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# *The Development of Young Infants' Intuitions about Support*

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**Previous research has shown that 3-month-old infants, like adults, expect a box to be stable when it is in full contact with a platform, and to fall when it loses all contact with the platform. Do young infants also have expectations about what should happen when the box is only in partial contact with the platform? The present research was designed to address this question. In Experiment 1, 6.5-month-old infants saw two test events: a full-contact and a partial-contact test event. In both events, the infants watched the extended finger of a gloved hand push a box along the top of a platform. In the full-contact event, the box was pushed until its leading edge reached the end of the platform. In the partial-contact event, the box was pushed until only 15% or 70% of its bottom surface remained on the platform. The infants looked reliably longer at the partial- than at the full-contact event when 15%, but not 70%, of the box rested on the platform. These results suggested that the infants were able to judge how much contact was needed between the box and the platform for the box to be stable. A control condition provided evidence for this interpretation. In Experiment 2, 5.5- to 6-month-old infants were found to look equally at the full- and the partial-contact events, even when only 15% of the box's bottom surface remained on the platform. This result suggested that prior to 6.5 months of age infants perceive *any* amount of contact between the box and the platform to be sufficient to ensure the box's stability. Interpretations of this developmental sequence are considered in the Conclusion.**

*Key words:* Infancy, cognition, physical reasoning, knowledge, support.

## INTRODUCTION

Consider the following situation: a man carrying a large present arrives at a birthday party and is directed to a small table laden with crystal goblets, porcelain figurines, silver candlesticks and brightly wrapped gifts. The man is then faced with the task of deciding where on the table to deposit his present so that the precarious assemblage does not come tumbling to the floor. Adults are often confronted with such problems, problems that call upon their intuitions about support relations among objects. Although for the most part implicit, these intuitions are nevertheless very sophisticated and enable adults routinely to solve, as in the above example, complex support problems involving multiple objects of various sizes, shapes, materials and weights.

Within the context of the present paper, however, only very simple support problems will be considered. Let us picture two objects: a small box and a larger, stable platform. At least three situations could be distinguished with respect to these objects:

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(1) the box could rest fully on the platform (full-contact event); (2) the box could rest only partially on the platform (partial-contact event); and (3) the box could be in mid-air, entirely off the platform (no-contact event). Adults would naturally expect the box to remain stable in the first event and to fall in the last event. Whether adults would expect the box to fall or to maintain its position in the second event would depend on how much contact there was between the box and the platform. Technically, an object resting on a platform is stable if a perpendicular line drawn through the object's centre of gravity falls within the platform's boundaries. Though generally unaware of this rule, adults typically adhere to it in their predictions. Therefore, adults would most likely expect the box to fall if less than half of its bottom surface rested on the platform, and to remain stable if more than half of its bottom surface lay on the platform.

Researchers have recently begun investigating young infants' ability to reason about support relations between objects (e.g. Baillargeon and Hanko-Summers, 1990; Needham and Baillargeon, 1991; in press; Spelke *et al.*, 1991). Many of these experiments have focused on simple support problems of the type described above. One experiment, for example, compared 4.5-month-old infants' responses to a full-contact and a no-contact event (Needham and Baillargeon, in press). In the full-contact event, a gloved hand deposited a box *on* a platform and then retreated a short distance, leaving the box supported by the platform. In the no-contact event, the hand deposited the box *beyond* the platform and then retreated, leaving the box suspended in mid-air with no apparent means of support. The infants looked reliably longer at the no-contact than at the full-contact event, suggesting that they expected the box to fall when it was released in mid-air and were surprised that it did not. This interpretation was supported by the results of two control conditions. In one, the box fell in the no-contact event when released by the hand beyond the platform. In the other, the hand retained its grasp on the box throughout the events, thereby providing continuous support for it. The infants in these two conditions tended to look equally at the test events. Together, these results indicated that 4.5-month-old infants, like adults, believe that objects cannot remain stable without support.

Another experiment indicated that even 3-month-old infants hold the same belief about objects (Needham and Baillargeon, 1991). The infants in this experiment were again shown a full-contact and a no-contact event. In both events, the extended index finger of a gloved hand pushed a box from left to right along the top surface of a platform. In the full-contact event, the box was pushed until its leading edge reached the end of the platform. In the no-contact event, the box was pushed entirely off the platform and stood suspended in mid-air with no visible source of support. The infants again looked reliably longer at the no-contact than at the full-contact event, suggesting that they expected the box to fall when it was pushed off the platform and were surprised that it did not. A control condition in which the hand grasped the box throughout the events supported this interpretation: the infants in this condition tended to look equally at the events.

