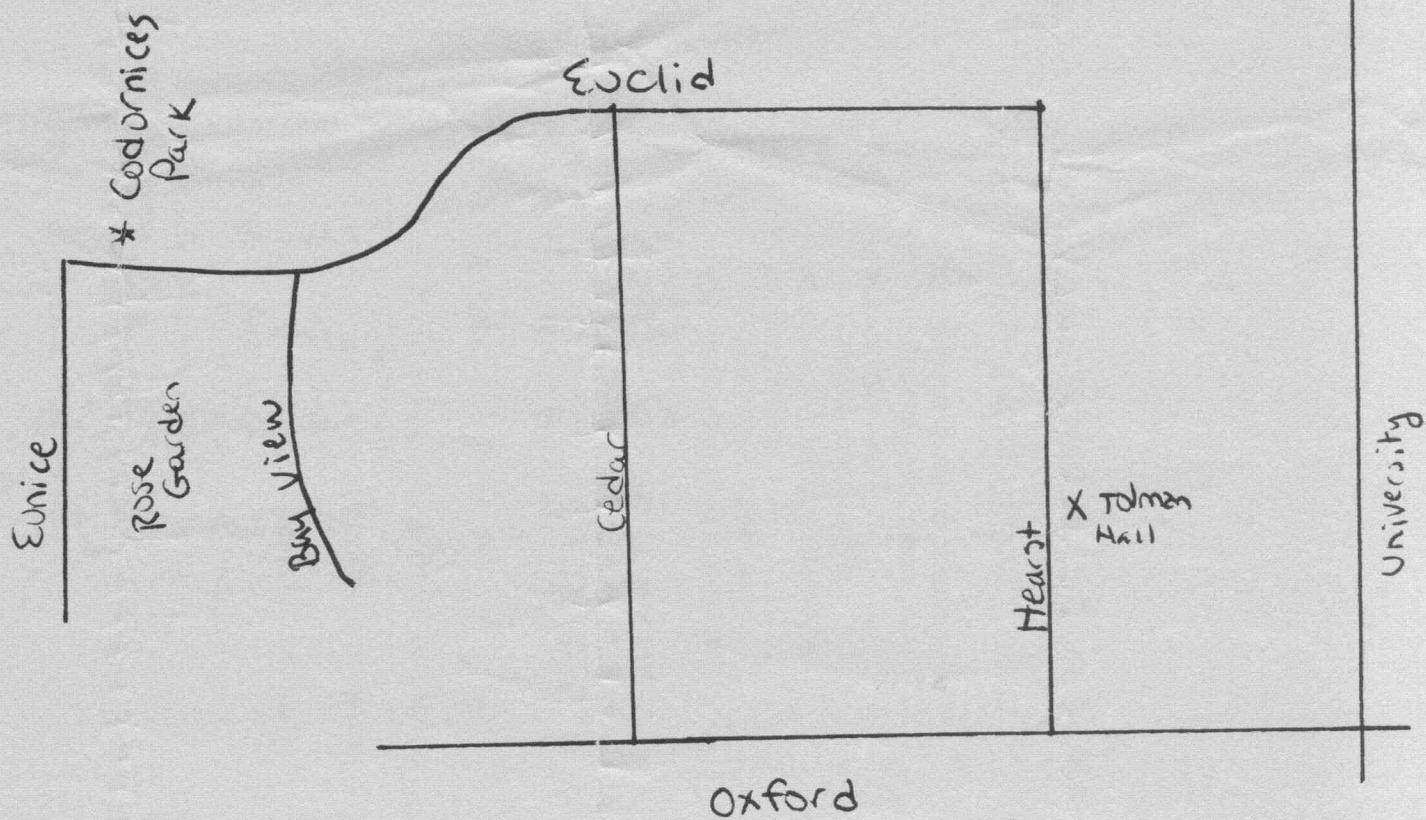


Directions to Codornices Park:



NINTH ANNUAL

BERKELEY-STANFORD CONFERENCE

BERKELEY, CALIFORNIA

MAY 16, 1987

9:00 - 10:00 **Breakfast 3105 Tolman**

10:00 - 11:12 **Session I 5201 Tolman**

10:00 - 10:18 **Maggie Shiffrar**

Directional biases in motion perception

10:18 - 10:36 **Allison Sekuler**

What "what you can't see" looks like:

