What is consciousness? This is the definition of consciousness that a very good dictionary of psychology gives:

Consciousness. 1. Generally, a state of awareness. This is the most general usage of the term and it intended in phrases like “he lost consciousness.” 2. A domain of mind that contains the sensations, perceptions and memories of which one is momentarily aware (Reber, 1985, p. 148.) To see the definitions that some introductory psychology texts give, click HERE.

Many definitions of consciousness include self-awareness as an essential feature, but then self-awareness needs to be defined operationally.

Gallup (1998) has devised one rather neat test that seems to tap self-awareness: the response an animal makes to its image in a mirror; does it recognize itself? Humans, of course, do at an early age. The only other species he tested that also shows that it recognizes itself is the chimpanzee.

Gallup's test was to anesthetize the animal just long enough to put a red dot on its forehead. When it recovered from the anesthetic, it was given a mirror. Only chimpanzees immediately react to the red dot they see on the face in the mirror. Each chimp reached for the dot on its own forehead (not one the image in the mirror). On the other side, Povinelli (1998) doubts that the mirror test addresses self-awareness and presents other evidence suggesting that self-awareness may not occur in any species except humans. To see more extensive description of this method and a debate about what it really shows, click HERE.

However, most people believe that many species of animals that do not pass this mirror test of self-awareness are in some sense conscious. So what is it about their behavior that suggests consciousness to us? Here's a list of some possibilities:

1. Verbal behavior: verbal access and control
2. Self-awareness
3. Complex behavior
4. Internal control, reflecting some kind of mediating process (~a process between input and output that can control and change information flow); Not dominated by sensory releasing stimuli
5. Selective Attention
6. Perception of objects (as opposed to their individual parts). You perceive your sensory environment as an organized collection of objects. (To see something as an object is to give it a label which puts it into a category with other related objects.)

The first on the list, verbal behavior, is, of course, relevant only to humans (though some would include chimpanzees and bonobos, gorillas, and grey parrots, which have been taught some kind of symbolic communication system). The second, self awareness, has already been discussed. The third, complex behavior, is far too broad. Many apparently complex behaviors turn out to reflect as sequence of responses to very specific external stimuli, and internal control seems to be an important feature of consciousness.

D. O. Hebb (1949) proposed the fourth in the list, internal control, to emphasize that conscious control of behavior is much more internally directed than is reflexive and other automatic control of behavior. Automatic reactions are tied to the sensory world; they occur when and only when their adequate stimuli occur. Consciousness is usually not tied to sensory stimulation. For example, sensory stimulation can be reduced to almost nothing, yet consciousness remains (see asgn4f). Conversely, people often operate effectively on “automatic pilot,” when the limited capacity of consciousness is directed at something else.

For example, I often walk to work right past one or more mail boxes with letters to be mailed clutched in my hand. Walking to work is quite automatic - often I cannot remember having actually walked several blocks when I happen to notice where I am, because my conscious mind was elsewhere. Mailing a letter requires conscious control, because I do it much less often; mostly I walk right past mail boxes, because I have nothing to mail and pay no attention to them.

Treisman (1986) proposed the fifth and sixth on the list: selective attention and object perception. Categorization (~ability to put related things into categories) -- as features of conscious perception. She contrasted them with simple features, like lines, edges, and some simple forms, like 0, which are processed pre-attentively (see asgn4b).

These two processes have three useful properties as features of consciousness:

1. They are features of behavior we describe as reflecting consciousness.
Several good operational measures exist for them.

A lot of empirical evidence shows that features (parts) of objects are processed pre-attentively (and therefore non-consciously), whereas in many conditions objects depend on conscious perception (Treisman, 1986). Some of these data are summarized in asgn4b.

Attention is closely tied to consciousness: you are almost by definition conscious of what you pay attention to. It is usually selective, reflecting voluntary internal control, as Hebb pointed out (#4 on the list above), though external stimuli can grab your attention. William James made this distinction, calling internally controlled selective attention active attention and externally elicited attention passive attention (James, 1890, p. 416).

Active attention is "top down" processing: It is selective, is driven by a person's goals and intentions, and guides attention most of the time. Because it requires mental resources to select what to attend to, it is slower and less reliable than passive, stimulus driven attention.

Passive attention is stimulus-driven, "bottom up," non-selective processing, which usually only interrupts active attention to direct it toward strong, unexpected, and/or sudden stimuli. It is automatic and is, therefore, fast and effortless.

Mark each item with the kind of attention it goes with best. A = Active B = Passive

Q1A. Six-month-old baby's eyes follow a model train going around a track
Q1B. Six-month-old baby stops playing and turns her head toward the sound of her mother's voice
Q1C. guided by unexpected external stimuli
Q1D. internally guided

Attention can be measured. Adult and infant humans and animals show that they are paying attention with some observable external signs in the form of the orienting response and other behavioral signs. Looking is useful and quite reliable for babies and toddlers (e.g., Fantz, 1961; Bower et al., 1971; Werker, 1989) and animals. For example, a cat intently watching a bird shows its attention very clearly from its posture. Other, more subtle measures of the orienting reaction include change in skin resistance, EEG, and other body reactions.

For example, Premack and Premack (1976) used the looking direction to infer what information chimpanzees were using to solve complex cognitive tasks. Watching what an adult human is looking is a useful, but not always reliable, index of attention in human adults. When people don't want to show what they are attending to, they can attend without looking directly at their target. Premack and Premack used the fact that a chimpanzee could look intentionally in the wrong direction to mislead a human as evidence showing that the chimpanzee understood what the human knew about where a treat was hidden (which that human stimulus had not shared with the chimpanzee on past trials.)