The results of this experiment indicated that, by 3 months of age, infants expect a box to remain stable when it is in full contact with a platform, and to fall when it loses all contact with the platform. Do young infants also have expectations about what should happen when a box is only in partial contact with a platform? Some evidence suggests that 8.5-month-old infants are able to judge, in simple situations at least, whether a box that rests partially on a platform is in sufficient contact with the platform to be stable (Baillargeon and Hanko-Summers, 1990). The infants in this experiment saw two small, identical platforms standing a few centimetres apart. A large box was placed on the right platform, with their right edges aligned; the overhanging left corner of the box rested on the left platform. About 70% of the box's bottom surface lay on the right platform, and about 15% lay on the left platform. Thus, whereas the right platform alone provided adequate support for the box, the left platform did not. The infants saw an adequate- and an inadequate-partial-contact event. In the adequate-partial-contact event, the left platform moved to the left, past the left edge of the box, which then rested exclusively on the right platform. In the inadequate-partial-contact event, the right platform moved to the right, past the right edge of the box, which then rested exclusively on the left platform. The infants looked reliably longer at the inadequate- than at the adequate-partial-contact event. This result suggested that the infants understood that the right but not the left platform provided adequate support for the box, and hence were surprised that the box did not fall in the inadequate-partial-contact event. A number of control conditions provided evidence for this interpretation. However, a surprising aspect of this experiment was that the infants showed a reliable overall preference for the inadequate-partial-contact

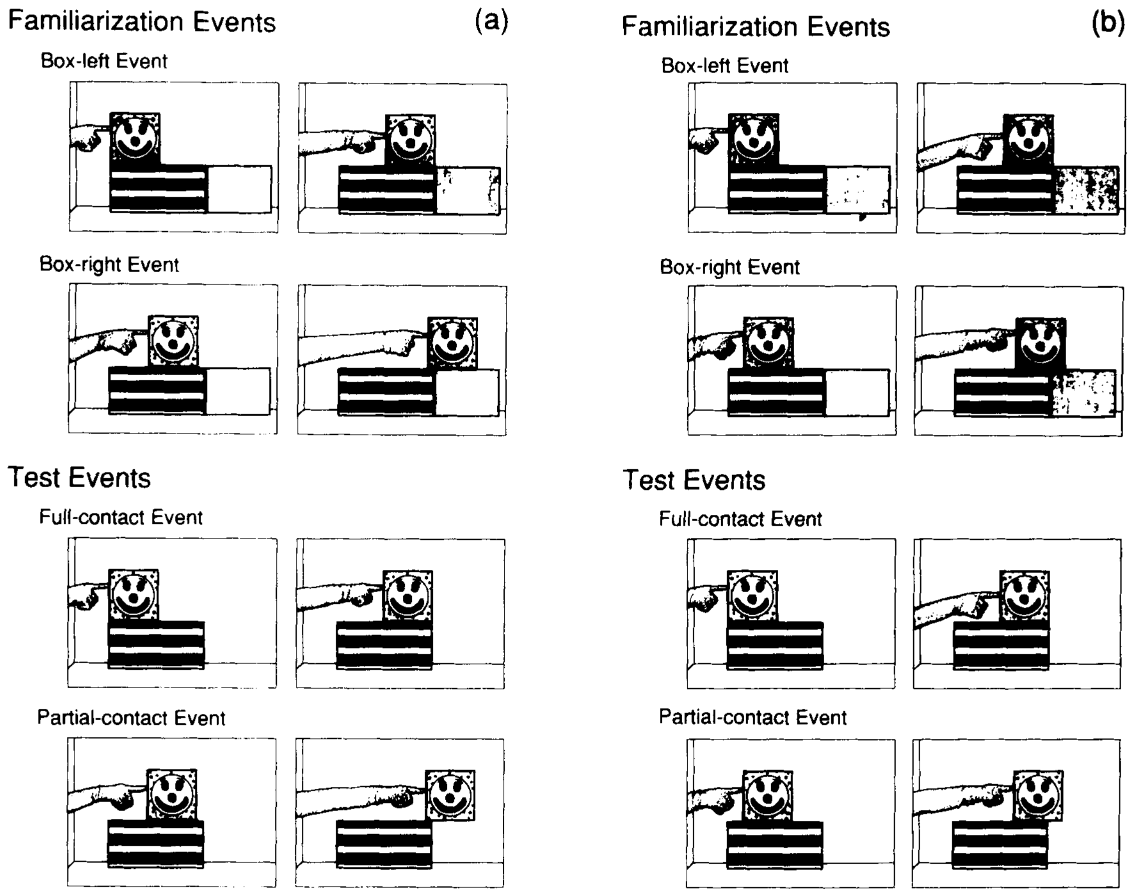


Figure 1. Schematic drawing of the events shown to the infants in the inadequate-partial-contact condition (a) and the adequate-partial-contact condition (b) in Experiment 1.

