decorated with small (approximately 1 cm × 1 cm) rectangles cut from strips of white and dark-blue plastic tape.

The Similar-angled display was the same as the Similar-parallel display except that the back box was tilted so that its (visible) right side remained 13 cm from the front box, but its (hidden) left side was moved forward until only 2 cm separated the two boxes. The angle produced by the two boxes was approximately 45°.

The Dissimilar-angled display was the same as a Similar-angled display, except that the back box was covered with red paper, decorated with green and yellow dots (each 1 cm in diameter) and then covered with a layer of clear contact paper.

During the test events, a screen was passed from one side of the apparatus to the other by two experimenters. This screen was 38 cm on a side, 0.5 cm thick, and was covered with brightly lined white contact paper with bright yellow tape along its edges.

The right and left walls of the apparatus contained windows that were 56 cm tall and 38 cm wide. Both windows were partially covered by fringed muslin curtains that hid the faces of the experimenters but allowed the screen to pass through the windows.

The infants were tested in a brightly lit room. Four clip-on lights (each with a 40-watt bulb) were
attached to the back and side walls of the apparatus to provide additional light. Two wooden frames, each 201 cm tall and 76 cm wide, stood at an angle on either side of the apparatus. These frames served to isolate the infant from the experimental room. Before each trial, a curtain consisting of a white muslin-covered frame completely blocked the infant’s view of the opening in the front of the apparatus. An experimenter behind the apparatus raised this curtain at the beginning of each trial and lowered the curtain at the end of each trial.

**Events**

To help the experimenter adhere to the prescribed script, a metronome beat softly once per second. The objects remained stationary throughout both events; a screen was moved either between the boxes to reveal information about the connection between the boxes or behind the boxes (see Figure 1 for a depiction of both test events).

At the start of each test trial, one of the two experimenters (who each wore a bright purple spandex glove on the hand used to produce the events) held the screen in the left window, with the screen’s leading edge about 18 cm from the front box. To begin the event, the experimenter pushed the screen to the right across the apparatus floor at the approximate rate of 15 cm/s. As the screen reached the centre (at second no. 3), the second experimenter reached in from the opposite side of the apparatus to grasp the other side of the screen; the first experimenter then released the screen and withdrew her arm from the apparatus. The second experimenter then pulled the screen to the other side of the apparatus (3 seconds), stopping when the screen’s left edge (soon to be its leading edge) was 18 cm to the right of the back box. The second experimenter paused for 1 second before beginning the event once again by pushing the screen across the apparatus floor. When the screen paused at the sides of the apparatus, it was about half-way out the window on each side. These cycles (composed of 6 seconds of movement and a 1 second rest) were repeated without stop until the computer signaled the end of the trial.

The only difference between the two events was the placement of the screen’s path: in the Screen-behind event, the screen’s path was behind the front box (approximately 48 cm from the front edge of the apparatus); in the Screen-between events, the screen’s path was between the front and back boxes (approximately 26 cm from the front edge of the apparatus).

**Procedure**

During the experiment, each infant sat on his or her parent’s lap in front of the apparatus. The infant’s head was approximately 64 cm from the front box. The parent was asked not to interact with the infant while the experiment was in progress. The parent was also instructed to close his or her eyes during the test trials.

The infant’s looking behaviour was monitored by two observers who viewed the infant through peepholes cut in the cloth frames on either side of the apparatus. The observers were not told and could not determine which display the infant was watching. Each observer held a button box connected to a Gateway 2000 computer and pressed the button whenever the infant attended to the event. Each trial was divided into 100 ms intervals, and the computer determined in each interval whether the observers agreed on the direction of the infant’s gaze. Inter-observer agreement was calculated for each trial based on the number of 100 ms intervals in which the computer registered agreement between the observers out of the total number of intervals in the trial. Agreement averaged 90% or more per trial. The looking times recorded by the primary observer were used to determine the ends of the trials.