Match the feature with the definition of consciousness it fits best.
Self-awareness Selective Attention Complex behavior Not dominated by sensory releasing stimuli
Q2A. can be measured to provide an operational measure of consciousness
Q2B. no operational definition, at least for non-human animals
Q2C. includes too many things
Q2D. indicates the internal control of behavior
Categorization seems to occur automatically when you are conscious of something. Whatever you perceive is immediately perceived as a member of some mental categories. Perceiving something as a member of a category activates all kinds of features related to the category. For example, as you sit at your desk, you notice your book, desk, chair, stereo, computer monitor, etc. Each is a member of a class: identified by the word used to name it: books, desks, chairs, etc.

Even when you don't perceive something correctly you still (mis)categorize it. For example, when I make one particular turn driving at night I usually see a man standing at the edge of the road, which always turns out to be two mailboxes when I get closer. I miscategorize the posts that held the mailboxes as a person's legs, even though I know about the mailboxes from many previous trips.

Many animal species show behavior that indicates they also categorize. Pigeons, whose bird brain is about the size of the first joint on your thumb, show a remarkable ability to put visual stimuli into (human-defined) categories. Pigeons can learn choose very reliably between pictures with and without a person, a tree, a car, etc., even new pictures they had never seen before (Herrnstein 1979; Wasserman, 1995). They can even show that they recognized the differences in the painting styles of Monet and Picasso (Watababe et al., 1995).

An experimental error showed very clearly that they must have treated the target pictures as member of a class. In one task, birds were trained to choose pictures with people and not to choose pictures without. They learned to do this perfectly except from one picture without and people, which they consistently chose as having people. When the experimenters examined that picture very carefully, they found a tiny person in the background (pigeons have excellent vision) (Hernnstein & Loveland, 1964).

Q3. If attention and object perception are features of consciousness, then you could study consciousness objectively across many different species and conditions by
A. training animals to talk and tell you what they are conscious of
B. identify the stimuli that control complex behavior
C. measure what triggers orienting responses (e.g., looking)
D. measure how and when mental categories are activated
E. C and D are both correct
F. A, B, C and D are both correct

You have to pay attention to something to be conscious of it. The penny demonstration in asgn3h showed that most people cannot select the real penny from among 15 versions, probably because they never paid attention to the all the features that pennies have. Your attention selects a very small fraction from the information reaching your senses. It selects the things that are important for your current purposes to put in into conscious working (or short-term) memory. Attention can select only a very few objects because working memory can hold only about seven items at a time.

If attention does not select information, it is not available to working (short-term) memory and consciousness. Unless it reaches procedural (implicit) memory, that information cannot affect behavior and is lost.

To see some demonstrations of inattentional blindness the inability to see changes if you are not paying attention to them, click HERE. Magicians depend on directing your attention to perform their illusions. To see an article about the role of selective attention in creating magic illusions, click HERE

Q4. Until I mention it, you probably didn't notice the pressure of the chair on your back, the conversation behind you, or the small tag on the computer in front of you. These things, and much more,
A. did not receive your attention
B. did not reach working (short-term) memory
C. (probably) did not affect your behavior
D. B and C are both correct
E. A, B, and C are all correct

Q5. Attention is guided by
A. strong, important, or unexpected stimuli
B. what's in sensory memory
C. what you perceive
D. what you do or intend to do
E. information in implicit (procedural) memory
F. A and D are both correct
The dichotic listening task (di = 2; otic = ear) is very useful way to study selective attention in the auditory system. It uses stereo earphones to deliver a different message to each ear (Cherry, 1953). The observer's task is to monitor the information coming to one ear and ignore the other. For example, the left earphone presents some text ( . . . right earphone may give a list . . .), and the right earphone simultaneously gives a list of random words. The observer is asked to pay attention to the message in the left ear (the text) and ignore the random words in the right ear. This experimental task asks how well you can fix your attention and how much information you get from your unattended ear gets into conscious awareness. It is a simplified version of what people often do: follow one conversation and ignore all the rest. This is sometimes called the "cocktail party effect."

Q6. Figure 1-4a at the left illustrates
A. dichotic listening task
B. method for studying selective attention
C. subject getting a different message in each ear
D. the stereo effect of a different message in each ear
E. A, B, and C are all correct

To make sure that attention is strictly focused on one message, the observer repeats aloud that message. This task, called shadowing, is difficult, and it is very effective in fixing attention to that one ear. Observers repeat the shadowed message in a stiff voice, showing that they are putting out quite a bit of effort to do the shadowing well.

Q7. The shadowing task:
A. makes observers pay strict attention to the message they get in the attended ear
B. switches attention between ears to shadow the maximum possible information
C. makes observers repeat word for word the message in the attended ear
D. makes observers attach the message in the unattended ear to the message in the attended ear
E. A and C are both correct
F. A, B, C, and D are all correct

When questioned about the message in the unattended ear, observers usually cannot report anything about it. They may be able to say that someone was speaking and identify the sex of the speaker. But they consciously recall nothing about the contents of the message, except the content of echoic sensory memory, the last few words before they report. There is one exception: About 1/3 of the time observers notice strongly emotional words in the unattended ear -- their name (Moray, 1959) or sexually explicit "taboo" words, especially if the observer had a higher anxiety level (Nielsen & Sarason, 1981).

Q8. In Figure 2-4a at the left, observer Eddie is shadowing the message in his left ear, while individual words go to his right ear once a second. Which word is Observer Eddie most likely to report hearing in his right ear?
A. bear
B. mirror
C. Edward
D. our
E. none of the above

Selective attention to a single channel is not restricted to hearing. For example, observers watch a video which shows two superimposed sequences of action. They can follow only one and recall very little of the other, even though they were looking directly at both (Neisser & Becklin, 1975).