The perception of partially  
occluded objects

10:36 - 10:54 **David Brainard**

Classification of color images

10:54 - 11:12 **Johanna Weber**

Symmetries in static and dynamic environments

11:12 - 11:30 **BREAK**

11:30 - 12:42 **Session II 5201 Tolman**

11:30 - 11:48 **Evan Heit**

Learning by observation: An adaptive method

11:48 - 12:06 **Lyne Plamondon**

Pitch out of chaos:

Detection of specific periods in a random sequence

12:06 - 12:24 **Susan Brennan**

The use of pronouns to center attention in discourse

12:24 - 12:42 **Steve Christman**

Task factors and hemispheric asymmetries

12:42 - 2:15 **Lunch 3105 Tolman**

2:15 - 3:27 **Session III 5201 Tolman**

2:15 - 2:33 **Mike McBeath**

The path of apparent motion

2:33 - 2:51 **Carol Varey**

Putting the ratio-difference debate into proportion

2:51 - 3:09 **Chip Heath**

The values of life and other ambiguous quantities

3:09 - 3:27 **Javier Rodrigues**

A connectionist model of contingency perception

3:27 - 3:45 **BREAK**

3:45 - 4:57 **Session IV 5201 Tolman**

3:45 - 4:03 **Todd Davies**

Data for a theory of evidential combination

4:03 - 4:21 **Pat Bennett**

Pattern discrimination in the central  
and peripheral visual fields

4:21 - 4:39 **Steve Sloman**

The aspects of context involved in  
accessing knowledge

4:39 - 4:57 **John Kruschke**

The perception of causality:

A performance measure of ampliation

**Picnic, Volleyball: Codornices Park**

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DEPARTMENT OF PSYCHOLOGY

BERKELEY, CALIFORNIA 94720

May 18, 1987

*Dear John*

I was really proud and pleased with the quality of the work and presentation of all of our students at the Berkeley-Stanford talks. It was a truly fun day for me and I hope that it was for you too.

Thank you,

*Great talk, great pants.* *Ev*

The perception of causality:  
A performance measure of ampliation.

by John Kruschke  
University of California, Berkeley

Presented at the Ninth Annual  
Berkeley-Stanford Conference  
in Cognitive Psychology  
16 May 1987

Imagine that my fists are billiard balls. When we see an event like this [perform launching with fists], most adults say they can see the one ball launch the other one; the first ball causes the second to move. Hume argued that such an impression of causality is a mere fabrication of a sophisticated mind, for there is nothing in the stimulus which corresponds to the impression of causality. We see something round because there is something round there. We see something move because there is something moving. But there is nothing visible in the stimulus which corresponds to causality. Hume argued that all we see, in repeated viewings of such a collision, is the spatial contiguity of the two balls, the temporal priority of the one ball's motion relative to the other, and the constant conjunction of the two motions. After many viewings our minds create a



nexus from the first motion to the second, which is a learned interpretation called causality.

Two hundred years later, the Belgian psychologist Michotte impugned Hume on several points. Michotte claimed that when one views a collision, one has an immediate, compelling, spontaneous percept of causality. The impression is not learned nor is it an interpretation via abstract knowledge of physical events. Rather, it is a spontaneous perceptual gestalt.

Michotte developed a theory of perceived causality in collision events. He claimed that the essence of perceived causality is "ampliation of motion." The word "ampliation" is a technical term he introduced to mean a combination of transfer and duplication. [SLIDE 1] That is, the motion of the incoming object is phenomenally transferred to the second object at the moment of impact. Moreover, that motion is phenomenally duplicated: It belongs to the first object while the second object has it. Thus it is not merely the contingency of the second motion on the first that is perceived, rather, the motion of the second object is seen as transferred from the first object, and as belonging to the first object while the second object has it.

Unfortunately, Michotte made only phenomenological observations. He made no performance measures to suggest that ampliation of motion is anything more than an

idiosyncratic epiphenomenon. In fact, one very candid article suggests that Michotte used his authoritarian personality to coerce his students to agree with his intuitions. As far as I know, until now no one has ever tried to show an effect on performance directly relevant to Michotte's claims.

