ESSAYS

Multiple Sources of Information: Threat or Menace?

John B Pittenger
U. of Arkansas—Little Rock

Early this year the notion of whether or not there exist multiple sources of information for perceived events was discussed in a flurry of Bitnet messages among some members of the society. While no one laid out a fully developed position, it seemed to me that the issue was either generating some disagreement or had revealed some ideas in need of clarification.

The following statement of my position is intended to motivate the theoretically inclined members of the Society to consider the issues and send in their own views. Two sorts of replies are especially desired. First, it would be good to see well - reasoned arguments for the claim that there are never multiple sources of information. If this is the case, we need to be sure of it. Second, I'd like to know what is wrong with the examples I've used. I expect that others, including opponents of the ecological perspective, use similar examples. Although we often do a good job on the first task, I think we tend to neglect the second. This I think is a mistake: The old examples just don't seem to go away. Notice for example the continuing use of the argument from illusion in critiques of J. J. Gibson's ideas!

Two claims

For years I have held two gut - level beliefs about multiple sources of information: 1) It is obvious that many everyday events are multiply specified and (2) Such multiple specification is fully consistent with a direct theory of perception. (By a "gut - level belief" I mean one which is firmly held even though the logical and empirical support for it hasn't actually been very well worked out.)

The first belief derives from a set of simple examples; fire, ball elasti- city and age. You can tell that a fire is occurring via smelling it, seeing it, hearing it and, with caution, feeling it. That is, there are at least four sources of information for this event (object?). If you wish to know how bouncy a ball is you can watch the rate at which the peaks of successive bounces become lower and lower and you can either watch or listen to the changes in frequency of contact with the ground. To perceive people's age you can attend to their head shape, the shape of parts of their face, or the height of their head relative to that of the rest of their body. The second belief follows from the fact that I've not seen any reasons to believe differently. More on this at the end of the essay.

The Bitnet discussions suggested to me that three topics need to be considered before we can fully understand multiple - specifications: what we shall mean by an object or event, what are appropriate criteria for deciding whether or not two apparently different sources of information are really the same, and what perceptual process are implied by the existence of multiple sources of information beyond those needed for unique sources. These topics are discussed in turn.

Multiplicity in the environment

One way around a claim that there are several sources of information for a given event (or object) is to show that there are really several different, though related, events (objects) being discussed, each with unique information in the array. That is, we've first got to get our heads straight about the environment before we can be sure about information for the environment. (Hum, that last sentence sure seems familiar.)

I suspect that some purported cases of multiple information can be made to go away on such grounds. Note for example Warren & Shaw's (1985) discussion of nested events. Recall that they cite an apple falling from a tree as a set of nested events. Just which event is perceived depends upon the perceiver's needs and activities; availability of food for a hungry animal, the ripening of the fruit for the apple picker, etc.

Another sort (well, I think its another sort) of multiplicity exists. For now let me call it *layering*. Consider a ball which is first at rest, then bounces and finally is grasped by the observer. That the object is a ball might first be perceived via detection of its size and shape. When we see it bounce we surely thereby know more than we did before. Note that if it were dropped but failed to bounce (say, became flattened and stuck to the floor) we would realize it wasn't a ball (but was a blob of hamburger.) Returning to the case in which it bounced, suppose I reach out and grab it. Again we know more than we did before. However, if my hand passed through the "ball", we'd know we had been earlier fooled—perhaps by a hologram.

I'm not quite sure what to make of "layering". As more sources of information become available are

we learning more and more about the same object or are we learning about different objects? That is, do there exist multiple, sources of information for one object or is this another case of different, but related, objects.

Finally, what about the fire example? Surely we can't use a multiple - events escape here; there is a fire there whether we feel, smell, hear, or see it. You could of course say that vision, hearing, etc. are different sources information for different properties of the fire. That sounds good — except than I don't understand what "fire" is. Surely we don't want to construct unity out of a bunch of properties. When are two sources really different?

As I thought about multiple - specification, it slowly dawned on me that I didn't know how to tell when it makes sense to say that two sources of information are different. After further thought, I still don't. I bet the issue is very important for ecological theory. We'd sure better be able to tell when two sources are the same. Even if its not vital to theory it still seems an interesting issue. I am not aware of any good treatment of the question in the literature. If there is published material, please advise. In the meantime, below are some examples and analyses.

It seems clear to me that different local aspects of a global source of information should not count as multiple sources. For example, change in the relative size of the forehead, of the length the nose and the protrusiveness of the jaw are all merely local aspect of cardioidal strain, the overall pattern of change in size and shape which occurs as the head grows. (The claim of sameness may not be justified; the local rate of growth is different at different locations on the head. Thus, this case may need further consideration.) Lee's tau in vision (Lee,1980) and sound provides another easy case; time - to - contact is specified both by the rate of expansion in the optic array and of the intensity of the sound at the perceiver's ear. Note here that the same relationship serves as information for the same fact about the observers relationship to the environment — all that is different is the modality over which it is carried.