event only if they first received a pretest trial in which they saw the box alone, suspended in midair (see Baillargeon and Hanko-Summers, 1990, for a discussion of the possible significance of this pretest trial).

Could infants less than 8.5 months of age also distinguish between adequate- and inadequate-partial-contact events? The present research was designed to address this question. Because the method used by Baillargeon and Hanko-Summers (1990) required a counter-intuitive pretest trial, a different method was adopted in the present experiments. This method was similar to that used by Needham and Baillargeon (1991). Two groups of 6.5-month-old infants were tested in Experiment 1. Both groups of infants saw a full-contact and a partial-contact test event. In the full-contact event, a box was pushed from left to right along the top surface of a platform until its leading edge reached the end of the platform. In the partial-contact event, the box was pushed until only a portion of the box's bottom surface remained on the platform. For half of the infants (inadequate-partial-contact condition), about 15% of the box's bottom surface remained on the platform, a proportion insufficient for the box to be stable (see Figure 1a). For the other infants (adequate-partial-contact condition), about 70% of the box's bottom surface remained on the platform, a proportion sufficient to ensure the box's stability (see Figure 1b). Prior to the test events, the infants saw two familiarization events identical to the test events except that a second platform was placed to the right of the first, so that the box was always fully supported.

Our reasoning was as follows. If the infants were able to judge how much contact there had to be between the box and the platform for the box to remain stable, then (a) the infants in the inadequate-partial-contact condition should be surprised by the partial-contact but not the full-contact event, and

(b) the infants in the adequate-partial-contact condition should find neither event surprising. Because infants' surprise at an event typically manifests itself by prolonged attention to this event, we predicted that the infants in the inadequate-partial-contact condition would look reliably longer at the partial- than at the full-contact event, whereas the infants in the adequate-partial-contact condition would look equally at the events. On the other hand, if the infants were unable to judge how much contact was needed between the box and the platform for the box to maintain its position, then the infants in both conditions should look equally at the test events, because none of the events would appear surprising.

## EXPERIMENT 1

### *Method*

#### *Subjects*

Subjects were 32 healthy, full-term infants ranging in age from 6 months, 0 days to 7 months, 2 days (mean=6 months, 16 days). Half of the infants were randomly assigned to the inadequate-partial-contact condition (mean=6 months, 14 days), and half to the adequate-partial-contact condition (mean=6 months, 18 days). Four additional infants were eliminated from the experiment, because of procedural error. The infants' names in this experiment and in the next experiment were obtained from birth announcements in the local newspaper. Parents were contacted by letters 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 182 cm high, 100.5 cm wide, and 45 cm deep. The infant faced an opening 34 cm high and 94 cm wide in the front wall of the apparatus. The floor of the apparatus was covered with light blue contact paper, and the side and back walls were covered with brightly flowered contact paper. Across the back wall of the apparatus, 22 cm above the floor, was a horizontal slit 3 cm high and 100.5 cm wide. This slit was partly concealed by a ribbon of white fringe 4.5 cm high affixed to the wall immediately above the slit.

In each test event, the infant saw two objects: a platform that rested on the floor of the apparatus, and a box that was pushed along the top of the platform. The platform was 15.5 cm high, 32 cm wide, and 9 cm deep, and was made of blue cardboard decorated with pink horizontal stripes. The box was 16 cm high, 16 cm wide, and 9 cm deep, and was made of yellow cardboard decorated with blue dots and gold stars. The front surface of the box sported a brightly coloured clown face.

In the familiarization events, a second, additional platform was placed to the right of the test platform. This second platform was 15.5 cm high, 21.5 cm wide, and 9 cm deep, and was made of orange cardboard decorated with red and yellow jagged stripes. When this second platform was added, the bottom surface of the box was always fully supported.

