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Causal Attribution

See **Cultural Differences in Causal Attribution**

Causal Perception, Development of

Intermediate article

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The perception of causality develops during the first year of life. In general, this development progresses from infants perceiving the individual elements of events (e.g. particular objects, whether or not those objects touch) to their perceiving the relationship between those objects.

INTRODUCTION

Perceiving cause-and-effect relationships is important for understanding how things work, how to produce outcomes and how to link events that co-occur. Philosophers and psychologists have long debated the origins of causal understanding. Hume, for example, argued that real causal

connections are unknowable. According to this view, humans determine causality through experience with regularities in the environment and causal perception should develop gradually. Infants may perceive the causality of some events from an early age, but a sophisticated appreciation of causality in a wide range of events develops as they gain experience of the world. Others have argued that the idea of cause and effect is an innate predisposition of the mind. According to this view, causality itself can be perceived without prior experience of events. Therefore young infants should be able to perceive causality in a wide range of events from an early age, and little development should be observed.

PERCEPTION OF LAUNCHING AND COLLISION EVENTS

Psychologists have primarily studied the development of infants' causal perception by assessing their perception of launching events or collisions (e.g. Leslie, 1984; Oakes and Cohen, 1990). At the start of a launching event, an object moves from one side of a display toward a second object sitting at rest in the middle of the display (Figure 1). The first object hits the second object, which begins to move immediately upon contact. Adults report that the first object appears to cause the second object to move (Michotte, 1963). The perception of causality can be interrupted by imposing a delay (i.e. the two objects remain stationary momentarily after they have made contact) or a spatial gap between the two objects (i.e. the second object begins to move before the first object contacts it). Infants' sensitivity to causality is tested using habituation procedures. They are first shown one event on several trials until their looking time habituates, or decreases to some specified criterion (e.g. 50% of their original level of looking). Then they are shown one or more new events, and if they perceive those events as being different from the familiarization event, they

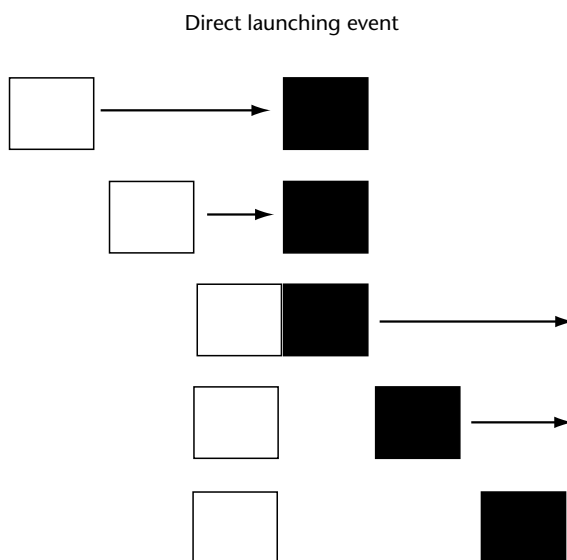


Figure 1. The sequence of actions in a typical launching event. The white object moves from the left of the screen towards the black object, which is initially stationary in the middle of the screen. When the white object makes contact with the black object, the black object immediately begins to move towards the right side of the screen. Reprinted from Oakes LM and Cohen LB (1995) with permission.

will dishabituate or increase their looking. For example, if infants perceive the causality of events, then infants who are habituated to a delayed launching event, a noncausal event, will dishabituate to a novel causal event but not to a novel no-collision event. However, if infants do not attend to causality, but instead attend to the particular features of the event (e.g. whether or not the two objects touched), then they will dishabituate to novel events that differ in terms of those features regardless of changes in causality.

Using this type of procedure, studies have revealed that young infants are sensitive to causality. Infants aged 6 to 7 months treat the causal launching event as different from noncausal events, and they treat different noncausal events as if they are equivalent (Leslie, 1984; Oakes, 1994; Cohen and Amsel, 1998). Thus we might conclude that some aspects of causal perception are innate. However, causal perception develops considerably during infancy. Infants under 6 months of age do not perceive the causality of launching events. Instead, following habituation with one event, these younger infants dishabituate to changes in other types of features of the event (e.g. whether or not the two objects touched) (Cohen and Amsel, 1998). Even once infants begin to perceive causality, their perception is limited. Infants aged 6 to 7 months only perceive the causality of launching events if the objects are simple (e.g. colored squares). They do not perceive the causality of events if the objects in the event are complex (e.g. multicolored, multi-featured objects). By 10 months of age, infants perceive the causality of launching events involving both complex and simple objects. However, if the objects do not move along the same trajectory, 10-month-old infants fail to perceive causality (Oakes, 1994; Oakes and Cohen, 1995). In general, therefore, the perception of launching events develops over time, and salient perceptual features of the events (or the objects in the events) may overwhelm young infants' ability to perceive the causal relationship in those events.

