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Background Processes Influence Perception at Every Level

Throughout history, the relationship between consciousness and the external world has been debated. As might be expected, philosophers have taken positions ranging from the notion that consciousness can have veridical knowledge of the external world to the notion that consciousness cannot know the external world (Binswanger, 1989; Kelley, 1986). Objectivism, the philosophy with which I am most familiar and which will be discussed in this paper, takes a ground that is somewhat between these artificial extremes. In Objectivism, consciousness has an identity, and so our knowledge of the external world depends on an interaction between the nature of our consciousness and objects in the external world. To be more specific, Objectivism takes a position about perception, the component of consciousness that identifies the nature of the external world, that is best described as realism. In realism, the sensory stimulus is all that consciousness uses to construct percepts, and our perception of the world is unmediated by background information.

In what follows, I will lay out some of the facts that Objectivists use to support this position. In many places, such as the nature of sensations, Objectivists are in clear agreement with the dominant beliefs in perception research. In others, their view differs radically from the standard view. The goal of this paper is two-fold. First, I want to delineate the Objectivist position on perception, with particular emphasis on its automatic nature. Second, I want to present research that leads me to question this position. I will begin with memory research to show how our expectancies, and some general biases, influence what we remember. After this, I will discuss other situations where our perceptual biases influence how we interpret a given scene; that is, how we identify objects. Third, and in some sense most crucially, I will present evidence that percept formation—that is, making the objects in consciousness—is also influenced by biases and involves choosing between multiple possible interpretations of the data. Finally, I will present data that shows that sensation itself is not automatic in the sense that Objectivists use the term.

Rand, the founder of Objectivism, rather uncontroversially asserts that sensations are automatic responses to stimuli from the external world, which only last as long as the stimulus that produced them. Rand further argues that perceptions are automatic integrations of sensations, which allow the sensations to be retained. As Rand (1964) says, "A 'perception' is a group of sensations automatically retained and integrated by the brain of a living organism, which gives it the ability to be aware, not of single stimuli, but of entities, of things" (p. 20, emphasis added). Later, in her work on epistemology, she reiterates the point, "On the lower levels of awareness, a complex neurological process is required to enable a man to experience a sensation and integrate sensations into percepts; that process is automatic and non-volitional" (1979, p. 29, emphasis added).

Thus, for Rand, in the same way that sensations are automatic responses to external stimuli, percepts are automatic integrations of sensations. Automaticity is key for the Objectivist position, for the objects of perception are the starting points of cognition, or epistemological primaries. This makes the facts of perception “self-evident” and “incontestable” (Peikoff, 1991, p. 54). The possibility of error is only introduced later, at the conceptual level of awareness (p. 40).

There are multiple meanings of the notion of automatic. One could argue, for instance, that automatic simply means quickly and without much effort. One could also argue that automatic means something more along the lines of “inevitably.” In explaining her notion of automatic, Rand writes that animals cannot “seek or evade” automatic knowledge (1964, p. 20); Peikoff expands this, writing that sense organs, being automatic, have “no power of choice, no power to invent, distort, or deceive” (Peikoff, 1991, p. 40). Thus, the later sense of automatic seems closest to what Objectivism means. This idea is similar to what cognitive scientists call “cognitively impenetrable.” In other words, sensations are integrated into percepts without conscious influence; neither our thoughts, hopes, fears, expectations, nor the like are expected to influence percept formation.

Given the position that we automatically integrate sensations into percepts, it would make little sense for Objectivists to argue that this involves multiple potential percepts. If there is “no power of choice,” then it makes no sense to speak about choosing among multiple potential percepts. To illustrate: If the sensory data from a scene of a cat in a chair always automatically leads me to form the percept of a cat and a chair, and automatically links the sensory data coming from the cat into the percept of a cat, then it makes no sense to speak about having to decide if some sensory data comes from the cat or the chair.