Affixed to the back of the box, hidden from the infant's view, was a metal rod 1 cm in diameter and 39 cm long. This rod protruded through the slit in the back wall of the apparatus. Behind the back wall, the rod was encased in a metal plate 8 cm high, 5.5 cm wide, and 2 cm deep. This plate was mounted via linear ball bearings on two metal shafts, each 1 cm in diameter and 91.5 cm long. These shafts lay parallel, one 7 cm above the other, forming a horizontal track (the shafts' endpoints were attached to a metal frame). When the experimenter pushed the box, the rod and plate slid smoothly and easily along the track.

The experimenter wore a gold glove 53 cm long on her right hand and arm. The tip of the experimenter's index finger was attached to the left side of the box by Velcro, to ensure that it remained in contact with the box throughout the events. The experimenter's arm entered the apparatus through an opening in the left wall that was 22 cm high and 18 cm wide and was partly concealed by a muslin curtain.

The infant was tested in a brightly lit room. Four clip-on lights (each with a 40 W light bulb) were attached to the back and side walls of the apparatus to provide additional light. Two wooden frames, each 181 cm high and 69 cm wide and covered with blue cloth, stood at an angle on either side of the apparatus. These frames served to isolate the infant from the experimental room. At the end of each trial a curtain consisting of muslin-covered frame 61 cm high and 100.5 cm wide was lowered in front of the opening in the front wall of the apparatus.

#### *Events*

The numbers in parentheses indicate the amount of time taken to produce each action.

**Inadequate-partial-contact condition events**

*Full-contact test event.* At the start of the full-contact test event, the platform was positioned 32.5 cm from the front edge of the apparatus and 16 cm from the left wall. The box's left edge was aligned with that of the platform, and the tip of the experimenter's index finger was pressed against the box's left edge, 12 cm above the platform. To start, the experimenter pushed the box to the right 16 cm, at a speed of about 8 cm/s (2 s), until the right edge of the box was aligned with that of the platform. After pausing for 2 s, the hand grasped the box (1 s) and pulled it back to its starting position, at the same speed of about 8 cm/s (2 s). The hand then resumed its initial pointing position (1 s), ready to begin a new event cycle.

Each cycle thus lasted approximately 8 s. Cycles were repeated without stop until the computer signalled that the trial had ended (see below). When this occurred, another experimenter lowered the curtain in front of the apparatus.

*Partial-contact test event.* The partial-contact test event was identical to the full-contact test event except that at the start of the event the box's left edge was 13.5 cm to the right of the platform's left edge. Thus, when the box was pushed 16 cm to the right, only the left 2.5 cm of the box, or about 15% of the box's bottom surface, remained in contact with the platform.

*Box-left and box-right familiarization events.* The box-left and the box-right familiarization events were identical to the full-contact and the partial-contact test events, respectively, except that the second platform was placed immediately to the right of the test platform, so that the box was always fully supported.

**Adequate-partial-contact condition events**

*Full-contact test event.* The full-contact test event shown to the infants in the adequate-partial-contact condition was identical to the full-contact test event shown to the infants in the inadequate-partial-contact condition.

*Partial-contact test event.* The partial-contact test event was identical to the full-contact test event, except that at the start of the event the box's left edge was 5 cm to the right of the platform's left edge. Thus, when the box was pushed 16 cm to the right, only the left 11 cm of the box, or about 70% of the box's bottom surface, remained in contact with the platform.

*Box-left and box-right familiarization events.* The box-left and the box-right familiarization events were identical to the full-contact and the partial-contact test events, respectively, except that the second platform stood immediately to the right of the test platform, so that the box was always fully supported.

The tip of the experimenter's finger remained in contact with the box's left side throughout the familiarization and test events shown to the infants in the inadequate- and the adequate-partial-contact conditions (recall that the finger was in fact attached to the box with Velcro). When taking hold of the box to pull it back to its starting position, the hand bent its index finger, maintaining contact with the box, and grasped the box with its other fingers (front of the box) and thumb (back of the box).

*Procedure*

Prior to the beginning of the experiment, each infant was allowed to manipulate the gold glove and replicas of the box and the platforms for a few minutes while his or her parent filled out consent forms. During the experiment, the infant sat on his or her parent's lap in front of the apparatus. The infant's head was approximately 75 cm from the objects in the apparatus. 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 in the cloth-covered frames on either side of the apparatus. The observers could not see the familiarization and test events and they did not know the order in which these events were presented. Each observer held a button box connected to a DELL microcomputer and depressed the button when the infant attended to the events. Each trial was divided into 100 ms intervals, and the computer determined in each interval whether the two observers agreed on the direction of the infant's gaze. Inter-observer agreement was calculated for each trial on the basis of the number of intervals in which the computer registered agreement, out of the total number of intervals in the trial. Agreement in this experiment and in the next experiment averaged 93% per trial per infant. The looking times recorded by the primary observer were used to determine the end of the trials (see below).