Each infant first received a familiarization trial. The purpose of this trial was to give the infant the opportunity to inspect the display and form an interpretation of the display as composed of one or two units. To allow the infant to focus his or her attention on the boxes in the display, neither the screen nor the experimenters’ hands entered the apparatus during the familiarization trial. The trial ended when the infant either (a) looked away from the display for 1 complete second after having looked at it for at least 10 cumulative seconds, or (b) looked at the display for 30 cumulative seconds without looking away for 1 complete second.

Following the familiarization trial, the infant saw the test event appropriate for his or her

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3The experimenters wore these gloves so that the hands of our many experimenters would look as similar as possible for all of the infants in the study.
experimental group. Each infant saw this event on six consecutive trials. Each trial ended when the infant (a) looked away from the event for 1 complete second after having looked at it for at least 6 cumulative seconds (the length of time the screen moved during each event cycle), or (b) looked at the event for 60 cumulative seconds without looking away for 1 complete second.

Two infants completed fewer than the full set of 6 test trials: one completed 5 trials, due to computer failure, and the other completed 4 trials, due to fussiness. These infants’ data were averaged according to the number of trials they contributed and included in the data analyses.

RESULTS

The mean looking times for the infants in the six experimental groups can be seen in Figure 3. Inspection of this graph reveals that the infants who saw the Similar-angled display tended to look longer at the Screen-between than at the Screen-behind event, whereas the infants who saw the Similar-parallel display or the Dissimilar-angled display tended to watch the two test events about equally.

Preliminary Analysis

A preliminary analysis examined the infants’ looking times during the familiarization trial. This analysis produced a reliable main effect of Event, in which the infants who would see the Screen-behind event (M=13.7, SD=4.1) watched the familiarization display reliably longer than the infants who would see the Screen-between event (M=12.0, SD=1.1), F(1,66)=5.6, p<0.05. Because the display seen during the familiarization trial in each of the three conditions (Similar-parallel, Similar-angled and Dissimilar-angled) was exactly the same regardless of which test event the infants would see, it is not clear how meaningful this effect is. From these findings one might conclude that the infants in the Screen-behind conditions just happened to be a group of very long lookers who would have looked longer than the infants in the Screen-between conditions at anything. However, because the infants’ looking times at the test events did not show this same pattern, it is unlikely that this was the case.

Comparison of the looking times during the familiarization trial of the infants who would see the Screen-between and the Screen-behind test events for each display led to the following results. The infants looked about the same length of time at the Similar-parallel display whether they were about to see the Screen-between (M=11.6, SD=1.1) or the Screen-behind test event (M=11.9, SD=1.9), F(1,66)=0.09. Likewise, the infants looked about the same length of time at the Similar-angled display whether they were about to see the Screen-between (M=12.4, SD=1.6) or the Screen-behind event (M=14.3, SD=4.7), F(1,66)=2.59, p>0.05. However, the infants looked reliably longer at

Figure 4. Mean looking times of the infants in the six experimental groups.
the Dissimilar-angled display if they were about to see the Screen-behind event ($M=14.7$, $SD=4.9$) than if they were about to see the Screen-between event ($M=12.0$, $SD=1.6$), $F(1,66)=4.8$, $p < 0.05$. Once again, it is unlikely that this effect is of any theoretical significance, in light of the infants' looking times at the test events.

A second analysis examined whether there were any reliable differences in male and female infants' looking times at the test events. This analysis produced no reliable main effects or interactions (all $Fs < 2.0$, $p > 0.05$), and the data were collapsed across this variable for subsequent analyses.

**Main Analyses**

Each infant's looking times over the six test trials were averaged and this number was entered into a $3 \times 2$ analysis of variance (ANOVA) with Display (Similar-parallel, Similar-angled, or Dissimilar-angled) and Event (Screen-between or Screen-behind) as between-subjects factors. This analysis yielded a significant Display $\times$ Event interaction, $F(1,66)=5.69$, $p < 0.01$. Planned comparisons revealed that the infants who saw the Similar-angled display looked reliably longer at the Screen-between event ($M=37.9$, $SD=11.2$) than at the Screen-behind event ($M=25.8$, $SD=6.6$) and Screen-behind ($M=30.7$, $SD=9.3$) events about equally ($F(1,66)=1.30$, $p > 0.05$). Likewise, the infants who saw the Dissimilar-angled looked at the Screen-between ($M=22.1$, $SD=9.7$) and Screen-behind ($M=25.9$, $SD=14.5$) events about equally ($F(1,66)=0.77$).

