Diagrams and a Theory of Seeing

Sun-Joo Shin

Department of Philosophy
Yale University
New Haven, CT 06511

In *Situations and Attitudes* Barwise and Perry aim to present a semantics which is more comprehensive than any existing formal semantics. Their method is to focus on information flow, which is the main role of the use of language. After developing their Situation Semantics, they test out the theory on statements with attitude verbs (e.g. 'see,' 'believe,' 'know,' etc.) and examine logical principles for 'see.' In this paper, I take their discussion of 'see' as a spring board to investigate the role of perception in diagrammatic reasoning.

Barwise and Perry made a distinction in the ways in which the word 'see' is used to report perceptual attitudes: *epistemologically neutral* and*epistemologically positive perceptual reports*(p. 179). (1) is an example for the former and (2) for the latter:

(1) Mary saw Prof. Barwise and Prof. Perry talking about her paper.

(2) Mary saw that Prof. Barwise and Prof. Perry were talking about her paper.

A picture of Mary and the two professors in an appropriate situation could be enough to prove the truth of (1), but for (2), we also need Mary's cognitive states. To disambiguate two different kinds of perceptual reports, they adopt the notations see_n and see_t.

After making two kinds of seeing depending on whether it is epistemologically neutral or positive, again, under see_t they introduce Dretske's distinction of *primary* see_t and *secondary* see_t, depending on whether it is the report of knowledge by direct perception or the report of knowledge based on direct perception plus one's assumption, belief, knowledge, etc. As an example,

I saw_p that the tree was whipping around, so I saw_s that the wind was blowing. (p. 194)

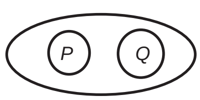
The taxonomy they drew for 'see' implies that only see_t, not see_n, could be ambiguous depending on whether one's extra-knowledge is used for the epistemic report. In this paper I claim a similar distinction can be drawn for see_n and I show that the distinction of *primary* see_n and *secondary* see_n highlights one of the fundamental differences between symbolic and diagrammatic representation.

Hanson starts his book *Patterns of Discovery* with a scenario about two people watching the sun rising. Kepler knows that the earth moves around the sun, but not Tycho. A question is whether Kepler and Tycho see the same thing or different things. According to Barwise and Perry's analysis of 'see,' they see_n the same scene, they $\text{see}_{t(p)}$ the same situation, but what they $\text{see}_{t(s)}$ is different because of their different astronomical knowledge. As an example for differences in $\text{seeing}_{t(p)}$, suppose you and I are watching a football game together and you know the game very well and I don't at all. Suppose that one player violated a rule, and call that foul scene s. You and I were watching s, and you realized what happened, and I did not at all. Did I see_n the same thing as you did? Now, our intuition is more vague than in the Kepler-Tycho case, since our difference in knowledge seems to directly matter more to what we see in this case than the previous one. Still, there is room to preserve the neutrality of see_n in this example. You and I saw_n the player's movements, but I did not see_t that the player was violating a rule of the game. One can see whether a player violates a rule *only when* one knows what a violation consists of. So, we are different in what saw_t in the primary sense (therefore, in the secondary sense as well).

Then, is the report made by b SEES_n ϕ always only epistemically neutral as Barwise and Perry seem to assume? In order to raise a question about this neutrality, let me draw your attention to a well-known example, Necker's cube (which Hanson also uses in his *Patterns of Discovery*). There are two ways to perceive Necker's cube. Suppose person A saw it as a cube facing down (let's call it 'cube_d') and person B saw a cube facing up (let's call it 'cube_u'). Do A and B see_n the same thing? Some might insist that what they see_n is the same Necker's cube, but what they see_t (either $\text{sees}_{t(p)}$ or $\text{sees}_{t(s)}$, or both) are different because of the different interpretations of the same cube. This solution has at least two problems. One is that, unlike with the Kepler-Tycho case, when one sees_n Necker's cube, he is bound to see one cube or another and there is no epistemically neutral cube scene. Second, when we see a cube, do we interpret a cube in a certain way based on our belief or knowledge? I do not think so. There is no time or room for interpretation in the same sense as in the Kepler-Tycho case or the football game case. Which cube, cube_d or cube_u, is seen_n by me is not determined by my belief or knowledge about a cube or any other things, but by which part of the cube I happen to focus on or from which perspective I happen to look at the cube. At this moment, the reader might recall Wittgenstein's rabbit-duck or Gestalt psychology's endless examples, e.g. the vase-facing faces picture. Now, we have a great temptation to conclude that we see_n different things.

However, I find a grain of truth in Barwise and Perry's intuition about the epistemic neutrality of seeing_n. In the above three examples, we cannot deny that there is something common that two observers (in each case) are seeing_n. Therefore, I claim that Dretske's primary versus secondary distinction be adopted in the case of see_n as well. I show this more fine-grained distinction nicely explains the efficiency that certain features of diagrammatic representation brings in.

The Alpha system of Charles Peirce's Existential Graphs was proven to be logically equivalent to propositional logic by Zeman and Roberts. In my work (Chapter 4 of *The Iconic Logic of Peirce's Graphs*), I presented a new reading algorithm of the Alpha system (called "Multiple Readings method") and argued that the Multiple Readings method is more intuitive and natural than the existing method (called "endoporeutic reading") since the former implements the practice of our perceiving graphs better than the latter. Let me illustrate this point by a simple example. The endoporeutic reading algorithm translates the following Alpha graph into propositional sentence '$\neg(\neg P \wedge \neg Q))$' only, (i) by interpreting cuts as negation and juxtaposition as conjunction, and (ii) by reading it from the outside inwards:



On the other hand, according to the Multiple Readings algorithm, as its name suggests, more than one translation may be directly obtained depending on how the reader happens to perceive a given graph. Given the above graph, let us discuss five possible cases. (For more details about how to apply the algorithm, see §4.3 of *The Iconic Logic of Peirce's Graphs* by Shin.)