CAUSALITY VERSUS INDEPENDENT FEATURES MODELS

Clearly, infants over 6 months of age, at least under some conditions, perceive causality (Oakes and Cohen, 1995). The causal event is treated as different from any noncausal event, and different noncausal events are treated as being equivalent. This pattern is consistent with the causality model (Figure 2b). This model is based on the idea that events can be organized in terms of causality, with

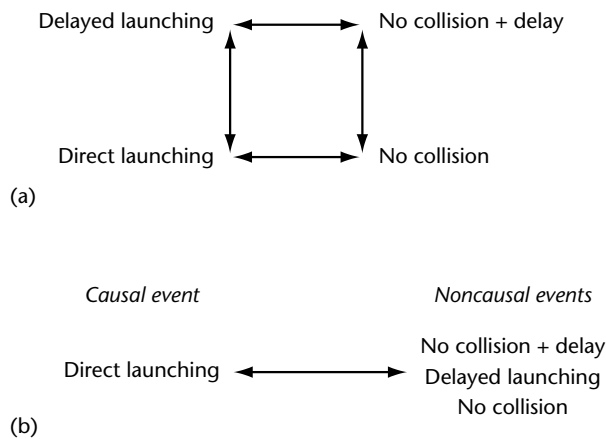


Figure 2. Abstract representations of (a) the independent features model and (b) the causality model of launching events. Reprinted from Oakes LM and Cohen LB (1995) with permission.

causal events being perceived as distinct from all noncausal events. According to this model, causal events or spatio-temporally contiguous launching events (events in which the objects touch and there is no delay imposed) are perceived as being different from noncausal events, or launching events with violations of spatio-temporal contiguity. Although this view is called the 'causality model', it is not clear whether causality *per se* is perceived. The same outcome is expected whether observers perceive the causality or are responding to the spatio-temporal contiguity of the events. That is, infants would respond in the same way if they treated a spatio-temporally contiguous event as different from any event that violates spatio-temporal contiguity. What is important is that differences between events are determined along a single dimension that corresponds to causality or spatio-temporal contiguity. As a result, two noncausal events that differ in two ways (e.g. in terms of both the temporal and spatial features) would be treated as the same, and a causal event and a noncausal event that differ in only one respect (e.g. only in terms of temporal features) would be treated as different.

However, infants younger than 6 months do not perceive the causality of events (Cohen and Amsel, 1998). Rather, these younger infants respond to differences in the independent features of the event (e.g. whether or not the two objects touch). The perception of launching events by infants younger than 6 months is consistent with the independent features model (Figure 2a). According to this model events are organized in terms of the presence or absence of specific features (e.g.

whether or not the two objects touch). If infants process events as sets of independent features, then the perceptual difference between any two events can be represented by an additive combination of the lines shown in the rectangle. Infants would not treat launching events that violate spatio-temporal contiguity as equivalent. Rather, they would respond to differences in the events, such as the presence or absence of a gap or a delay.

In summary, therefore, infants first perceive events according to the independent features model, and in the middle of the first year of life they begin to perceive events according to the causality model. Importantly, this developmental transition is not 'all or none'. Infants can perceive the causality of collisions involving simple objects by approximately 6½ months, but it is not until 10 months of age that they perceive the causality of collisions involving more complex objects.

AGENT VERSUS PATIENT DISTINCTION

Perceiving causality does not simply mean recognizing the difference between causal and noncausal events. Rather, in causal events the two objects have meaningful roles, and a full appreciation of causality requires a recognition of the difference between those roles. Consider the events depicted in Figure 3. For adults, in the initial event the white object appears to cause the black object to move, and it is therefore the causal agent. What makes an object an agent? The agent has the force to cause an outcome, and may be thought of as acting in pursuit of goals (Leslie, 1995). Infants seem to be sensitive to the different roles that objects have in events (Cohen and Oakes, 1993). In this study, 10- to 12-month-old infants were habituated to a causal and a noncausal event in which either the first object was associated with the type of event (e.g. object A was always seen in the agent role of a causal event, and object B was always seen in the agent role of a noncausal event), or the second object was associated with the type of event. The infants were then tested with an event in which the roles were switched (e.g. object A was in the agent role of a noncausal event). Infants dishabituated to this role switch when the agent was associated with the type of event, but not when the patient was associated with the type of event. In other words, they linked the agent with whether or not the event was causal, but not the patient. This is an important step in distinguishing between the agent and the patient in the events. However, simply linking the first object with the type of event does not reflect a