This is the crux of the Objectivist argument: percept formation is automatic. In fact, however, any given sensory data can potentially be represented by multiple potential percepts. The rest of this paper will be devoted to expanding on this notion, illustrating that identical sensations can be integrated into multiple percepts, that percepts are undetermined by sensations. Second, I will show that our conscious perceptual knowledge results from inferences made about sensory data, inferences that are open to conscious influence. In so doing, I will show that there are three ways that we determine what the objects of perception are: what sensations are grouped together into specific percepts; what the percepts are (e.g., trapezoid or tilted square); and, finally, what category the object belongs to (e.g., that is a person, so they must be a mammal).

I will start with relatively uncontroversial examples from memory on how our expectations, needs, or other processes (which I will just call background processes) influence our recollections of events. I will then show how the same processes are at work in our recollection of sensory data. It is hoped that this will set the stage to illustrate how this process also influences how we perceive objects.

There are multiple ways that background processes influence memory. They influence how we remember what we remember, how we encode information, and what we look for.

First, background processes influence how we remember scenes and objects. Specifically, we tend to regularize scenes and objects, remembering them more as we expect them to be than as they are. Wulf (1938) showed subjects several figures and asked subjects to draw them immediately and at times later (e.g., a day, a week, and two months). Wulf discovered that memory traces undergo several definite changes once in memory. Over time the objects in subjects’ drawings were leveled and sharpened; leveling was “a weakening or toning down of a particular pattern; sharpening was “an increase of exaggeration" (Koffka, 1935, p. 498). In general, the objects in the drawings were normalized, changing in structure to "approximate more and more some well known structure" (Wulf, 1938, p. 140).

Carmichael, Hogan, and Walter (1932) found similar processes at work in their subjects' reproduction of figures. One of the main differences between theirs and Wulf's work was that they labeled the objects for the subjects, and this label influenced how the subjects recalled the objects. For example, they showed somewhat ambiguous objects to subjects and told one group of subjects that they were looking at the number 7, and another group that they were looking at the number 4. When they were asked to recall the object, subjects drew the ambiguous object as looking more like its standard form; thus, those who were told that it was a 7, drew a 7.

Finally in their classic study of rumors, Allport and Postman (1945) found similar process at work as they asked subjects to describe what they had heard to other subjects. Just as expected from the classic game of telephone, as the message got passed along, it got altered. The story changed, however, in rather predictable ways. The story was sharpened and flattened in ways that fit general themes and expectations. For example, a drug store that was presented in the middle of a block was moved to the end of it (to become the "corner drugstore") and a series of ads on a wall became one big ad.

Thus, as we have seen, background information can alter memory. More importantly, it tends to alter our memories to make them more consistent with our prior beliefs and expectations. In a similar way, subsequent knowledge can alter our memories of events.

In a series of studies, Elizabeth Loftus has performed some of the best experiments showing that perceptual memory is influenced by background processes. The general design in her experiments is that a car comes through an intersection and either hits a pedestrian or is in some accident. Loftus and her colleagues have found that they are able to alter the subject's memory of the event by the types of questions that they ask.

For example, Loftus showed her subjects pictures of a car passing either a stop sign or yield sign. Then, she asked them questions about either a yield sign or a stop sign (Loftus, Miller, & Burns, 1978, Experiment 1). For example, they asked, "Did another car pass the red Datsun while is was stopped at the stop sign?" The subjects were then asked to pick the slide they saw. If the slide was consistent with the question, 75% picked the correct sign. If the question was inconsistent, then only 41% did.

The nature of questions can also alter memories in more subtle ways. For instance, just by changing an article from "a" to "the", Loftus and Zanni (1975) caused more subjects to make a definite statement about whether they saw something and more subjects to introduce items that were not present. For example, participants asked the "Did you see the broken headlight?" were more likely to claim that there was a broken headlight than were participants asked the question "Did you see a broken headlight?"