Bouncing balls provide some mixed results. With a respect to perceiving elasticity, I can buy sameness in the temporal pattern of impacts with the ground via vision and hearing. Again its the same pattern (mushier balls damp faster) just via different pick-up systems. Also the seen heights of bounces will covary with the intensity of the sound when the ball hits the ground. Rates of change of these are equivalent. However, shall we say that the change in height and change in impact intervals are "the same"? Is strict covariance of two sources enough to call them "the same" or do we want the same mathematical function to occur in both? I'm not sure.

Other cases seem to be "really" different. That is, I can't see how to ground a claim of sameness. In the fire example how can we make crackling sounds and odor the same? Cutting's book (1986) provides other, and to me strong, examples.

Implications for theory

To this point I've talked myself into believing that we can dispense with some cases of proported multiple specification by showing that the multiplicity lies in the environment rather than in information. Other cases go away by showing that apparently different sorts of information aren't really different. However, I don't yet see how to make them all go away. This hasn't bothered me because I don't see why, as an ecological psychologist, I'd need to do so. That is, it seems to me that perception can be direct even if there are multiple sources of information.

Cutting's (1986) argument in favor of directed perception meets the issue head on and thus provides a good basis for my remarks. Much of his book is devoted toward empirical demonstrations of multiple sources of information. At the end of the book he argues that the existence of such sources requires us to abandon theories of direct perception and adopt what he calls directed theory.

The key to directed theory seems to lie in the fact that multiple sources of information will require multiple special-purpose mechanisms for their detection. "In direct perception, information specifies process (the individual picks up what is there, one source of information)—", (page 247). By contrast, with multiple sources of information there is an important implication for process. Since different sources will be detected by different special purpose devices, which device is used for perceiving a given object or event depends on what source is used in a given encounter with the object or event.

For present purposes, the question of importance is whether or not the processes required by multiple sources are any different from those required for dealing with unique sources. If not, direct perception is not challenged. Unfortunately Cutting is not very specific about the nature of the process. Undaunted, I'll suggest possible processing implications and comment on them.

As a preliminary, recall that under the ecological approach, arrays are full of information, much of which is irrelevant to an organism's current purposes. Ecologists rarely talk about the internal activ-

ities involved in search; exactly how search is guided, whether or not special purpose devices are "activated" so as to be ready to resonate, etc. Given these facts, let us now consider three cases of the system's use of multiple information.

Case 1: *Any source can be used.* This sounds to me like a parallel search; information is taken into the perceptual system, and when one of the sources is delected (by its own special purpose mechanism), perception occurs. I don't see how this is different from search for a single source. All that is required is that whatever occurs internally during a search for a single source occurs also in parallel when multiple sources are availabel. There is no threat to direct perception here.

Case 2: *Only one of the multiple - sources is to be used* This case is likely to be very important since it often seems to speak of different sources of information being used in different contexts. I expect that some examples of what appear to be this case actually involve nested events. That is, there is a different source of information for each sub - event (e.g. Warren and Shaw's apple example.)

Other instances however seem to involve multiple sources. For example, with an approaching object visual tau during the day and auditory at night. What new processes are required? Beats me. First consider the role of context when there are only unique sources. The perceptual system must have some way to control its internal processes so that, in a given context, it is attuned to the information relevant to the aspect of the environment of interest. That is, we all agree that direct theory can handle the situation; different information for different objects in different contexts. Now consider what would happen if we needed to use different information for some single event as a function of context. How could it matter whether or not the information - context pairs were tied to different events? As with unique sources the system searches for the information relevant to the context. When the information is detected the event, whatever event it happens to be, is then perceived.

Case 3: *Combining information.* This one may be the only dangerous case. It does seem to me that "combining" information (as in Bruno & Cutting's studies of combination of depth information). This sure sounds like it has to involve an internal process which a) detects information, in I'd suppose a direct way, and then b) does "something" with them. Whatever that something might be, it sure doesn't sound direct to me.

There may be an escape here. Perhaps some instances of this case involve what I earlier called "layering". If so, and if layering can be treated as different events, each with its own sort of information, we're ok. If not, we may have problems.

Conclusion

Well, the issues don't seem entirely resolved. Indeed, I now think they are more complex than I'd first supposed. While I may have greatly muddied the waters, there is at least one idea I see as of real potential use; there are three places at which we might draw the line on multiple information. First, is that there just aren't any instances of multiple sources. Second, there may be instances of multiple specification but their "processing" is direct. Third, multiple sources, being combined by the perceptual system, do pose a problem for direct theory.

References

Bruno, N. & Cutting, J.E. (1988). Minimodularity and the perception of layout. *Journal of Experimental Psychology: General, 117,* 161-170.

Cutting, J.E. (1986). *Perception with an eye for motion.* Cambridge, Massachusetts: MIT Press.

Lee, D.N. (1980). The optic flow field: the foundation of vision. *Philosophical Transactions of the Royal Society. London, B290,* 169 -179.

Warren, Jr., W.H. & Shaw, R.E. (1985). Events and encounters as units of analysis for ecological psychology. In W.H. Warren, Jr. & R.E. Shaw (Eds.), *Persistence and change: Proceedings of the first international conference on event perception* (pp. 1-27). Hillsdale, New Jersey: Lawrence Erlbaum Associates.