Each infant participated in a two-phase procedure that consisted of a familiarization phase and a test phase. During the *familiarization* phase, the infants in each condition saw the box-left and the box-right familiarization events described above on alternate trials until they had completed two pairs of trials. The purpose of these trials was to acquaint the infants with the actions of the hand and the two possible trajectories of the box. We hoped that these trials would help the infants focus in the test events on the crucial relation of the box and the platform. Each familiarization trial ended when the infant either: (a) looked away from the test event for 2 consecutive seconds after having looked at it for at least 8 cumulative seconds (the duration of one event cycle); or (b) looked at the event for 60 cumulative seconds without looking away for 2 consecutive seconds. During the *test* phase, the infants in each condition saw the full-contact and the partial-contact test events described above on alternate trials until they had completed three pairs of trials. The criteria used to determine the end of the test trials were the same as for the familiarization trials.

The order of presentation of the box's two starting locations was kept constant across the familiarization and test phases of the experiment, and was counterbalanced across infants. Thus, half the infants in each condition saw the box-left familiarization event and the full-contact test event first, while the other infants saw the right-box familiarization event and the partial-contact test event first.

Only one of the 32 infants in the experiment did not complete the full set of three pairs of test trials. This infant completed only two test pairs, due to fussiness, but was still included in the data analyses. Preliminary analyses revealed no significant effect of order on the infants' looking times at the test events (all $Fs<2.64$, $p>0.05$). The data were therefore collapsed in subsequent analyses.

### *Results*

The results of Experiment 1 are shown in Figure 2. It can be seen that the infants in the inadequate-partial-contact condition tended to look longer at the partial- than at the full-contact event, whereas the infants in the adequate-partial contact condition tended to look equally at the two events.

The infants' looking times at the test events were compared by means of a 2×2×3 mixed-model analysis of variance (ANOVA), with Condition (inadequate- or adequate-partial-contact condition) as the between-subjects factor and with Event (partial- or full-contact event) and Test Pair (pairs 1–3) as the within-subjects factors. Because the design was unbalanced, the SAS GLM procedure was used to calculate the ANOVA (SAS, 1986). The analysis revealed a significant Condition×Event interaction, $F(1, 148)=7.85$, $p<0.01$. Planned comparisons indicated that the infants in the inadequate-partial-contact condition looked reliably longer at the partial- (mean=28.2) than at the full- (mean=19.7) contact event, $F(1, 148)=10.17$, $p<0.005$, whereas the infants in the adequate-partial-contact condition tended to look equally at the partial- (mean=19.5) and the full- (mean=21.6) contact events, $F(1, 148)=0.63$.

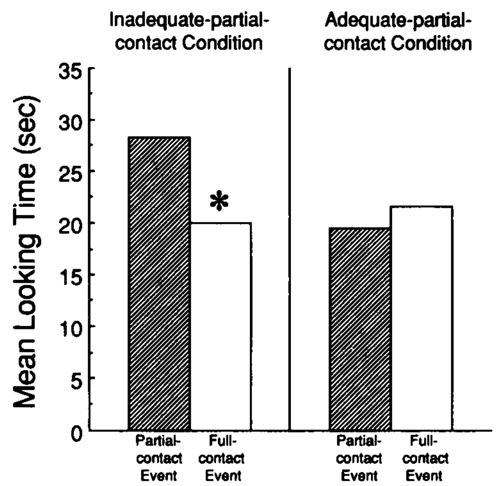


Figure 2. Mean looking times of the infants in the inadequate- and the adequate-partial-contact conditions in Experiment 1 at the partial- and full-contact test events (*indicates a statistically significant difference).

### *Control Condition*

One interpretation of the results of Experiment 1 was that the infants: (a) realized that the box was adequately supported when 70%, but not 15%, of its bottom surface rested on the platform; and (b) expected the box to fall when it was inadequately supported and were surprised that it did not. However, another interpretation of the results was that the infants in the inadequate-partial-contact condition looked longer at the partial-contact event because of some superficial aspect of this event, such as that it presented a greater change in the amount of contact between the box and the platform than any of the other events.

