Non-intelligent perception

Some researchers have proposed that perception is intelligent (e.g., Gregory, 2001; Kennedy, 2001; Rock, 2001); that some kind of intelligent inference is made every time an object in the world is perceived, or, stated in other words, that perceiving is problem-solving, or hypothesis-making (Gregory, 1980, 1997, 2001). Mayer, Caruso and Salovey (1999) list three criteria an intelligence must meet "before it can be considered scientifically legitimate". In the present paper, three theories of intelligence in perception will be examined and criticised, and they will all be shown not to follow the third criterion: "the abilities of the intelligence should develop with age and experience" (Mayer, Caruso and Salovey 1999, p. 267), from now on called C3. Several other objections to the notion of intelligence in perception will also be raised. The three theories of Rock, Kennedy, and Gregory will be examined in turn, and hopefully, their weaknesses will be exposed on the way. It will be concluded that the concept of intelligent perception is not a useful one.

Rock (2001) investigated visual illusions such as the Ames room (fig. 1) and the elongated horse (fig. 2). Since these illusions persist even when the observer knows what is going on, the most obvious conclusion to draw would be that perception is rather stupid, since it does not learn even as the perceiver does. Rock draws the opposite conclusion, because he holds that these effects can be explained if perception relies on inference and rule. Take the Ames room illusion, for example. Since the observer is only using one eye, normal depth-cues from stereoscopic vision are not available. Hence, Rock observes, it is "a 'plausible' assumption on the part of the brain that the rear wall is in a place perpendicular to the line of sight" (pp 16-17). Why this is a plausible assumption, he does not explain. He could not possibly rely on the observer having seen many rooms before, and hence knowing that rooms in general are of so-and-so shape, since he holds that perception is “autonomous and insulated from knowledge” (p. 9). Neither does it seem plausible that evolution would have provided humans with rules that make rooms-with-this-shape easier to perceive than rooms with other, and to us, implausible shapes, since rooms are a relatively modern invention. But, following Rock, this assumption is made, and from this it correctly follows that the person to the left in the room appear smaller than the person to the right in the room, presumably because of their different relative sizes on the retina, in relation to what appears to be a ‘normal room’. This is what Rock wants to call “an intelligent process” (p. 17).

Figure 1. The Ames room. Source: Pettijohn (1999).

Rock (2001) goes on to consider the case of the elongated horse (fig 2). He explains this effect as one that has to do with what the Gestalt theorists would call good continuation. The brain rejects coincidences, and two halves of a horse behind an occluder is too much of a coincidence, it *has* to be a long horse; therefore, we see a long horse. “[T]he perceptual system, like a good detective, rejects the conclusion that a coincidence has occurred in the eyes” (p. 20). Again, he wants to call this ‘reasoning’ an intelligent process. But the analogy is weak. A *good* and *intelligent* detective would certainly take into account his knowledge about horses, and conclude that there are two horses behind the occluder, or that a horse has been sawed in two, or that there is some other trick. He would *not* conclude that there was, indeed, a long horse. Rock would presumably answer that the knowledge of the perception is separated from the knowledge of the perceiver, and that perception follows its own rules, applying its own knowledge in an intelligent way.

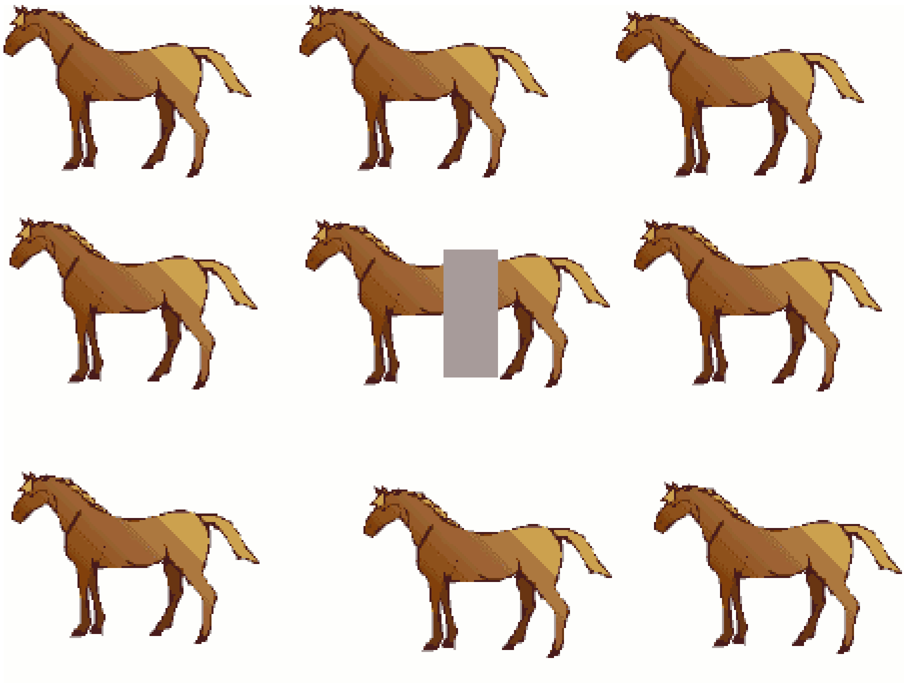

Figure 2. The horse in the middle looks longer even when surrounded by normal horses. Adapted from I. Rock (2001).