In addition, comparison of the infants' looking times who saw the Screen-between event across the displays indicated that the infants who saw the Similar-angled display ($M=37.9$, $SD=11.2$) looked reliably longer than the infants who saw the Similar-parallel display ($M=25.8$, $SD=6.6$), $F(1,66)=7.78$, $p < 0.01$ and the infants who saw the Dissimilar-angled display ($M=22.1$, $SD=9.7$), $F(1,66)=13.31$, $p < 0.001$.

No other effects were significant.

**DISCUSSION**

The infants who saw the Similar-angled display looked reliably longer at the Screen-between than at the Screen-behind event, suggesting that they posited a connection between the two boxes and did not expect the screen to pass through this connection. In contrast, the infants who saw the Similar-parallel display or the Dissimilar-angled display looked about equally at the Screen-between and Screen-behind events, suggesting that they did not infer a connection between the boxes and therefore considered both test events to be equally plausible.

These findings suggest that, by 9.5 months of age, infants use the spatial information (specified by the precise spatial arrangement of the objects) and the featural information (specified by the similarities or dissimilarities in the colour and pattern of the objects) present in a display to determine whether there is a hidden connection between the objects in the display. The results also provide insight into infants' strategies for integrating interpretations based on spatial and featural information.

The infants seemed to interpret the spatial information in the Similar-parallel display as evidence that the display was composed of two units, even in the presence of conflicting featural information (i.e., the infants saw the similar-looking portions of the Similar-parallel display as separate units). In contrast, the spatial information present in the angled displays was apparently ambiguous to the infants, because the infants segregated these displays according to their featural properties (i.e., the infants saw the Similar-angled display as composed of a single unit and the Dissimilar-angled display as composed of two separate units). This pattern of results suggests that when spatial and featural information could both be used to interpret a display, featural information was only used when

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4One issue our results do not address is whether infants may have perceived a conflict within the featural sources of information for the Similar-angled display. In this display, the colour and pattern led to the interpretation of a single unit, but the three-dimensional shape of this unit is certainly not simple or ‘good’, in the Gestalt sense. One could argue that this represents a conflict within featural information—colour and pattern suggest one unit, but shape suggests two separate units. Although ongoing research in our lab indicates that infants do use object shape to find object boundaries as early as 4 months of age, what is not clear is whether infants evaluate shape from their vantage point only or whether they can assess the three-dimensional shape of an object that would be seen from a perspective other than their own (in this case, a top view would reveal the unusual three-dimensional shape of the Similar-angled display). Additional issues such as the (low) likelihood of seeing two objects of identical colour and pattern in that particular spatial arrangement could come into play for infants of this age.
the spatial information did not allow a clear interpretation of the display.\(^5\)

**Featural Information: Subordinate to Other Sources**

These conclusions are consistent with a number of other findings in the literature that infants’ use of featural information to segregate a display is limited by the presence of other information in the display (Kellman and Spelke, 1983; Needham and Baillargeon, 1997a). One example can be found in Experiment 6 of Kellman and Spelke (1983). In this experiment, 4-month-old infants saw a centre-occluded ‘rod–polygon’ display consisting of a rod above the occluder and a polygon below the occluder. The featural information, including shape, colour and texture, indicated that the rod and polygon were separate units. During habituation, the rod–polygon moved as a single unit behind the occluder; this motion information specified that the rod and polygon were connected. Next, the occluder was removed, revealing either a connection between the rod and polygon or a broken display, with a gap between the objects. The infants looked reliably longer at the broken than at the connected display, indicating that, during habituation, the infants perceived the rod and polygon to compose a single unit and were surprised to see the unit broken apart. According to the authors, these results demonstrated 4-month-old infants’ inability to use the featural properties of objects to find object boundaries.