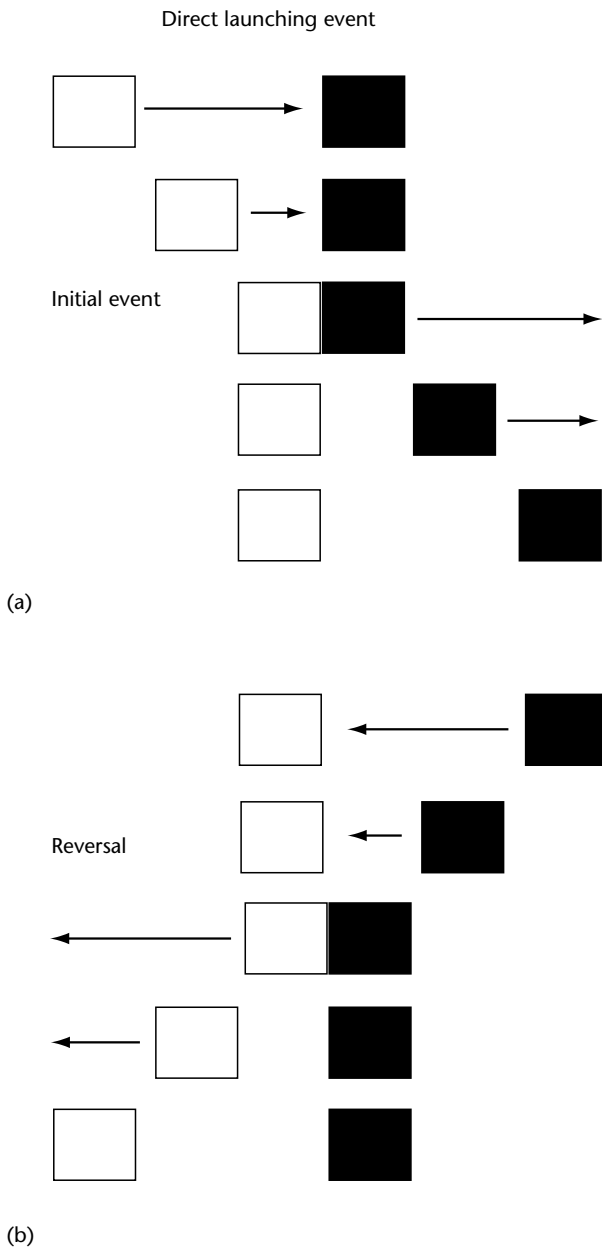


Figure 3. The sequence of actions in (a) a typical launching event and (b) a reversal of that event. Note that when the event is causal, a reversal not only involves a reversal of the direction of movement, but also a change in the roles of the objects in the events.

full understanding of the distinction between the agent and the patient.

The difference in the roles of the two objects is illustrated by the reversal of the event (Figure 3b). In this event, the action occurs in the opposite direction to that in the initial event and, importantly, the roles of the black and white objects have changed. In this reversal, the black object appears

to cause the white object to move, and it is now the agent. A reversal of a causal event should therefore be more compelling than a reversal of a noncausal event. Reversals of causal events involve changes in the agent–patient roles, and reversals of noncausal events do not. In fact, infants do find reversals of causal events more interesting than reversals of noncausal ones, which suggests that they are sensitive to the agent–patient distinction (Leslie and Keeble, 1987; Cohen *et al.*, 1998). However, their recognition of this distinction develops during infancy. Six-and-a-half-month-old infants notice the agent–patient distinction when the objects involved are simple red and green bricks (Leslie and Keeble, 1987), but it is not until they reach 14 months of age that infants notice the agent–patient distinction when the objects are complex and multi-featured (Cohen *et al.*, 1998).

RELATION TO LANGUAGE

The development of general concepts such as causality is believed to be a prerequisite for learning language. Indeed, infants perceive causal relationships long before they learn the corresponding linguistic concepts. Thus we have evidence that the development of cognitive concepts precedes language development. For example, infants perceive the distinction between ‘pushing’ and ‘pulling’ at between 10 and 14 months of age. However, they do not associate labels with the type of action until 18 months of age (Cohen *et al.*, 1998). In other words, infants first perceive the type of action (pushing and pulling), and only later learn a label for that action. Thus they appear to be able to learn the general concept earlier than they can learn the linguistic concept. Interestingly, by 14 months of age infants can associate labels with objects (Werker *et al.*, 1998), which suggests that they can first associate labels with the individual objects in events, and can only later associate labels with the relationships between the objects. In general, therefore, infants are able first to learn words that refer to parts or features of the event, and only later are they able to learn words that refer to the relationships between those parts.

CONCLUSION

In summary, the perception of causality develops gradually during the first years of life. Infants’ perception of causality itself develops from initially perceiving the independent features of events, such as the particular objects or some aspects of the relationships between those objects (e.g. whether

or not they touch), to distinguishing causal events from noncausal ones. However, the perception of causality does not emerge fully developed. Rather, infants perceive causality earlier in some events than they do in others. They are sensitive to the agent–patient roles in events, but they recognize this distinction earlier in events that involve simple objects. Finally, it is only relatively late in infancy that they become able to associate labels with the actions in the events. Thus, in general, infants first learn about particular objects and only later learn about the relationships between those objects. Therefore an understanding of causality develops gradually with experience.

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