Q9. The dichotic listening and the simultaneous image task all show that
A. conscious directed attention is restricted to vision and hearing.
B. vision and hearing compete with each other for attention.
C. attention focuses on one channel of information at a time.
D. senses other than vision and hearing gain attention only by passive, bottom up attention.
E. A, B, C, and D are all correct
You know from your own experience that attention can change quickly and often. You can shift your attention from one thing to another and back again, but only with a lot of effort and/or practice can you to attend to two things simultaneously. Even the process of detecting something you are looking for strongly affects attention. Detecting a target after a search is followed by an "attentional blink" (Duncan et al., 1994; Wolfe, 1997). After an observer has detected a target, s/he is less likely to another target that comes less than 1/2 second later. This effect can be quite potent. During such a blink, important parts of the visual scene, such as people, can be changed without the observer noticing.

Q10. You visually searching for your friend Jill in a crowd. When you finally see her
A. your directed (active) attention is reinforced.  
B. your hearing now competes with your vision for attention.  
C. you must focus on a different channel of information.  
D. you are less likely to notice another friend Calvin as he walks past Jill.  
E. A, B, C, and D are all correct

To see an article on current research about consciousness and the brain, click HERE

asgn4b, CONSCIOUSNESS: Models of Attention

Two kinds of models have been proposed for selective attention, early selection and late selection. Attention was not an important topic in psychology, especially in the U. S., during the first half of the 20th century. When interest in attention revived, the first model proposed was an early selection model (Broadbent, 1958), (sometimes also called filter model). In this model, attention selects its target very early in the processing of sensory information. That target is the only channel of sensory information is processed beyond sensory memory at any one time. Selecting only one channel for access to conscious working (short-term) memory prevents overloading its limited resources.

Performance on the dichotic listening task (asgn4a) illustrates selective processing for one channel at a time. In the typical experiment, observers can report almost nothing from the unattended ear. For example, Underwood (1974) asked observers to listen to sets of letters with a few digits mixed in and report only the digits. The two ears received a different message. The observers reported almost all the digits in the attended ear, but only 8% in the unattended ear.

A dichotic listening task using sensory memory shows more directly that people process different messages to the two ears one at a time. In this task observers hear pairs of digits, one in each ear. After hearing three pairs they are asked to report the digits they heard. Instead of reporting the first pair, the second pair, and the third pair (as they would if they hear only three digits in one ear), they report the three digits from one ear (often the right ear), and then the three in the other (Broadbent, 1958). Figure 1-4b summarizes this experiment.

The early selection model explains several features of attention. For example, it proposed that shifts in attention reflect brief sampling of unattended information channels to check whether anything important is there. Therefore, when observers fix attention on the message in one ear during a dichotic listening task, the other ear is not sampled. Conversely, fatigue, loud background noise, alcohol, etc. decrease people's ability to focus attention and permit other channels to intrude and depress performance on the target channel.
Problems with the early selection model of attention.

Further research has demonstrated the limits of the early selection model. First, attention can shift from one channel to another more flexibly than the early selection model proposes. For example, Gray and Wedderburn (1960) asked observers to report different 3-item lists presented dichotically. These lists had the form:  

\[
\text{who 6 there} \\
\text{1 goes 4}
\]

to one ear and  

\[
\text{who goes there} \\
\text{1 6 4}
\]

Observers reported these lists as  

\[
\text{who goes there} \quad \text{and} \quad \text{1 6 4}
\]

showing they easily combined the words in the two ears to create a single meaningful phrase.

Second, the almost complete loss of information from the unattended channel depends on the similarity of the messages in the attended and unattended channels. If the unattended messages are pictures, observers recalled about 90% of them (Allport et al., 1972). This result indicates that attention can process two channels. One of them appears linked to phonological storage and the other to visuospatial storage in working memory.

Third, much evidence now shows that information not attended to can still influence behavior through procedural (implicit) memory.

Late selection models were introduced because the early selection model failed to account for several findings about attention. These models state that attention selected what to send to working memory late in the processing of sensory information. Therefore, many channels of sensory information are partially processed before attention selects what to send on (Deutsch & Deutsch, 1963; Neisser, 1967).

However, an observer with years of experience on this task (Moray, who uses this task in his research) did much better. He reported correctly over half the words in the unattended ear (Underwood, 1974). Apparently the shadowing task has become partly automatic for him, which means that less conscious capacity is needed to do the shadowing and is available for detecting information.

Figure 2-4b illustrates two kinds of models of selective attention. It shows attention as a function of working (short-term) memory. In the early selection model, attention operates before perceptual processing and allows only one channel to reach the perceptual processing system. In the late selection model, several channels reach the perceptual processing system. Selective attention selects from the perceptually processed information what gets into working memory. The early selection and late selection models make different, testable predictions about preattentive processing and nonconscious effects on behavior.

Preattentive perceptual processing:

\begin{itemize}
  \item According to the early selection model, preattentive processing does not occur. All processing beyond sensory memory is devoted to the specific channel from sensory memory that attention has selected.
  \item According to the late selection model, preattentive processing does occur.
\end{itemize}

Non-conscious effects on behavior:

\begin{itemize}
  \item According to the early selection model, information not selected by attention is lost and has no effect on behavior or mental processes, because no information other than the attended channel receives any processing.
    \begin{itemize}
      \item To detect important, attention grabbing signals, attention briefly checks other channels, so that important information in other channels can be detected and sent to working memory.
    \end{itemize}
  \item According to the late selection model, information not selected by attention can affect behavior or mental processes. Perceptually processed information that attention does not select can still affect behavior through procedural (implicit) memory part of long-term memory.
    \begin{itemize}
      \item Implicit memory is not available to conscious search. But it carries out such non-conscious processes as simple Pavlovian (classical) conditioning, skill learning, and priming.
    \end{itemize}
\end{itemize}
Q1. According to the early selection (filter) model of attention, information not attended to ___. According to the late selection model of attention, information not attended to ___
A. disappears;   may be transferred to implicit memory
B. does not modify behavior;   may modify behavior
C. is occasionally sampled for important information to which attention then shifts;   may affect behavior through priming or other non-conscious processes.
D. is not processed at all;   is partially perceptually processed
E. all of the above are correct

Several lines of evidence show that the predictions that early selection model makes are not supported by the data, whereas the predictions made by late selection models are supported: sensory information is perceptually processed preattentively, and unattended information can affect behavior.