Finally, the effect of the question seems to depend on whether one's question presupposes the existence of something or not (Loftus, 1975, experiment 4). This might explain the a/the distinction. In one experiment, Loftus either directly asked subjects if they saw some object in the crash scene (e.g., a school bus) or asked them the same question indirectly (e.g., did you see students getting on the school bus?). Those who had gotten the indirect questions were more likely to say that they had seen nonexistent items in the film than the subjects who got the direct questions.

In related experiment, subjects who were asked how fast two cars were going when they hit produced lower estimates of the cars' speed than subjects who were asked how fast the cars were going when they smashed. Further, those who gave higher estimates of the speed at which the cars were traveling were more likely to think that they had seen broken glass (Loftus & Palmer, 1974). Thus, people's memories rely not only on what they have witnessed or experienced, but also on cues about what they might have witnessed or experienced. Such cues may come from general knowledge of the world (as with the corner drugstore) or from questions they are asked about their experience.

These studies show that memory, both for scenes and for objects, is influenced by background information.

Background processes also influence how much we encode in memory and what we encode. Context relevant details, for example, are more likely to be remembered immediately, and somewhat less likely to be forgotten later (Prichert & Anderson, 1977). In their experiment, they had subjects read passages from one of two perspectives, and later asked them to recall details from the passages. For example, subjects who read a description of a house while taking the perspective of a burglar remembered more details that would be important for a burglar (e.g., that they kept the door unlocked) than details that would be important if they were buying the house (e.g., that the roof leaked).

Providing a context prior to presenting information facilitates comprehension and recall (Bransford & Johnson, 1972). In their experiments, Bransford and Johnson presented subjects with an appropriate picture or a semantic label before or after presenting a passage. For example, they gave subjects the following passage:

> The procedure is really quite simple. First you arrange things into different groups depending on their makeup. Of course, one pile may be sufficient depending on how much there is to do. If you have to go somewhere else due to lack of facilities that is the next step, otherwise you are pretty well set. It is important not to overdo any endeavor. That is, it is better to do too few things at once than too many. In the short run this may not seem important, but complications from doing too many can easily arise. A mistake can be expensive as well. The manipulation of the appropriate mechanism should be self-explanatory, and we need not dwell on it here. At first the whole procedure will seem complicated. Soon, however, it will become just another facet of life. It is difficult to foresee any end to the necessity for this task in the immediate future, but one never can tell. (p. 722)

The subjects who were told that the passage was about doing laundry prior to hearing the passage recalled more items than subjects who were not given a context or given the context after reading the passage.

These last two studies indicate that background processes influence how we search our environment. In other words, background processes influence what we look for, which can only influence what we remember about a scene.

There are other studies that make the point somewhat differently. For example, when people are taken into a room, what they remember being in the room depends on what type of room they think they went into. For example, in one experiment, individuals were taken into what they believed to be a graduate student's office, left for about 35 seconds, and then taken to another room tested for objects that were in the office (Brewer & Treyens, 1981). Subjects made just the kind of identifications and errors that would be expected if they were reconstructing their memory of the scene based on the knowledge that it was a graduate student's office. For example, they mentioned things that would likely be in a graduate student's office even if they actually were not. They were also more confident that things that fit the stereotype were in the office than things that were not.

As memory has long been known to be reconstructive, this material is fairly uncontroversial. What we expect influences what we look for, how and whether we encode it, and what we remember. We can, I think, extend this argument to cover perception.

In order to substantiate this claim, I want to again start with uncontroversial examples. We can localize light and sound sources with a high degree of accuracy. That is, if we are presented with a tone or a flash of light, we can accurately point to where the flash or tone came from. In natural conditions, a sound can usually be quickly localized to an object because they will be coming from the same direction. It is interesting to examine what happens when sounds and lights come from different directions (Bertelson & Radeau, 1981). In their experiment, Bertelson and Randeau presented simultaneous flashes of light and tones come from the same location or from different locations and asked subjects to point to where they heard the tone or saw the flash. They found that subjects were greatly biased to hear the tone come from the direction of the visual stimulus. There was also a mild effect for subjects to see the flash of light in the direction of the source of the sound. These processes underlie the ventriloquism effect.