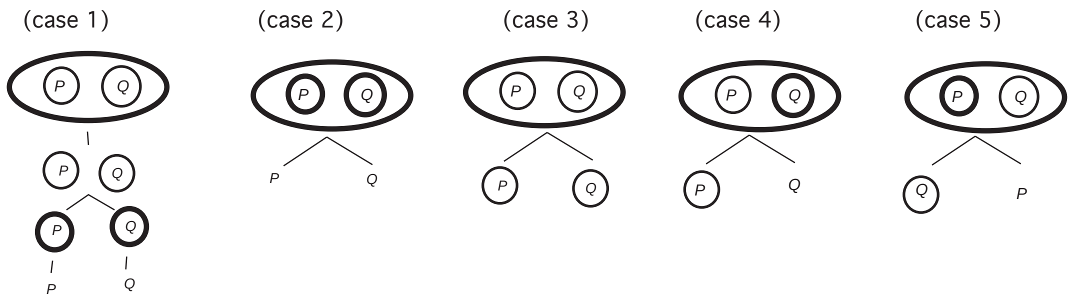
(Case 1) As Peirce originally instructed us, some reader might perceive this graph from outside inwards. Then, we get '$\neg(\neg P \wedge \neg Q))$.'

(Case 2) Some reader might pay attention to the following visual features: Both P and Q are enclosed by an even number of cuts, and these are juxtaposed in an area enclosed by an odd number of cuts. Then, the algorithm yields us the sentence '$P \vee Q$.'

(Case 3) Some might notice that both a cut of P and a cut of Q are enclosed by an odd number of cuts and they are juxtaposed in an odd area. So, the reading '$\neg\neg P \vee \neg\neg Q$' is obtained.

(Case 4) In some case, the scroll (i.e. one cut inside the other) might catch the reader's eye. Then, the graph is read off as '$\neg P \rightarrow Q$.'
(Case 5) Similarly, the reader reads off a scroll, but the other form of a scroll. So, we get the contraposition of case 4, that is, '$\neg Q \rightarrow P$.'

Let me illustrate the cases by highlighting the cuts which catch the reader's eye first:



A graph, unlike a language in a linear system, can be perceived in more than one way depending upon which way the reader happens to carve up the given graph. Let me call the non-uniqueness of the ways of perceiving one and the same graph the "Multiple Carving Principle." This principle reflects a fundamental difference between diagrammatic and symbolic representation, and I argue that this difference can be analyzed by the distinction between two kinds of see$_n$.

Do the readers in the above five cases see$_n$ the same Alpha graph or different ones? I do not think the different ways each reader carves up the graph has something to do with their belief or knowledge, but the differences take place at a purely perceptual level. Being quite similar to the Necker's cube case, they all see the same Alpha graph in some sense, but they see it in a different way, depending on where the reader happens to focus. Hence, they see different graphs in another sense. Dretske's primary and secondary distinction which Barwise and Perry adopted for see$_t$ can be used for see$_n$, that is, see$_{n(p)}$ and see$_{n(s)}$. However, unlike with the see$_{t(p)}$ and see$_{t(s)}$, no judgment or knowledge is involved, but the difference is between neutral and biased (i.e. how it is perceived by an observer) perceptual reports. So, in our Alpha graph example, everybody is seeing$_{n(p)}$ the same thing, but each person in each case see$_{n(s)}$ a different thing. In the case of a symbolic language, the syntax is set up so that we may perceive one and the same sentence in only one way. That is, there is no distinction between what the reader sees$_{n(p)}$ and what he sees$_{n(s)}$. Furthermore, a symbolic system blocks any possibility of the difference between see$_{n(p)}$ and what he see$_{n(s)}$. For example, a string '$P \rightarrow Q \vee R$' is not well-formed, since the reader might see$_{n(s)}$ different strings, depending on how to carve up the string, either $(P \rightarrow Q) \vee R$ or $P \rightarrow (Q \vee R)$. This would cause an ambiguity, which is a disaster to a representation system.

Importantly, the Multiple Readings method which implements the Multiple Carving principle may yield us more than one translation, but all of them are logically equivalent to one another. This interesting fact increases the efficiency of the system. In the case of the five sentences obtained in the above five reading cases, we need to show at least six derivations to prove the logical equivalence among them. However, we do not need any manipulation if we use the Alpha system. By the fact that what the five people see$_{n(p)}$ are the same graph and by respecting the differences among what they see$_{n(s)}$, we can show that all of these five sentences are logically equivalent to one another. No effort for manipulation is needed.

To conclude: In the case of a non-linear system, the see$_{n(p)}$ versus see$_{n(s)}$ distinction is almost inevitable, since how to carve up a diagram or where to focus could make a difference in what we see$_{n(s)}$. Therefore, a correct algorithm respecting this distinction and allowing multiple readings can increase the naturalness and the efficiency of the system, while a linear system which does not allow the distinction between see$_{n(p)}$ and see$_{n(s)}$ requires a unique reading.