Neurons in primary visual cortex respond to individual features, such as edges or colors. Neurons in visual association areas respond to conjunctions (~combinations) of features, such as corners, "stars," simple shapes, meaningful forms like hands and faces.

This information flow, illustrated in figure 3-4b, suggests that individual feature detection and processing is pre-attentive, whereas later conjunction of individual features into forms depends on conscious attention.

At the simplest level, basic features of a visual scene are processed pre-attentively, whereas combinations of basic features depend on attention. Evidence for this conclusion comes from a series of studies on what kinds of stimuli are detected automatically and what kinds require attention.

Treisman and co-workers (Treisman, 1986; Treisman & Gelade, 1980) showed observers images with an array of rows of made with one or two forms, often capital letters, as in Figure 4-4b. The observers' task was to find a target form, which differed from the rest by either one basic feature or a combination of two basic features.

Treisman's approach was to see what features seem to "pop out" automatically from background array. Such features are probably pre-attentively processed. Edges, slopes, and colors are three such features. For example, in Figure 4-4b, compare how quickly and easily the backward L in the right panel and the tilted T in the left panel “pop out.” In Figure 5-4b compare how long it takes you to find the green O in the left panel and the blue O in the right panel.

Most people take longer to find the backward L and the green O. The reason is this: The targets at the right differ by conjunctions (~combinations) from the backgrounds, whereas the targets on the left differ from the background on a single basic feature. In Figure 4-4b the tilted T target differs on the single feature of slope from the background Ts. The backward L target and the background Ts differ in the conjunction of the same horizontal and vertical lines. In Figure 5-4b the blue O target differs in one feature, color, from the background red Os and on two features, shape and color.
from the background green Vs. The green O target differs on a conjunction of one feature from the background red Os and one from the background green Vs.

Treisman (1986, p. 119) summarizes the results of her studies as follows:

“. . . only a small number of features are extracted early in visual processing. They include color, size, contrast, tilt, curvature and line ends.

Research by other investigators shows that movement and differences in stereoscopic depth are also extracted automatically in early vision. In general the building blocks of vision appear to be simple properties that characterize local elements, such as points or lines, but not relations among them. Closure appears to be the most complex property that pops out pre-attentively.”

Treisman’s conclusion must be qualified. It holds for the test conditions she used. In other test conditions, almost the opposite outcome occurs: Large “global” wholes “pop out,” whereas the individual “local” features from which they are constructed need attentive processing. As the Gestalt psychologists repeatedly pointed out wholes – shapes or objects – are perceived before their parts are noticed.

Recognition of wholes before parts shows up in a large letter constructed out of small ones, as shown in

Figure 6-4b. Large letters constructed out of small letters that are either the same letter as is the large one (left H and right L) or different letters (middle H and L). Most people respond to the large letter faster than the small ones.

| H | H | L | L | H | L |
| H | H | L | L | H | L |
| H | H | L | L | H | L |
| H | H | L | L | H | L |
| H | H | L | L | H | L |

Everyday experience supports the Gestalt view. People see pictures like the scene in Figure 7-4b as houses, fences, and trees before they notice the edge, the shading, and the texture elements that make them up.

Q3. Navon (1977) did another study using stimuli like those in Figure 6-4b, except this time observers reported as quickly as possibly which letter they heard. If recognition of wholes precedes recognition of parts of the whole, what result would you predict? Observers would report the letter they heard.

A. faster when the large letter was the same as the one they heard.
B. slower when the large letter was different from the one they heard.
C. at the same speed, because they responded to letters they heard.
D. faster only when both the large letter and the small ones it is made of were the same as the one they heard.
E. A and B are both correct.
Non-Conscious Processing of Unattended Stimuli

The other prediction of late selection models of attention states that unattended stimuli can affect behavior through non-conscious processes. Several different kinds of studies that assess procedural (implicit) memory have confirmed this prediction. For example, in the dichotic listening task, information in the unattended ear is virtually unavailable to conscious working memory. If information in the unattended ear can still affect behavioral measures that depend on implicit memory, then this finding supports a late selection model.

One test used Pavlovian (classical) conditioning. A word was paired with shock, so that it triggered the same kind of body responses (increased perspiration) that the shock itself triggered. When that word was played to the unattended ear, it produced increased perspiration as measured by the electrodermal response (also called galvanic skin reflex or GSR), indicating that it had been processed (Corteen & Woods, 1972), even though observers were unaware of the word in the unattended ear (Corteen & Dunn, 1974). In two published attempts to replicate this experiment, two were successful (Vila & Tudela, 1982; von Wright et al., 1975), but the third was not (Wardlaw & Kroll, 1976).

Another test used priming. Priming refers to a variety of techniques in which prior exposure to information improves performance on tasks that do NOT require conscious memory. In one such priming experiment using dichotic listening, a word in the unattended ear modified the way observers remembered and interpreted the message in the attended (shadowed) ear (McKay, 1973). In this study observers attended to sentences like "They threw stones at the bank" in one ear while either "river" or "money" was played in the unattended ear. Later they were asked to identify which of two sentences they had heard:
1. They threw stones at the side of the river.
2. They threw stones at the side of the savings and loan.