Interestingly, this bias to look in the direction of the appropriate sound appears early, at least for language. In a series of experiments, Kuhl and Meltzoff (1982; Meltzoff, 1990) had infants sit between two faces articulating either an /a/ sound (as in "pop") or an /i/ sound (as in "peep"). Between the two pictures, there was a speaker playing one of the two sounds. Kuhl and Meltzoff predicted that infants would look longer at the face articulating the vowel sound that went with the one being spoken. This is what they found.

Not only does vision influence where we hear sounds originate from, visual expectations also influence what we hear. If subjects are asked to listen to a recording of someone repeating syllables (e.g., ba-ba or ga-ga), they are quickly able to identify the syllables. However, if they are asked to listen to one set of syllables (e.g., ba-ba) while watching someone produce other syllables (e.g., ga-ga) they hear a different syllable: da-da (McGurk & MacDonald, 1976).

The general conclusion from this line of research is that we have expectations about how the world is organized. We use these expectations to guide the interpretation of the world.

This still might not be a real problem for the Objectivist argument. It could be said, for instance, that we automatically, or always, interpret the world in this way. That is, we might err, but the error itself is an indication of the unmediated aspects of perception. However, other findings from perception research may be even more difficult to reconcile with the Objectivist position.

In English, there are many homonyms (i.e., words that sound the same but have different meanings). It is an empirical question about whether we actually have to make a decision about which meaning of a homonym is intended in a given context. It could be argued, for instance, that consciousness uses the context to automatically access the correct meaning of the word, and not the contextually inappropriate meaning. One way to test this idea is to examine response times to picking the correct meaning. In a series of experiments Swinney and colleagues have studied this question (Onifer & Swinney, 1981; Swinney, 1979).

The logic of Swinney's experiments is as follows: Without any systematic effects, subjects should take equally as long to determine whether a given letter string is or is not a word. If, however, there are systematic effects (e.g., context), then subjects should be faster at identifying a contextually appropriate letter string as a word. For example, if I read a story using the word "tax," subjects should identify contextually appropriate words faster (e.g., income). We can expand this argument to determine whether or not consciousness uses contextual cues to solely and automatically access the appropriate meaning of a word. If I only access the appropriate meaning of the word, then only the contextually appropriate meaning should be primed in a given context; that is, if I hear a story using one homonym (e.g., tax) in the appropriate context, only "income" should be primed and not the contextually inappropriate "nails." Or, if I use "bail," in an appropriate context, only "jail" should be primed, and not the contextually inappropriate "bucket."

This is not what Swinney found. He found that both meanings of the homonym were primed. That is, subjects were also more quickly able to identify the contextually inappropriate word as a word than irrelevant words. In Swinney's interpretation, both meanings of a homonym are briefly activated (the multiple priming only lasts for about three syllables). While the priming effect is brief, it clearly indicates that background information influence how we interpret ambiguous stimuli in a natural context.

This later point is very important. Previous researches have presented ambiguous images (e.g., Necker's cube, duck-rabbit) and argued that subjects use background processes to influence how they interpret the ambiguous figure. Kelley (1986), however, made the cogent point that just because background knowledge plays a role in impoverished conditions it need not play one in normal conditions. Thus, he argued, just because subjects have to use background processes to understand Necker's cube does not mean they have to for normal objects. Swinney's results show that subjects do use background knowledge when interpreting ambiguous stimuli.

This example is relevant in a different way as well. Although most of Kelley's (1986) arguments deal with visual perception, we must remember that consciousness has other types of access to the world. In auditory perception, one can look at a spectrograph of a sentence. The conscious perception of words as discrete units does not match the observed breaks in the spectrograph.

There are other examples that make this point as well: we entertain many guesses about what an object might be before we decide on it. These guesses, however, usually go unnoticed because they occur so quickly and, very often, do match the structure of the world. Let me first demonstrate some of our assumptions about the world, and then how this influences object perception. One general point can be stated at the outset: whenever we have perceptual biases, we are able to find situations that do not meet the conditions under which the biases usually operate. It is those conditions that we would expect errors.