However, it is possible that the infants would have used the prominent featural differences between the rod and polygon to group these surfaces into separate units if the motion in the display had not indicated otherwise (e.g., if the display were stationary). Perhaps the infants in Kellman and Speike’s (1983) Experiment 6 favoured the interpretation specified by motion over that specified by features just as the infants in the present research and in Needham and Baillargeon (1997a) favoured the interpretation specified by spatial or physical information over that specified by features. New evidence indicating that 4-month-old infants do use featural information to segregate stationary partly occluded and adjacent objects lends support to this argument (Needham et al., in press).

Why would infants systematically rely upon sources of information other than featural information to interpret object displays?

**Accuracy or ‘Ecological Validity’ of Different Kinds of Information**

One possibility is that featural information is less consistently related to the locations of object boundaries than the other kinds of information we have discussed. This claim is similar to that made by Brunswik (1956) that certain kinds of information are more accurate or ‘ecologically valid’ for certain perceptual judgements than other kinds of information (see also Kellman, 1993, 1996; Neisser, 1976). According to the current literature, it seems likely that infants learn about the utility of featural information for predicting the locations of object boundaries later than they learn about the other sources of information and that they use information other than featural to form interpretations of displays when it is possible to do so. These two findings could both be a result of the lower ecological validity of featural information for object boundary locations when compared to the other sources of information. Infants could develop strategies for interpreting displays that exploit these differences in the relative accuracies of different sources of information, thereby increasing the likelihood that they will produce a veridical interpretation of a display.

One possibility for how infants consider the various sources of information available about a display is the following. Infants first consider interpretations suggested by the most accurate kinds of information they know about (because of the consistent ‘data’ available from these sources, infants could learn about these early): kinetic, spatial and other kinds of physical information (such as solidity or support information). If there is a clear interpretation available from one of these sources, this is the interpretation the infant uses. If these sources of information allow only ambiguous interpretations, infants then consider interpretations based on less accurate information, such as featural information. According to this model, sources of physical information are positioned above featural information in a hier-
The view presented here is consistent with an account of adult perception given by Kellman (1993), who was the first to suggest that the ecological validity of different sources of information could provide a basis for deciding which kind of information to use to interpret a display. Although Kellman suggests that infants’ strategies are likely to be based only on the most accurate sources of information, we believe that it could be important for young infants to utilize all of the relevant information they can detect to interpret displays. From our perspective, it seems likely that infants must attend to and use different sources of information to learn about their accuracy for predicting object boundary locations, and that infants must gather information about the relative accuracies of different sources of information to produce the best information hierarchy.

In support of this perspective on infants’ learning are a number of recent findings that, in several physical domains, infants form incorrect interpretations of events before developing correct interpretations of events in that domain (Aguiar and Baillargeon, in press; Baillargeon and DeVos, 1991; Baillargeon et al., 1992; Needham and Baillargeon, 1997b). One possibility is that these incorrect interpretations play an important role in infants’ eventual learning of the correct physical rule.

Concluding Remarks

Although there is currently disagreement about the utility of featural information in young infants’ representations of objects (Xu and Carey, 1996), the present results and those of other studies (Needham, in press; Needham and Baillargeon, 1997a; Needham et al., in press; Rochat and Hespos, 1996; Wilcox and Baillargeon, 1997) suggest that infants are quite capable of using featural information in some situations.

It is clear that there are circumstances under which infants will use information other than featural information to form an interpretation of a display or event (see the Similar-parallel condition in the present research, Kellman and Spelke, 1983; Needham and Baillargeon, in press, 1997a; Xu and Carey, 1996). The present results and those of other experiments point out that just because infants do not use featural information to form an interpretation of a particular display or event does not necessarily mean that they are unable to do so. It could mean (as it seems to in the present research) that infants base their interpretation on other available information, possibly because the other sources of information tend to be more accurate than featural information for making the judgments required by the particular experimental tasks.

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