The observers who had "river" played in the unattended ear usually reported hearing the first sentence. The observers who had "money" played in the unattended ear usually reported hearing the second. If these results are reliable (reproducible), they would provide strong support for the late selection models of attention. Link to a summary of the main theories of pre-attentive processing.

Q4. Implicit (procedural) memory can be tested by priming. If information in the unattended ear of a shadowing task cannot be recalled consciously but shows up using the priming procedure, this fact would

A. support late selection models of attention  
B. support early selection models of attention  
C. show that the unattended information had been processed  
D. show that the unattended information had been repressed  
E. A and C are both correct  
F. B and D are both correct

The ability to pay attention selectively develops slowly until at least the time of puberty. Recent work shows that its normal development depends on normal sensory experience. Deaf children are often described as more distractible and impulsive than are hearing children of the same age. To measure this difference, Quitter et al. (1994) tested deaf and hearing children (who did not differ on other variables) with a task requiring focused visual attention. The task asked them to watch a stream of visually presented digits and report whenever a 9 appeared immediately after a 1. The task required focused, sustained attention, because targets appeared infrequently; only about 1/10 of the digits that appeared were targets.

At ages 6-8 years, hearing children had 40 hits out of a possible 45 and very few false alarms. The deaf children had fewer hits (25 hits for the 45 targets) and many more false alarms (25 out of the possible 495). At ages 9 to 13, hearing children had almost all of the 45 possible hits and less than 2 false alarms. Deaf children had about 37 out of 45 possible hits and 16 false alarms. Deaf children with cochlear implants (electrodes that could stimulate the inner ear, to help hearing) were intermediate between the normal and deaf children.

However, deaf children are not poorer on all visual tasks that require attention. Although they do less well than do hearing children on this task, which requires focused attention, they do better on other kinds. They detect signals at the edge of the visual field and notice and remember complex visual patterns better than do hearing children. These results indicate that development of attention is not simply an automatic unfolding process, independent of environmental effects. Rather, it depends on the environmental

...
inputs available during development, just as perception does (see asgn2q).

The preceding study does not show that hearing is the primary underlying process in attention, yet some features of hearing suggest that it may have such a role. First, it cannot be turned off. We don't have “earlids,” and even if we did, sound reaches the inner ear by conduction through the skull as well as through the ears. Second it is the last sense to shut down as we fall asleep or go under anesthesia.

Q5. Deaf children do worse on some visual attention tasks than do hearing children, but not on other tasks. This fact supports the idea that attention
A. is a late selection process
B. is shaped by environmental influences
C. is based on hearing
D. affects false alarms more than hits

Controlled and Automatic Processing

Controlled processing is under conscious control; therefore it is slow and interferes with other tasks that use controlled processing. Automatic processing does not use conscious control; therefore it is fast and does not interfere (much) with simultaneous tasks that use controlled processing. When people do an unfamiliar task, they must use attention, which directs the information people need to working memory (elaborated version of short-term memory). The needed information comes from the senses through sensory memory and from long-term memory. Working memory is the active part of mental processes. It carries out consciously controlled processing. As the tasks become well practiced, they require less and less conscious attention; then, people can do the task using automatic processing. (Controlled processing and automatic processing in retrieval from long-term memory were briefly introduced in asgn3o.)

Q6. [Mark ALL that are correct] When attention is needed to do a task, it
T F A. interferes with another task that also requires attention
T F B. uses automatic processing
T F C. uses up (much of) the limited capacity of working (or short-term) memory
T F D. uses controlled processing
T F E. lets you do something else better at the same time

Tasks that initially require controlled processing slowly become processed automatically with much practice. A task that is very well-practiced becomes automatic: Such tasks require little or no mental resources, so that they can be done at the same time as other tasks. They are done quickly and seem automatic, requiring little or no conscious guidance. For example, now, as an experienced driver, you do many routine driving tasks (like coordinating pedals and steering or, on a stick shift coordinating the clutch and shift lever) quite automatically and unconsciously. You can react to the traffic conditions, and steer and brake because practice has made these reactions more or less automatic. You can carry on a conversation while driving. But when traffic becomes difficult and driving requires more conscious attention, you have less working memory available for conversation (or any other activity).
Q7. A skilled pianist can play a well-practiced song and carry on a conversation at the same time. Someone who is just learning the song cannot. The skilled pianist can do this because

A. the talking is automatic and does not interfere with controlled processing for playing the piano
B. well-practiced skills can increase the capacity of working memory
C. practice makes a task automatically processed
D. playing the piano does not use the same muscles that talking does

To make a task automatic when it starts out requiring controlled processing, the specific task must be practiced; changing a feature of the task before it becomes automatic usually prevents it from becoming automatic. The conditions under which controlled processing becomes automatic have been studied extensively in the laboratory (Schneider & Shiffrin, 1977). One kind of task is perceptual. Sets of four letters are flashed very rapidly on a computer screen in front of an observer. The observer's task is to detect the presence of target letters which might appear once in the set.

Q8. In the experiment described above, perceiving the target letters did not become automatic because

A. perception always requires controlled processing
B. the target letters changed before their recognition became automatic
C. the second task that the observers did prevented the target detection from becoming automatic
D. four letters exceeds the capacity of working memory

In the second general condition for this task, the target letters remained the same throughout testing, which lasted for several thousand trials. Because the target letters remained the same, processing eventually became automatic, detecting the target became much faster, and observers reported that the target seemed to jump out from among the other letters. Performance on this task became much better than on the controlled processing task. Furthermore, when observers did the controlled task and the automatic task at the same time, their performance was not affected. This shows that the automatically processed task requires little or no working memory or conscious attention.