We assume, for instance, that the world remains stable during the brief time it takes us to make saccades. Researchers have shown that altering a stimulus during a saccade is not noticed by subjects. For example, in several studies subjects practiced reading a text with adjacent letters alternating between lower and upper case (e.g., TwAs BrIlLiG aNd ThE sLiThY tOvEs DiD GyRe AnD gYrE aNd GiMbLe In ThE wAbE). Then, the experimenters alternated between cases every time subjects made saccades, or quick movements that the eyes make when moving from one fixation point to the next (e.g., TwAs BrIlLiG would change to tWaS bRiLlIg). The subjects did not notice this manipulation and it did not affect their reading speed (McConkie & Zola, 1979; Rayner & Pollatsek, 1983).

Recent investigators have altered more dramatic parts of scenes. For instance, Grimes (1996) reports a series of experiments where subjects were told to study scenes for a memory recognition test. Subjects studied one scene, which was then altered in some non-too-subtle ways during a saccade. Subjects did not notice rather major changes; for example, the majority of subjects did not notice when two men exchanged hats or even exchanged heads, or when a child or a building was made 25% larger.

Change blindness also exists with artificially induced saccades. For example, O'Regan, Rensink and Clark (1999) found that subjects did not detect changes that occurred in scenes when a portion of the screen was occluded, even when the change was not in the portion of the screen that was occluded. Change blindness can also occur in strobelight-like conditions. In an experimental design known as the flicker design, a scene is presented and then occluded for a brief time, after which an altered scene is presented. Rensink, O'Regan, and Clark (1997) found that changes to items of marginal interest were less likely to be noticed than changes to items of central interest. Changes to central interest items still took nearly five seconds to notice, however.

Subjects are also more likely to notice changes to central objects, and there is some evidence that subjects use different processing strategies depending on the information content of an area of a scene (Antes, 1977). Subjects made more errors by assuming that contextually appropriate peripheral objects were in the scene than that contextually appropriate main objects were not.

In short, some large-scale changes can be made to full-color scenes, and subjects are likely to miss these changes, if the changes occur during saccades. Most likely, since changes are noticed if they occur independent of saccades or a flicker, change blindness is due to functional blindness during saccades. Thus, surprisingly, it seems that very little visual information that would allow some sort of visual integration is carried over from one visual fixation to the next (Henderson, 1997).

The relevance of all this to the problem at hand is fairly straightforward: we come to the world ready to assume that the world does not substantially during saccades. In other words, we expect that there will be no major changes. As a consequence, when there are changes during saccades, we do not notice them. Here, our expectations clearly influence what we do and do not notice in the visual world.

There is, however, a more fundamental problem with the Objectivist viewpoint that supports the viewpoint that perception decides among multiple possibilities. While percepts may be epistemologically primary, they are not perceptual primaries. In other words, we do not combine percepts to identify scenes but use scenes to identify percepts. We do not walk into an environment and think, "I see a stove, a sink, a coffee pot, so this must be a kitchen." Rather, we classify the environment as a kitchen based on large-scale features, and this facilitates the identification of the component objects.

There are several reasons to support this view rather than views that require us to build up a representation from fixations or views that require us to deduce the scene from objects. First, subjects are able to identify scenes prior to the first saccade (Potter, 1975). In her experiment, Potter (1975) found that subjects were able to categorize a scene based on the scene's meaning after just a 125 ms presentation. Other experimenters (e.g., Mackworth & Morandi, 1967) found that subjects are able to zero in on the most informative areas of a scene within two seconds.

Schyns and Oliva (1994) found that subjects used coarse features to identify a scene nearly three times as frequently as they used fine features. In their experiment, subjects viewed scenes either for 30 or 150 ms. Some of these scenes were normal; other were high or low passed (i.e., different spatial frequencies were present); other scenes were hybrids or low and high which emphasized low or high spatial frequencies. Subjects were then shown a second scene and were asked to determine if the second scene was the same as the first. During the short presentations, subjects relied on coarse features, and only used fine-grained features during the longer durations; this implies that coarse features, or those that can be represented by a low spatial frequency, are utilized prior to fine-grained features.