My idea was to adapt a paradigm developed by Kahneman, Treisman, and Gibbs. I am carrying out this research with the collaboration of Danny Kahneman in Kahneman and Treisman's laboratory. I call their method the "prime-in-the-box" paradigm. A prototypical example might display to the subject two boxes, one left and one right of fixation, with a colored letter in each box, here labelled L1 and L2. [SLIDE 2] The letters disappear after a few hundred milliseconds or so, but the boxes remain visible. The empty boxes then quickly move to new positions [SLIDE 3], equidistant from the original positions. A third letter, here labelled L3, then appears in one of the boxes [SLIDE 4], and the subject's task is to indicate whether or not the third letter is the same in both color and character as one of the first two letters. The interesting result is that when the third letter matches the previous letter from the same object, response times are faster than when the third letter matches the previous letter from the other object [SLIDE 5]. Let's call that the object specificity effect.

One way to interpret the object specificity effect is that the properties of an object cohere within the object for a while even if the properties disappear and the object moves. So when the third letter appears in an object, one is faster to match to the letter that was previously in the same object. Thus one might say that the memory trace of a property is object specific.

Here's my adaptation of the paradigm [SLIDE 6]. This is a frame-by-frame diagram of the stimulus. First, two circular objects appear with a fixation point between them. Then a colored letter briefly appears in each object, labelled here as L1 and L2. The letters disappear, and the objects move. The event diagrammed here has the objects move together, which we call coherent motion. The objects then stop and a third letter, here labelled L3, appears in the far object. The subject's task is to indicate whether or not the third letter is the same in both color and character as one of the first two. A second event [SLIDE 7], called launching, shows one object launch the other, like one billiard ball striking the other.

[Demonstrate with hands the motions and letter appearances in the two events.]

Note that the positions of the objects in the first and last frames are the same in the two events, and that the positions of the letters are the same in the two events. Note also that the object correspondence is the same in both

events. That is, the left object in the first frame corresponds to the left object in the last frame, in both events.

Because the object correspondence is the same in both events, one might predict that the object specificity effect would be the same magnitude for both events. But Michotte's idea of transfer of motion across objects suggests that other properties may also be transferred. Thus the properties of the launching object may be transferred to the launched object, partially negating the object-specificity of properties. So in the launching event, matching the third letter to the other object may be easier than in coherent moving, because the other object's properties are transferred. Similarly, matching the third letter to the same object may get harder because the other object's properties interfere. Therefore I predicted a decrease in the magnitude of the object specificity effect in launching relative to coherent moving.

Here are the results [SLIDE 8]. Clearly the object-specificity effect is reduced in launching, relative to the coherent moving. As far as I know, these are the first performance data ever observed which are motivated by and consistent with Michotte's theory.

Are there other possible explanations of these results? Of course, and they come in two basic varieties [SLIDE 9a,b,c]. The first variety claims that there is not



really a reduction of the object specificity effect in launching, rather, the apparent reduction is an artifact of differences in fine details between the two events. By 'artifact' I do not mean design oversights; rather, I mean necessary confounds in the very nature of the difference between coherent moving and ~~passing~~<sup>launching</sup>. For example, in coherent moving the objects move at the same speed, whereas in launching one object moves faster than the other. One might suppose that the difference in speed could differentially attract attention, and differentially affect reaction times. I have run an experiment which controls for many of these potential artifacts, with results that make this variety of explanation very unlikely. Unfortunately, I simply don't have time to describe that experiment today.

The second variety of explanation accepts the conclusion that there is indeed a reduction of the object specificity effect in launching. One explanation for that reduction is the notion of ampliation, as I have described. Another possible explanation we have considered denies ampliation. It argues instead that in matching the third letter to the two initial letters in memory, one usually accesses first the initial letter from the same object. But if the objects have recently interacted with each other, then one sometimes first accesses the other object's history. This explanation denies ampliation of properties from one object to the other in memory; rather, it assumes that

object interaction changes the relative accessibility of distinct objects.