Q9. In the task described above, the detection of the targets became very fast and accurate, and it did not interfere with another task which required controlled processing. The detection had become ____ because the target letters remained the same.

A. controlled  B. automatic  C. repeated  D. unconscious  E. B and D are both correct

asgn4c -- STATES OF CONSCIOUSNESS:
Is consciousness in charge?

This exercise summarizes some of the evidence showing that people are consciously aware of only a small fraction of their mental processes. Most mental processes are automatic. They are non-conscious (not available to consciousness) or seldom receive conscious attention. The mind automates most mental processes for the same reason that engineers automate as much of a complex system as possible: Conscious control is a scarce resource because of the limits of working memory. Therefore, the mind uses consciousness only for tasks that require top level decisions to select the information and the responses needed to achieve an individual's goals, both immediate and long-term.
Everyday experience tells you that if you are not paying attention to something, it is not there for you consciously at least. Everyday experience also tells you that you can run on "automatic pilot" while your attention is elsewhere. For example, when you are driving and talking to your passenger, you may have no memory of how you got to your destination (or how you got somewhere else instead). The studies described below bring these everyday experiences under experimental control. Experimental control helps figure out how automatic mental processes work and how they relate to conscious mental processes.

Conscious control of behavior is largely limited to highest level executive functions; most mental processes are unconscious or non-conscious (unavailable to consciousness). Most people believe that they are in conscious control most if not all the time (except while asleep or in drug-induced states). Several traditions in psychology suggest otherwise.

Best known is the psychoanalytic idea of unconscious motivation, which is repressed from consciousness but affects mental processes and behavior in a variety of indirect ways. This idea is Freud's major lasting contribution to psychology, though many psychologists do not accept Freud's emphasis on repressed infantile sexuality. Behaviorism also claims that (much of) behavior was automatic and not consciously guided. Furthermore, behaviorists emphasized the role of external, environmental control of behavior. For example, Skinner saw behavior changed by its consequences, especially reinforcing consequences and guided by discriminative stimuli, which signal when different kinds of consequences will occur.

Q1 Match the approaches to conscious control of behavior with the approach that fits it best.
Q1A. Painful infantile emotional and sexual conflicts are actively repressed from consciousness but strongly affect behavior.
Q1B. People are often unaware of the mental processes that actually control their behavior
Q1C. Internal mental processes are not very important or effective because environmental signals and consequences control behavior.

Most people believe that consciousness is an important, even necessary, player in mental processes, but most of the data indicate that consciousness does very little except to guide overall plans. Cognitive and social psychologists have lots of data showing that consciousness controls very little mental, except overall tactics and strategy to achieve people's currently active goals. Indeed, many conclude that most mental processes are completely unavailable to consciousness.

In an influential paper, Nisbett and Wilson (1977) concluded that people are quite unaware of many variables that affect their thinking processes or how those processes work. Nevertheless, they are quite confident they know how they reached the decisions they made. For example, one study showed that subjects did not believe that group discussion about a controversial issue changed their attitudes about that issue. However, comparison of attitude measures taken before and after the discussion clearly showed the change. The researchers even reminded the subjects that they had filled out attitude surveys on that topic some time before the discussion, which they (the researchers) would compare with their current ratings (Nisbett & Wilson, 1977).

For example, priming with the word "moon" increases the number of people who name *Tide* when asked to name a laundry soap. When asked to explain why, people gave answers like "It's the kind my mother uses" or "It's the best-selling detergent." When asked to choose which of four identical pairs of stockings they prefer, people choose the pair in the third position than any other. When asked why they chose that pair, people said things like "it was better quality" or "I liked the color better."

Another study showed that participants automatically make inferences about a person, even when they had no reason to make them. Subjects simply saw photos of people and brief self-descriptions (Cardston & Skowronski, 1994). As much as a week later, they learned to associate the photos with their self-description faster than with randomly selected self-descriptions. This association occurred whether or not participants were directed to try to recall the photos and associated self-descriptions, and whether or not they could recognize the photos and self-descriptions that had been presented together. This result supports the idea that we automatically make inferences about the people we meet based on whatever limited information we happen to get about them. Bargh and Chartrand (1999, p.462) have concluded that "most of moment-to-moment psychological life must occur through nonconscious means if it is to occur at all." For example, when told to ignore external distractions during a video they were to rate, participants confidently believed the distractions had no effect. Nevertheless their ratings were reliably lower than were ratings made by other participants without the distraction.
Q2. These examples show that people
A. had different experiences with detergents and stockings, so they have different reasons for making their choices.
B. were trying to please the experimenter by saying what would prove his/her hypothesis.
C. have little access to the mental processes involved in thinking, so they make up plausible (~reasonable) answers to why they made the choice they made.
D. generate good answers to behaviorally stated questions, showing that Introspection is a useful method for studying mental processes.

People have a limited capacity for conscious control.
The limits on conscious control appear in many other settings and tasks. Self-control in one domain reduces participants’ persistence on completely different activity (Baumeister et al., 1998). For example, not eating from a plate of chocolate chip cookies decreased the time subjects spent tracing patterns without retracing a line or lifting the pencil. Figure 1-4c summarizes several other studies that found the same effect.

Other studies have shown that priming from external environmental events can activate goals quite unconsciously. For example, participants had their motivation to achieve success primed by searching for words like “strive” and “succeed” in long lists of words. These participants outperformed unprimed control participants on verbal tasks (Bargh & Chartrand, 1999).

Unconscious activation of emotions affects activity in the limbic system, which organized and controls motivational and emotional processes. In one study, participants looked at faces flashed on a screen while their brain activity was measured with fMRI scans (Whalen et al., 1998). Although they reported seeing only faces with neutral expressions, those faces were immediately preceded by faces showing either happy or fearful expressions. The consciously undetected fearful faces increased activity in the amygdala of the limbic system, which plays an essential role in recognizing emotional expressions, and which is required for development of conditioned fear.