Many studies support the idea that a context typically promotes the identification of context appropriate objects. For example, Biederman (1972; Biederman, Glass, & Stacy, 1973) found that subjects were better able to detect objects in scenes that had an order to them versus jumbled scenes. Interestingly, Biederman, Glass and Stacy (1973) found that subjects were able to more quickly state if it an object was not in a scene if it was impossible for the object to be in the scene (e.g., an automobile in a kitchen scene). Palmer (1975) also found that context facilitated the recognition of objects. Of more interest, however, is his finding that in an inappropriate context subjects typically made mistakes by replacing contextually inappropriate objects with similarly shapes contextually appropriate objects (e.g., a mailbox would be replaced with a loaf of bread in a kitchen scene).

Thus, background processes influence every aspect of perception. It influences how we remember scenes, how we search scenes, and how quickly we are able to identify objects in scenes. Further, Swinney's work demonstrates that multiple interpretations of stimuli are entertained prior to deciding on a final interpretation. It still remains to be determined, however, how percepts are formed and objects recognized.

The answer to the first question is not known at the moment. A best guess is that Gestalt factors, such as closure and good continuation, influence how sensations are grouped (Palmer, 1999). This is still a powerful effect, however. For example, Palmer, Neff, and Beck (1996) showed that subjects assumed that occluded objects were completed by good continuation, and perceptually grouped occluded objects by their expected completed form, not their visual form.

This still leaves of with the question of how objects are described in a recognition system. As Marr (1982) rightly pointed out, a viewer centered object recognition system rapidly suffers from a combinatorial explosion of objects. Because the viewer-centered recognition system specifies objects from a specific vantage point, it is forced to treat distinct views of objects as distinct objects. In this case, the object-centered viewpoint has an epistemic advantage. It is more accessible, can represent a wider variety of objects, and can represent objects at multiple degrees of scale without losing fidelity. Further, as compared with the viewer-centered system, it is only necessary to store a single description of an object's spatial structure.

Following the reasoning of Marr (1982; Marr & Nishihara, 1978) the best idea at present for how objects are recognized is based on detecting their component structures. These component structures will most likely be volumetric primatives (i.e., the simplest components of objects). One version of this is Biederman's geon theory (1987).

Geons, or geometric ions, are simple volumetric shapes, such as cones, cylinders, wedges, or blocks, which lack any deep concavities. Objects are segmented into geons at regions of greatest concavity, and our internal representation of an object is of the component geons and a description of their structure.

Biederman argues that only a maximum of 108 geons are needed to identify objects. Geons are generally viewpoint invariant, and can be produced from a simple structure (such as a cube) by modifying it in one of five ways. Geons can be distinguished from one another by cross-sectional curvature, in which the cross section can be either straight or curved. Second, geons can be distinguished by one of three symmetric properties. They can either be asymmetric, or have reflectional symmetry, or reflectional and rotational symmetry. Third, they can be distinguished by whether their sweeping axis is straight or curved. Fourth, distance between their sides can be constant, expand, or expand and contract. Finally, geons can be distinguished based on their aspect ratio, the ratio of sweeping axis to cross sectional area.

In Biederman's theory, perception proceeds through several stages. The most important stages involve the extraction of invariant features in order identify component geons and then using these geons to construct a representation of the object. This geon-representation is then matched, in a parallel fashion, to objects stored in memory in order to identify the specific object.

Recent studies tend to support Biederman's view. For example, Biederman and Bar (1999; Biederman & Gerhardstein, 1993) found that as long as the majority of the non-accidental properties of an object were visible, there was not a deficit in identifying the object. Other studies have found that object degradation only interferes with object perception if the objects are degraded at geon components (Biederman, 1987).