To test this alternative interpretation, an additional group of 16 infants (range 6 months, 6 days to 6 months, 28 days, mean=6 months, 17 days) was tested in a control condition identical to the inadequate-partial-contact condition, with one exception. Throughout the familiarization and test trials, the hand grasped the box (four fingers in front of the box, thumb in back of the box) both to push and pull the box along the top of the platform. The box was thus always adequately supported by the hand's grasp.

The looking times of the infants in the control condition were compared to those of the infants in the inadequate-partial-contact condition in a 2×2×3 mixed-model ANOVA with Condition (control or inadequate-partial-contact condition) as the between-subjects factor and with Event and Test Pair as the within-subjects factors, as before. The analysis revealed a significant main effect of Event, $F(1, 90)=4.55$, $p<0.05$, as well as a significant Condition×Event interaction, $F(1, 90)=11.38$, $p<0.005$. Planned comparisons indicated that, while the infants in the inadequate-partial-contact condition looked reliably longer at the partial- (mean = 28.2) than at the full- (mean = 19.7) contact event, $F(1, 90)=15.14$, $p<0.001$, the infants in the control condition tended to look equally at the partial- (mean = 17.2) and the full- (mean = 19.1) contact events, $F(1, 90)=0.77$. These results provided evidence that the infants in Experiment 1: (a) expected the box to fall when only 15% of its bottom surface rested on the platform; but (b) expected the box to remain stable when 70% or more of its bottom surface lay on the platform.

### Discussion

The infants in the inadequate-partial-contact condition looked reliably longer at the partial- than at the full-contact event, whereas the infants in the adequate-partial-contact condition tended to look at the two events equally. These results suggested that the infants: (a) believed that the box could not remain stable without support; (b) judged that the box was adequately supported when 70%, but not 15%, of its bottom surface rested on the platform; and hence (c) expected the box to fall in the latter case and were surprised that it did not.

It might be objected that the results of Experiment 1 are insufficient to conclude that the infants in the inadequate-partial-contact condition expected the box to fall when 15% of its bottom surface remained on the platform. After all, the data do not rule out the possibility that the infants expected the box, when pushed to its unstable position, to levitate above the platform, to become detached from the finger and carry on moving horizontally across the apparatus, or to effect a somersault. However, there are two reasons why such hypotheses are unlikely. One is simply that they are far less plausible than the more commonplace interpretation that the infants expected the box to fall. Boxes do fall in infants' daily experience, but rarely if ever do any of the deeds mentioned in the other hypotheses. It seems more reasonable to suppose that infants' expectations would be in line with what they have commonly rather than infrequently observed. The second reason is that, as was mentioned earlier, there is now evidence that 4.5-month-old infants do not show surprise when a box falls after its support has been removed, but do show surprise if the box fails to fall (Needham and Baillargeon, in press). Given that by 4.5 months of age infants already possess a clear expectation that objects should fall when unsupported, the assumption that the 6.5-month-old infants in the inadequate-partial-condition expected the box to fall in the partial-contact event seems warranted.

In contrast to the infants in the inadequate-partial-contact condition, the infants in the control condition tended to look equally at the partial- and the full-contact events. This result provided evidence against the hypothesis that the infants in the inadequate-partial-contact condition looked preferentially at the partial-contact event because of some superficial aspect of the event (e.g. because they were intrigued by the change in the amount of contact between the box and the platform, or found the arrangement of the two attractive). In addition, the results of the control condition gave further weight to the conclusion that even young infants realize that a hand can provide support for an object that would otherwise be unstable (Needham and Baillargeon, 1991; in press).

## EXPERIMENT 2

The 6.5-month-old infants in Experiment 1 realized that the box was unstable when only 15% of its bottom surface rested on the platform. Would younger infants also be able to judge how much contact was needed between the box and the platform for the box to be stable? Experiment 2 was designed to address this question. Infants between 5.5 and 6 months of age were tested using the same procedure as in the inadequate-partial-contact condition in Experiment 1.

### Method

#### Subjects

Subjects were 16 healthy, full-term infants ranging in age from 5 months, 16 days to 5 months, 29 days (mean = 5 months, 23 days). One additional infant was eliminated from the experiment because of computer failure.

*Apparatus, Events and Procedure*

The apparatus, events, and procedure in Experiment 2 were identical to those used in the inadequate-partial-contact condition in Experiment 1. Preliminary analyses revealed no significant effect of order on the infants' looking times at the test events (all $Fs < 0.75$). The data were therefore collapsed in subsequent analyses.