Q3. Consciousness is in charge
A. most of the time when we are awake
B. when motivation and emotion are not active
C. when behavior is under verbal control
D. when it is needed to override automatic processes

Brain Functions in Attention and Consciousness

Many different parts of the brain are involved in attention and consciousness. One of the turning points of neuroscience in the mid 20th century was discovery that the brain controls its own level of wakefulness. G. Moruzzi and H. Magoun’s (1949) showed that electrically stimulating the reticular formation while an animal is asleep wakes the animal up. It looks around as if looking for something (Magoun, 1958). This means that the reticular formation in the core of the brain stem arouses the rest of the brain.

Figure 2-4c shows the location of the reticular formation inside the brain stem, some of its inputs from the senses, and its widespread connections to the cerebral hemispheres. (It also excites the spinal cord.) The reticular formation receives excitation from all the senses (Starzl et al., 1951). The sensory connections can activate the reticular formation, especially when an unexpected or strong stimulus reaches a sense organ. For example, noise or touch wakes you up from sleep.
However, **the reticular formation does not require sensory input to keep the rest of the brain active.** It contains areas that generate the day/night cycle that all animals have (see asgn4k), and it receives excitation from many brain areas, especially the cerebral cortex (Adey et al., 1957). Damage in this area produces coma (long-lasting unconsciousness). The coma can last anywhere from few hours to many years or indefinitely, depending on the location and severity of the damage (Lindsley et al., 1950). Recently PET scans have shown increased activity in the reticular formation when human volunteers switch from a relaxed waking condition to a reaction time task, which requires a lot of attention (Kinomura et al., 1996).

**Q4.** Sam was unconscious for two months after suffering a head injury in a traffic accident (he wasn’t wearing his seat belt and slammed his head against the door post). This unconsciousness reflects
A. injury to the cerebral cortex spreading from the brain stem  
B. injury to the reticular formation in the core of the brain stem  
C. failure of activation in the reticular formation  
D. inhibition of the brain from the reticular formation  
E. B and C are both correct

Several parts of the cerebral cortex play a vital role in selective attention (Posner & Dehaene, 1994). *The cortex has a system of interconnected areas, each of which participates in a different aspect of attention.* In the visual system, for example, parts of the visual association areas on the occipital lobe do the initial rough selection. Parts of the temporal and parietal lobes refine the selected information. Parts of the frontal lobe do the overall guidance of attention, especially in tasks that require sustained attention. Figure 3-4c shows the location of these areas.

Evidence for the role of these cortical areas in attention comes from several sources. Brain damage in human patients and experimental disturbs attention in different ways, depending on which brain area is affected. Damage in the temporal and parietal lobes, especially on the right, disturbs passive attention elicited by external stimuli and also internally generated active attention. Damage in the frontal lobe disturbs active attention. Brain activity during normal attention changes as measured from brain scans in humans and from the activity of single neurons in experimental animals.

In the occipital lobes, brain scans in normal human volunteers and activity of single neurons in the sensory association areas show increased activity during tasks that demand attention.

[Figure 3-4c. Location of the occipital, temporal, parietal, and frontal lobes, showed on the right cerebral hemisphere.]

Damage to the right temporal and parietal lobes often produces neglect on the left side of the body. [Remember that each cerebral hemisphere controls the opposite side of the body.] Patients with such damage leave food on the left side of the plate and draw figures leaving out part or all of the left side, as illustrated in Figure 4-4c.

[Figure 4-4c. The reticular formation inside the brain stem, its inputs from the senses (not all inputs shown), and widespread output to the cerebral hemispheres. These outputs "wake up" the cerebral hemispheres, keeping the person conscious.]

Other symptoms following damage in the parietal lobes also show its role in attention. Smultanagnosia is a rare consequence of bilateral (~both sides) damage to the parietal lobes. A person with this disorder can recognize one object at a time in his/her visual field. However, if s/he has two objects in the visual field, s/he can report seeing only one or the other. One object "grabs" attention, and the patient cannot redirect attention to the other. This disorder reflects a defect in ability to shift attention, something normal people can do with ease.

Evidence for the importance of the right temporal and parietal lobe in directed attention also comes from animals doing tasks that require active, directed attention. Neurons in this structure show increased activity during such directed attention. PET scans and other measures of activity in normal human brains
also show that this area becomes more active in tasks requiring directed attention. For example, the parietal lobes become more active when observers scan a display for a combination of features (color and motion) (Corbetta et al., 1995). The frontal lobes also play a role in attention, which is consistent with their role in executive functions: planning and choosing what to do. Damage in this structure, especially on the right hemisphere, disturbs a variety of higher level attentional processes, such as direction of attention in extrapersonal space, selective attention, and sustained attention (Foster et al., 1994). Brain scans in normal volunteers show that parts of the frontal lobe become more active during tasks that require sustained attention. In monkeys working on a task requiring selective attention, neurons in the frontal lobes became more active while the monkey was anticipating the target (Rainer et al., 1998).

Q5. Mark ALL that are correct about selective attention and the brain
T F A. The whole cerebral cortex must be activated for selective attention to occur.
T F B. Each cortical area involved in selective attention has its own job.
T F C. An area of the brain that is important in attention can be identified from the effects of damage there.
T F D. An area of the brain that is important in attention can be identified from the changes in activity measured with brains scans.