I have hinted that we use expectancies to identify objects. For example, we expect books to be in a student's office and not VCRs. It seems that as a rule the visual system uses sets of regularities, our expectancies, to reduce the processing demands in object identification. Perhaps most importantly, we have a regular set of cues about the probable orientation of objects. Our vestibular systems tell us if we are upright or not, and this biases us to the canonical orientation of objects. Objects also provide cues to their orientation. The tops of objects tend to have more information content, and less mass, than the bottoms of objects (Attneave, 1955). This has two implications. First, once the top of an object has been identified the bottom is usually identified as well (without the necessity of mental rotation). Second, this might explain why when subjects had to match objects, they relied more on the tops than on the bottoms of the objects (Chambers, McBeath, Schiano, & Metz, 1999).

We also take advantage of other regularities. When we are viewing a symmetrical object, for instance, we tend to assume that we are looking at it straight on; the more asymmetric a figure is, the greater the angle we assume that we are looking at it (McBeath, Schiamo, & Tversky, 1997).

There are other regularities that we take advantage of when navigating through the world. For example, we are generally getting closer to objects that are growing larger on our retina. Even infants take defensive actions against looming objects. In a series of experiments, Bower, Ball and Tronick found that infants as young as two weeks of age responded defensively to the perception of an object about to collide with them (Ball & Tronick, 1971; Bower, 1982). Ball and Tronick found that two-day old infants were even able to respond differentially to whether objects appeared to be about to hit them, miss them, or if it was coming toward them yet was on a path that would pass by them. If, for instance, an object appeared to be about to hit them, they moved their head backwards and brought their hands up to their faces in order to protect them.

We also make assumptions about the general direction of a source of light: we generally assume that it is coming from above, from the sun. As the standard example of detecting bumps and dents in a container shows, this leads us to assume that convex things are lighter on top and darker on the bottom; we assume that convex things are darker on top and lighter on the bottom.

Finally, to consider one last example of biases, we can consider biases in which sense we prefer to follow. Here, just as in the auditory situation of conflicting syllables, vision dominates. Lee (1980) reports a series of experiments where visual and mechanoreceptive information conflict. For example, he had subjects stand in a room and either moved the room around them or moved them. He found that subjects typically believed they had moved as far as their visual information told them they had—even if they had not moved at all (Lishman & Lee, 1973). In other experiments, he found that infants could be led to believe that they were falling simply by presenting visual information that made it appear that they were (Lee & Aronson, 1974).

Up to this point, we have seen how background processes influence perception. We seek information, interpret information, and remember information that accords with our biases.

I want to consider one final way situation in which background processes influence a part of consciousness that Objectivists consider automatic: sensation. Objectivists say that sensation is automatic, a form of knowledge that “consciousness can neither seek nor evade” (Rand, 1964, p. 20). As this is written, this usage of automatic is intolerably vague, allowing for multiple interpretations. One could argue that sensation is automatic at the cellular level; thus, one would argue that sensory receptors automatically respond to stimulation. One could also argue that what we sense is automatic; thus, one would argue that sensations automatically make themselves known to our consciousness. This second sense best corresponds to how Objectivists have used the term. As Rand writes, “On the lower levels of awareness, a complex neurological process is required to enable a man to <u>experience</u> a sensation” (1979, p. 29, emphasis added).” In the same vein, Peikoff writes, “when light rays strike the retina . . . they produce a sensation of color” (1991, p. 52). It is incorrect to argue that sensations match the levels of sensory stimulation that produce them and that consciousness does not influence the experience of sensations.

Sensations do not match the levels of sensory stimulation that produce them. This has been known since the 19th century. As Weber, and others since him, showed, our experience of a sensation does not change directly with changes in stimulation. It is not clear exactly how our experience varies with the level of stimulation; in other words, it is not clear how much change in a stimulus is necessary to perceive a change. It might be a fraction of the stimulus, a logarithmic relationship, or as a power function (Palmer, 1999). What is, clear, however, is that the relationship is not direct.