### *Results*

The results of Experiment 2 are presented in Figure 3. It can be seen that the infants looked at the partial- and the full-contact events about equally.

The infants' looking times were analysed by means of a 2×3 mixed-model ANOVA with Event (partial- or full-contact event) and Test Pair (pairs 1–3) as the within-subjects factors. The main effect of event was not significant, $F(1, 45) = 0.65$, indicating that the infants tended to look equally at the partial- (mean = 21.5) and the full- (mean = 23.4) contact events. No other effect was significant.

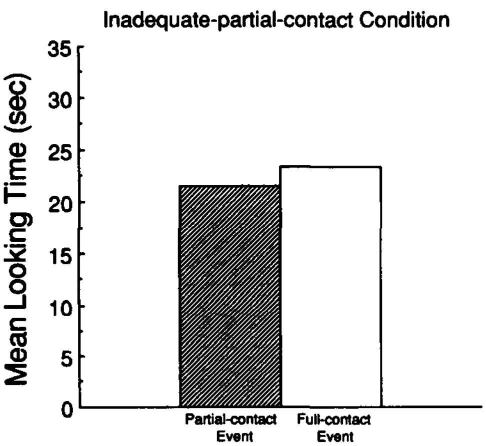


Figure 3. Mean looking times of the infants in Experiment 2 at the partial- and full-contact test events.

### *Discussion*

Unlike the 6.5-month-old infants in Experiment 1, the 5.5–6-month-old infants in Experiment 2 seemed not to be surprised that the box remained stable when only 15% of its bottom surface rested on the platform. These results, together with those of Needham and Baillargeon (1991; in press) summarized in the Introduction, suggest the following sequence in the development of infants' intuitions about support. By 3 months of age, infants expect a box to fall when pushed completely off a platform, and to remain stable otherwise; *any* amount of contact between the box and the platform is considered sufficient to ensure the box's stability. Around 6.5 months of age, however, infants begin to be able to estimate how much contact between the box and the platform is needed for the box to be stable. To what might one attribute such a developmental sequence? This question is addressed in the Conclusion.

## CONCLUSION

The 6.5-month-old infants in Experiment 1 were surprised that the box did not fall when 15%, but not 70%, of its bottom surface rested on the platform. How did the infants determine that the box should fall in the first case, but not in the second? At least two hypotheses could be advanced. One is that the infants attended to the proportion of the box's bottom surface that was in contact with the platform and ruled that 70% was sufficient to ensure stability, but 15% was not. The other hypothesis is that the infants (as though drawing on the box an imaginary line extending the right edge of the platform) compared the proportion of the box above the platform to that off the platform, and again judged that 70% was adequate for stability but 15% was not. The main difference between the two hypotheses would thus be that in the first only the bottom surface of the box was taken into account, whereas in the second the whole box was considered.

The results of the present experiments are not sufficient to decide which of these two hypotheses is correct. However, the results of a recent experiment in our laboratory suggest that the first hypothesis is more likely. In this experiment, infants aged 13 months and younger were given a support problem involving a platform and an asymmetrical, L-shaped box. The results indicated that it was not until 12.5 months of age that the infants began to consider the shape of the box in making judgments about support. The infants aged less than 12.5 months expected the box to be stable when half of its bottom surface rested on the platform, regardless of whether the vertical, heavier portion of the L was on or off the platform.

These results, together with the present results, suggest that, beginning around 6.5 months of age, infants expect an object to remain stable if a significant portion of its bottom surface is in contact with a supporting platform. How do infants attain such a rule? The results of Experiment 2 suggest that it emerges shortly after the sixth month of life.

Interestingly, it is at 5–6 months of age that most infants learn to sit with support or, to use Rochat's (1991) terminology, become 'self-sitters'. This observation suggests the following speculations. It may be that, as infants become 'self-sitters', they are more likely to be seated in high-chairs, walkers or sassy-seats in front of tables or trays. For the first time, infants may have the opportunity to deposit objects on surfaces and to note that objects tend to fall unless a significant portion of their bottom surfaces is supported: bottles, cups and toys placed on the edges of tables typically fall to the ground.