The experiments I ran included a third event, which addresses that counter-explanation [SLIDE 10]. This third event begins and ends in exactly the same positions as coherent moving and launching, only the motions of the empty objects differed. In this third event, called passing, the objects appeared to pass through each other. There were no occlusion cues to suggest that one passed in front of the other. If this event qualifies as "object interaction," then the counter-explanation would predict a reduction in the object specificity effect just as in the case of launching. On the other hand, the ampliation hypothesis predicts no reduction, for the simple reason that there is no ampliation perceived in passing.

Here are the results [SLIDE 11]. There is no reduction in the object specificity effect whatsoever in the passing event. It seems that the ampliation hypothesis survives.

In conclusion, these are the first performance data motivated by and consistent with Michotte's theory of ampliation, in the nearly fifty years since he first began studying causality. Moreover, I've suggested an extension of Michotte's notion of ampliation. Not only is motion transferred as Michotte suggested, but other properties may also be transferred across objects.

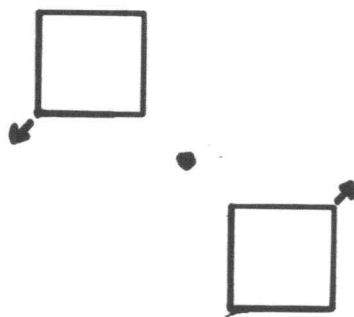
"ampliation"

= TRANSFER + DUPLICATION

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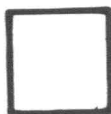
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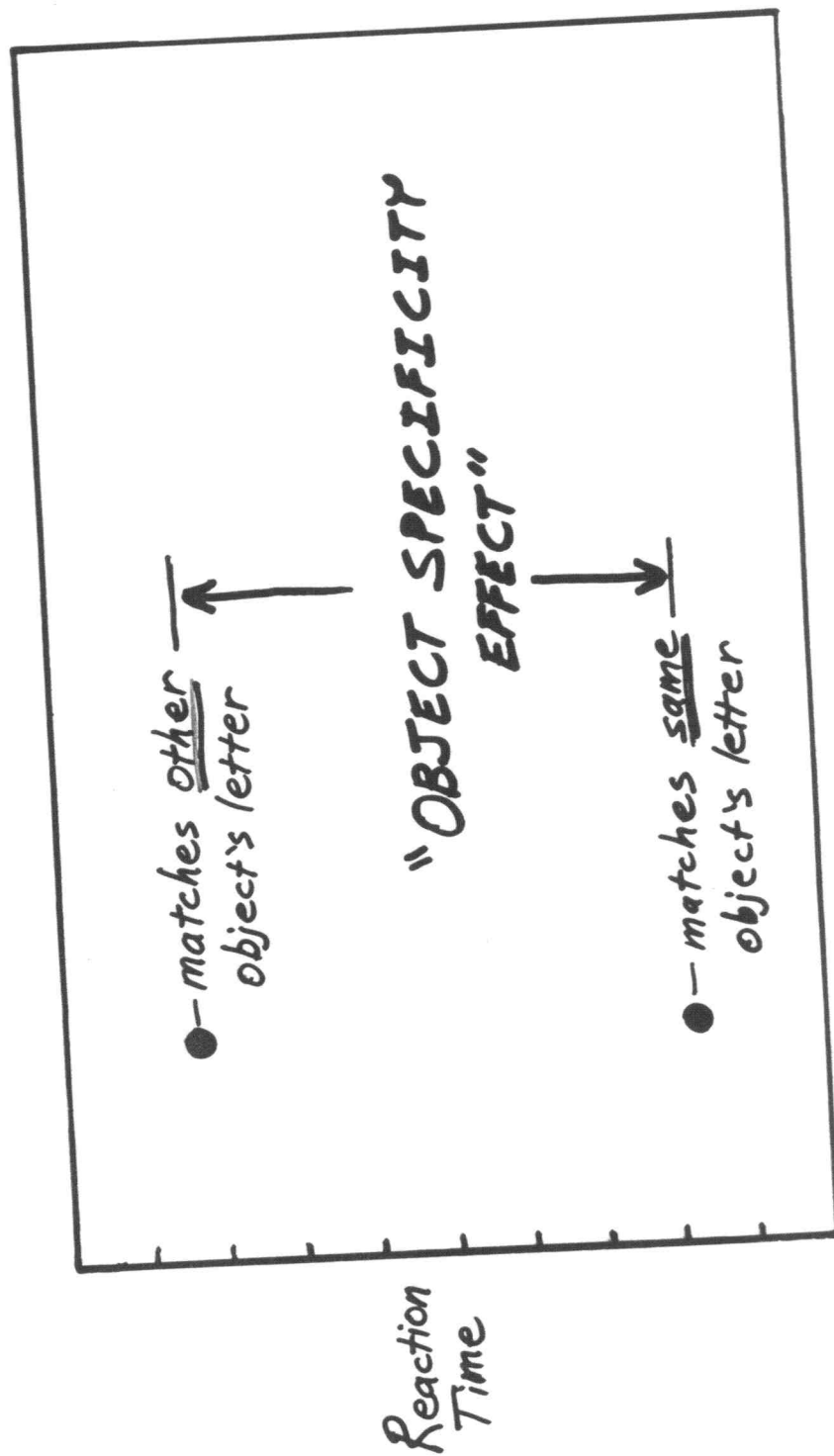