Second, conscious biases are able to influence whether or not we perceive a stimulus. In psychophysics, signal detection theory specifies how a given individual's response bias influences whether they detect a given sensory stimulus. To study this, researchers have used situations where they sometimes present a given stimulus and sometimes where they do not. For example, researchers will have subjects sit in a room looking at a screen; then the researchers will either present a blip of light or not present one. By manipulating the subject's motivation to accurately detect blips of light and avoid missing blips or incorrectly stating that they saw blips when they did not, researchers can produce dramatically different correct responses, errors, and false alarms (i.e., cases where the subjects say they saw a blip when there was no blip).

These lines of research show that background processes can and do influence the sensory level of perception. However, it has not been shown that percept formation (or perceptual grouping, as it is called in perceptual literature) is not automatic. Most perceptual literature, indeed, sidesteps this problem. When they do not sidestep it, they generally deal with two-dimensional ambiguous stimuli (e.g., Necker's cube, the duck-rabbit figure). It has been shown on numerous occasions that we entertain multiple hypotheses about the correct interpretation of two-dimensional ambiguous stimuli. As Kelley (1986) rightly points out, two-dimensional ambiguous stimuli generally lose their ambiguity as soon as they are constructed in three dimensions. Therefore, what we need to nail the point are three-dimensional examples where individuals entertain more than one perceptual interpretation of stimuli. We need more than the presumption established in this paper that since background processes influence every other aspect of perception that they also influence percept formation.

At present, I can only think of a few naturalistic situations where the perceptual system clearly makes multiple interpretations of the sensory data. The main one is camouflage. As is well known, many animals and insects are shaped to resemble their general environment or other objects in their environments (Owen, 1980). For example, a stick-bug, a caterpillar of the European brimstone moth, and other insects, resemble sticks. The Eurasian bitten, a type of bird, looks like the reeds that it lives among; indeed, when threatened it sways to resemble them even more. Many animals also camouflage their eggs to avoid detection as well.

The main point of these camouflage examples is to show that there are real situations, not simply artificial, two-dimensional ones, where percept formation is clearly not automatic.

My final point about the Objectivist argument is more methodological. Kelley asserts that "if a visual discrimination is to be direct . . . there must be something in the array of light energy striking the retina that is specific to constant shapes, sizes, colors, and motions that we see" (1986, p. 66). Given his commitment to automaticity, this is doubly question begging. First, it begs the question about whether the information necessary for percept formation and then object identification is actually in the stimulus. Second, it begs the question about whether this is an automatic process. The entire thrust of this paper has been to show that background processes influence perception at every level, including percept formation. It is my contention that percept formation is not automatic in the sense of being immune to influence from background processes.

What implication does this have for the Objectivist viewpoint? Objectivism has argued that perception is direct, unmediated by background knowledge. The most direct implication is that I think that Objectivism has erred in linking itself to a direct perception visual philosophy. The error is clearly stated: Just because initial percept formation involves a choice among alternatives does not imply that percept formation is riddled with errors. The key here is that we continue to process more information after the initial percept formation, and, if necessary, revise our percept.

It seems that part of the appeal of direct perception for Objectivists is that it is the only perceptual viewpoint that is compatible with a primacy of existence orientation. That is, it is the only perceptual position that supports the view that existence precedes consciousness and that consciousness discovers existence as a whole and specific existents. I want to make clear that these studies do <u>not</u> suggest that consciousness creates reality. They do not show that consciousness has some metaphysical primacy, but that it must go through a series of stages in order to construct accurate percepts. These percepts are then tested against the data coming in, and are kept or rejected depending on how well they match.

In conclusion, Objectivists have argued that percept formation is automatic in the same way that sensory responses are automatic. I have presented evidence that sensory responses are not automatic. I have also presented evidence that perception, as a process, is influenced by background factors. Finally, I have presented a few three dimensional cases where these background processes influence perception. It is my contention that these lines of evidence show that percept formation is an active process, but not a metaphysically potent one.

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