This interpretation of the development of infants' ability to distinguish, in simple cases at least, between adequate- and inadequate-partial-contact events is one that easily lends itself to empirical verification. On the one hand, one could compare infants of the same age, (a) who are self-sitters and have had experience depositing objects on surfaces, and (b) who are self-sitters but have not had the experience of depositing objects on surfaces, or (c) who are non-self-sitters. One would predict that group (a) would perform correctly if tested with the procedure used in Experiment 1, but that groups (b) or (c) would perform like the younger infants in Experiment 2. Alternatively, one could select a group of young infants, for example, 5-month-old infants, who are non-self-sitters, and give these infants experience in depositing objects on surfaces. One would then test, as in Experiment 1, whether this training facilitated the development of the infants' ability to judge whether an object that rests partially on a platform is adequately supported. Rochat (1991) has found that non-self-sitters who are provided with external posture control in the guise of inflatable cushions show manual explorations and manipulations similar to those of self-sitters. The use of such inflatable cushions might thus make relatively easy the training of non-self-sitters in support tasks.[1]

Such training would be interesting not only in demonstrating the role of specific manipulations in the development of infants' intuitions about support, but also in shedding light more generally on infants' approaches to learning about the physical world. How many observations and what types of observations would infants require before concluding that objects fall unless a significant portion of their bottom surfaces is supported? Answers to these questions would give us a glimpse into the highly-constrained, innate learning mechanisms that have been hypothesized to guide infants' acquisition of physical knowledge (e.g. Baillargeon, 1992; in press a).[2]

Another, more practical advantage of the type of training research described above is that it might make possible the construction of *dynamic* rather than *static* tests of cognitive development for assessing at-risk populations (e.g. Campione, 1989; Campione *et al.*, 1991). In a static test, one would simply ask whether a group of at-risk infants possesses an ability known to be found, for example, around 6.5 months of age in normal infants. In a dynamic test, however, having established that infants *lack* the ability under examination, one would proceed to determine whether the infants would benefit from the same training (i.e. the same type and quantity of observations) known to produce detectable improvements in normal infants. One can readily imagine a situation in which two groups of at-risk infants might fail a static test; but while only one group readily benefits from training (pointing to motor rather than cognitive deficits), the other does not. Such different outcomes would naturally suggest different prognoses as well as different intervention programmes.

Until now, we have been concerned mainly with the experiences that might contribute to the development of infants' intuitions about support. But one could speculate about the characterization of this development as well. It has recently been suggested (e.g. Baillargeon, 1992; in press a) that, in their first pass at understanding physical events, infants construct all-or-none representations that capture the essence of the events but few of the details. With further experience, these initial, core representations are progressively elaborated. Infants identify variables that are relevant to the events' outcomes, study their effects, and incorporate this accrued knowledge into their reasoning,

[1]In mentioning these results we do not mean to imply that infants could learn to attend to the degree of contact between an object's bottom surface and a support *only* through their own manipulations. It seems to us likely that infants could also learn from pertinent visual observations, and that manipulations may usually be necessary only because infants must rarely observe adults deposit objects on the edge of surfaces. In any case, the question of whether infants could learn about support relations from visual observation as well or as readily as from their own manipulations is one filled with exciting research possibilities.

[2]One interesting question to pursue would be whether infants, when judging whether a box that rests partially on a platform is adequately supported, initially focus on the proportion of the box's bottom surface in contact with the platform because of the limitations of their learning mechanism, or because they are typically given symmetrical objects to manipulate (e.g. cups, bottles, bowls).

resulting in increasingly accurate predictions over time. The results of the present research, together with those of Needham and Baillargeon (1991; in press a) fit neatly within such a model. Initially, infants expect a box to fall if it loses all contact with a platform, and to remain stable otherwise. By 6.5 months of age, however, infants are aware that the proportion of the box's bottom surface in contact with the platform can be used to predict whether or not the box will fall.

In the characterization just proposed, the development of infants' intuitions about support is seen as a facet of the development of their physical reasoning. However, it might be argued that the present results do not require the postulation of reasoning processes—that the data readily lend themselves to an account in terms of the progressive recognition of perceptual regularities. Are there reasons to adopt a characterization that emphasizes infants' reasoning rather than a more parsimonious interpretation focusing on perceptual learning? There is now evidence that young infants sometimes fail to show surprise at events that violate their physical expectations because they are able to generate explanations (sometimes correct and sometimes incorrect) for these violations (see Baillargeon, in press b, for a review). These and other findings (e.g. Baillargeon *et al.*, 1990) lead us to conclude that infants are not merely detecting perceptual regularities, but are actively engaged in the process of reasoning about and making sense of their physical world.

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