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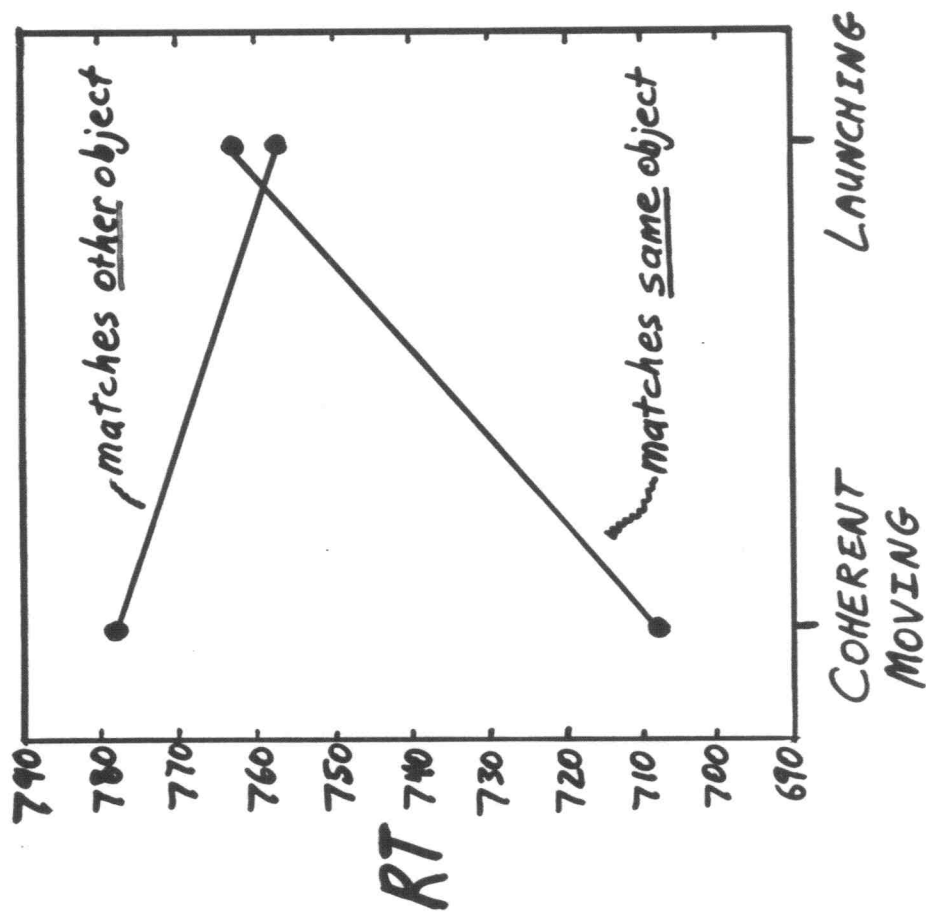


# COHERENT MOVING

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# LAUNCHING

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Possible explanations of  
observed interaction

Object specificity  
effect is not really  
reduced. The apparent  
reduction is merely  
an artifact.

Object specificity  
effect is indeed  
reduced...

ampliation

equalized  
access to  
histories of  
interacting  
objects

PASSING

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