Even if one agrees with Rock that perceptions relies on inference and rules, as might be argued from the cases above, it is still not clear why it should be considered as intelligent. First, it does not seem to hold up to C3; it does not develop with age and experience. Even when the Ames room illusion is explained, it persists; and the elongated horse still seems long after it has been pointed out that this is an illusion. Secondly, an entity that draws conclusion based on inference rules is certainly not intelligent by that account alone, as this is something a relatively simple computer program can do (e.g., Luger & Stubblefield, 1998); no one who can read the computer code would claim the program was intelligent; it is in fact rather obvious that it is following simple rules in a quite dumb manner. This might be true for human perceptions too, of course. Persistent illusions might be explained by a dumb, inference-making, rule-following system, which does not know how to include new information, or how to correct its mistakes, and which is oblivious to its foolish errors.

Kennedy (2001) discusses quite different reasons for why perception should be called intelligent. Following J. J. Gibson, he examines information, or clues, given by the environment: texture gradients, optic flow, and accretion and deletion (occlusion and disocclusion). Light, he points out, conveys information because it has a kind of “specificity” (Kennedy, 2001, p. 33). For example, you can only see a wolf if there is actually a wolf present (this is not falsified by, for example, a picture of a wolf; in that case, you do not see a wolf, you see *a picture of a wolf*, which is something else). Because of this specificity, life could evolve that took advantage of the information present in light. For this information to be useful, though, it has to be analysed in some way, using built in general principles. These principles are, maybe amongst others, those of texture gradients, optic flow, and accretion and deletion, which tell us about invariant, higher-order properties of the environment (Gibson, 1979).

Texture and gradients tell us about surfaces. The optic gradient is “the rate of change of the density of optic texture” (Kennedy, 2001, p. 35). When this rate of change is constant, we see a continuing, flat surface; but if the gradient changes suddenly, this indicates a change of surface. Optic flow happens when the observer moves in relation to his environment. Objects to the left or right of the observer become farther to the left or right as he moves towards them. Only the point directly in front of him stays at the same place. The subjective speed of movement is estimated by the change in angle per-unit-time (Kennedy, 2001). For example, Lee and Raddish (1981) showed that plummeting gannets use the quantity τ to estimate time to impact with a target, where τ is a parameter of flow in the optic array. The third general principle of analysis is that of accretion and deletion. When an opaque object moves in front of a texture, say, from left to right, the right end of the texture is deleted from view, and the left end is accreted at exactly the same rate. This tells us that the object is in front of the texture (Kennedy, 2001).

Kennedy concludes that perception uses geometry, and calls this "Smart Geometry". It is not clear to what extent he would call perception intelligent. As Neisser (2001) points out, these three ways of acquiring information may "just [be] adaptation at its best" (p. 80). On that account, the quantity τ used by the plummeting gannet is not *calculated*, the "perceptual system has direct sensitivity to it, much like a velocity meter is sensitive to velocity without measuring meters and seconds" (van Leeuwen, 1999, p. 272). This may be a highly efficient way of acquiring information from the environment, but it is hardly an intelligent process. Furthermore, to the degree that this 'smartness' is provided by evolution, it does not hold up to C3. These same arguments also apply to the information gathered from the other environmental invariants.

The third and last account of intelligent perception to be considered in this paper is argued by Richard Gregory, who holds that perceptions are to be likened to hypotheses in science (Gregory, 1980, 1997, 2001). Hypothesis in science lets us interpolate and extrapolate from available data (Gregory, 1980); they let us fill in gaps in the data, and predict the future. As such "perception is smart – making intelligent use of knowledge stored from the past" (Gregory, 2001, p. 51). We *see* that an ice cream is cold, because we have experienced ice creams to be cold in the past, and we extrapolate this knowledge into what would happen if we came in contact with an ice cream again. Thus, perception is to a large extent governed by a top-down process, where stored knowledge helps behaviour "escape the tyranny of reflexes" (Gregory, 2001, p. 51). Gregory's main example is the hollow mask; it is almost impossible not to see a normal face even when the mask is looked at from behind. For Gregory, this is a prime example of how information guides our perceptions. Neisser (2001) points out that this is a special case; there is strong evidence that there are special neural mechanisms for face-recognition (Andreasen et al., 1996). Still, there is a general tendency to view objects as convex, even though this tendency is weaker for other objects than faces (Gregory, 1997). So, the mind-brain comes up with an hypothesis about what the real world is like, probability guiding it to believe that most objects, and especially faces, are convex, and this hypothesis *is* the percept. Old knowledge, in the form of analogies, is used to make sense of new situations.

Gregory proposes a model in which top-down knowledge of the past, together with "side-ways rules", help guide what we perceive from the bottom-up action potentials from the retina (Gregory, 2001, p. 62). The side-ways rules are interventions, such as algorithms and attentional selection; here might lay an opening for 'free will' in Gregory's model. He recognises that human beings are not mere passive receivers of information by adding on an "input task" component to his model; we do not only *see* the world, we *interact* with it, constantly receiving feedback and changing our behaviour accordingly. Finally, he recognises that consciousness, or qualia, plays a role, and speculates that qualia might be the brain's way of flagging the present, so that it is not confused with memories from the past (Gregory, 1997); in doing so he avoids the zombie problem that riddles Gibsonian perceptual theory (van Leeuwen, 1999).

Thorough as Gregory's (2001) model may seem, it still does not answer the question of why illusions persist. According to Gregory, perception has its own knowledge store, somewhat separated from the rest of the perceiver's knowledge, where information slowly seeps through from one store to the other. This must be so, he holds, for two reasons. First, we must be able to experience new percepts, without being bound by what we already know. Second, perception must be fast in order for us to survive; hence requiring a smaller and quicker memory store. But since his theory to a large degree relies on our ability to learn from what we perceive (which holds up to C3), it is inconsistent with the observation that visual illusions persist (which does not hold up to C3), even for a lifetime (as noted by Gregory himself). As has been pointed out several times in this paper already, the perception system sometimes fail to reveal to us the "true" properties of the world, and often, it cannot learn from its mistakes.

In the present paper, three different theories of intelligent perception have been examined in some detail; different problems with the three accounts have been identified, and furthermore, it has been shown that none of them hold up to one criteria for an intelligence: that it should develop with age and experience. It would be natural to conclude that, at the least, the notion of an intelligent perception is not a useful one. At the present, it does not add to our understanding of what perception is, it might even confuse and distort it.

References

Andreasen, N. C., O'Leary, D. S., Arndt, S., Cizadlo, T., Hurtig, R., Rezai, K., Watkins, G. L., Ponto, L. B., & Hichwa, R. D. (1996). Neural substrates of facial recognition. *Journal of Neuropsychiatry and Clinical Neuroscience, 8*, 139-146.

Gibson, J. J. (1979). *The ecological approach to visual perception.* Boston: Houghton Mifflin.

Gregory R. L. (1980). Perceptions as hypotheses. *Philosophical Transactions of the Royal Society of London - Series B: Biological Sciences*, *290(1038)*, 181-97.

Gregory R. L. (1997). Knowledge in perception and illusion. *Philosophical Transactions of the Royal Society of London - Series B: Biological Sciences*, *352(1358)*, 1121-7.

Gregory, R. L. (2001). Action potentials to potential actions. In T. E. Parks (Ed.), *Looking at looking: An introduction to the intelligence of vision* (pp. 51-71). Thousand Oaks: Sage Publications.

Kennedy, J. M. (2001). Smart geometry! In T. E. Parks (Ed.), *Looking at looking: An introduction to the intelligence of vision* (pp. 31-49). Thousand Oaks: Sage Publications.

Lee, D. N., & Raddish, P. E. (1981). Plummeting gannets: A Paradigm of ecological optics. *Nature*, *293*, 293-4.

van Leeuwen, C. (1999). Perception. In W. Bechtel, & G. Graham (Eds.), *A companion to cognitive psychology* (pp. 265-281). Massachusetts: Blackwell Publishers Ltd.

Luger, G. F., & Stubbelfield, W. A. (1998). *Artificial intelligence. Structures and strategies for complex problem solving* (3rd ed.). Sydney: Addison-Wesley Longman.

Mayer, J. D., Caruso, D. R., & Salovey, P. (1999). Emotional intelligence meets traditional standards for an intelligence. *Intelligence, 29*, 267-298.

Neisser, U. (2001). Admirably adaptive, occasionally intelligent. In T. E. Parks (Ed.), *Looking at looking: An introduction to the intelligence of vision* (pp. 75-81). Thousand Oaks: Sage Publications.

Pettijohn, T. F. (1999). *Psychology: A ConnecText* (4th ed.). New York: McGraw Hill College Div.

Rock, I. (2001). Stupid perceptions? In T. E. Parks (Ed.), *Looking at looking: An introduction to the intelligence of vision* (pp. 3-29). Thousand Oaks: Sage Publications.