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asgn4d -- ALTERED STATES OF CONSCIOUSNESS: Controlled and Automatic Processing
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asgn4d -- Hemispheric Differences in Consciousness

This idea has been around for more than 100 years, since Broca, Wernicke, and others showed that defects in grammar, vocabulary, and phonetics (~speech sounds) followed damage to the left hemisphere. In 1863 Broca described a deficit in generating grammatical speech. This kind aphasia (~language disturbance) also interferes with understanding complex grammar. Within a decade, Wernicke described a different form of aphasia, in which understanding and producing meaningful language was disturbed. Figure 1-4e shows the location of these areas on the lateral (outer) side of the left hemisphere. Link to a review of the basic properties of the deficits in language following damage in the left hemisphere. Link to a first-person account of the experience of aphasia.
Q1. The left and the right cerebral hemispheres of the brain are especially important for different psychological functions. Early evidence for this idea came from the
A. effects of injury to one or the other cerebral hemisphere
B. interaction that goes on between the two cerebral hemispheres
C. difference between size and shape of the two hemispheres
D. fact that they form the top of the brain

**The left and right hemispheres have different roles in language communication and emotional perception and reaction.** Since Broca’s report that damage in the left hemisphere affected language, many studies have described different deficits following left and right brain damage. For example, damage to the right hemisphere rarely affects understanding and production of normal-sounding language, showing that in most people the left hemisphere plays the primary or exclusive role in grammar or phonetics (~speech sounds). Nevertheless, damage in some area in the right hemisphere can produce severely disturbed communication. These disturbances are in the pragmatics of language.

**Grammar, word meaning, and phonetics are primarily functions of the left hemisphere in most people.** Pragmatics (tone of voice, metaphorical meaning, and related processes) in language depends much more on the right hemisphere. Damage in Broca’s area, Wernicke’s area, and related parts of the left hemisphere often produces obvious defects in grammar, word understanding use, and phonetics (~speech sounds). These obvious language problems have gotten much attention in the treatment of language disorders and in the study of brain function in language.

The right hemisphere also plays a very important role in language. It carries out the pragmatics of language: gesturing, prosody (~rhythm and tone of voice), metaphor, and related processes (Weylman et al., 1998). The pragmatics of language tell the listener what you mean by the words and sentences you say. **Tone of voice** (sarcasm, surprise) and metaphor often communicate a lot of the meaning in a sentence. (Metaphor = the nonliteral meaning -- if you order a hamburger and say “step on it,” you mean “hurry up” [metaphoric meaning] not “put your foot on it” [literal meaning])

**Pragmatic parts of language can be more important for communication of meaning than the grammar and phonetics you use (Argyle et al., 1970).** To illustrate the importance of the right hemisphere in communication, Weylman et al. (1998) compared two patients. One, who had severe left hemispheric damage, had very little speech left, but he communicated quite effectively and was actively involved in his rehabilitation program. The other, who had right hemispheric damage, had the phonetics and grammar of speech intact, but he communicated quite poorly and was quite uninvolved in his rehabilitation or much of anything else. These two cases illustrate the idea that the importance of grammar and phonetics is often overemphasized at the expense of communicating meaning, which involves the right hemisphere as much as the left.

Match the brain area to the best fitting items below.

1. Wernicke’s area
2. Broca’s area
3. both Wernicke’s and Broca’s
4. neither Wernicke’s and Broca’s

**Q2A.** left hemisphere (for most people) **Q2B.** producing grammar **Q2C.** frontal lobe **Q2D.** word understanding **Q2E.** pragmatics **Q2F.** sarcasm, metaphor, tone of voice

**The two hemispheres play different roles in emotional perception and expression.** Many other differences exist between the hemispheres. The right hemisphere is much more important in processing emotional information, especially negative emotions. Damage in the parietal or temporal lobe of the right hemisphere can result in what is called the **indifference reaction.** The patient is indifferent to his/her deficits, and s/he is at least superficially cheerful and often denies having any deficit. This denial is called **anosognosia.** In contrast, **damage to the left hemisphere can produce what is called a catastrophic reaction.** Patients with this reaction are extremely upset and depressed by the deficits they have. This kind of difference between hemispheres also appears in rats in which a main artery was tied to simulate a stroke (Robinson, 1979).

**Patients with right hemisphere damage may have difficulty recognizing or expressing emotional content.**
(Bear, 1983). For example they can understand the words in a sentence but cannot recognize the emotional content, like sarcasm, from the prosody (the tone and emphasis) of speech. Sometimes they cannot produce emotion in their voice. One grade school teacher returned to the classroom after recovering from a right hemisphere stroke (−clogged blood vessel). She had many discipline problems, which she did not have before, because she spoke in a low monotone. The impact of "Now class, that's enough," is much less when spoken in a monotone than when spoken with emotion.

Q3. Compared to the left hemisphere, the right hemisphere is more involved in
A. the pragmatics of language  B. emotional (especially negative processing
C. understanding metaphor, humor, etc.  D. B and C are both correct  E. A, B, and C are all correct

The effects of brain damage on psychological and behavioral functions is difficult to figure out. These studies, like all studies testing humans with brain damage are difficult to interpret in terms of the mental and behavioral processes they affect. These difficulties include:

1. The effects of brain damage interact with other variables. For example, language problems following left hemisphere damage are on the average more severe if the patient did not know how to read (LeCours et al., 1986).

2. The disturbed functions that follow brain damage DO NOT necessarily depend on the damaged areas. They DO show what the rest of the brain can do in the absence of the damaged tissue.

3. Patients often show considerable recovery, which may continue slowly for years. This recovery appears to depend on the brain reorganizing after damage. Children show much better recovery, apparently because the immature brain is not as fixed as the adult brain in the way it is organized.

[Mark EACH item True (T) or False (F)]

Mick is 9 years old; Mack and Marie are 39 years old. They all suffer from damage in the same part of the left hemisphere.

Q4A  T  F  A. Mick will show less recovery from the brain damage than will Mack and Marie, because the immature brain is more vulnerable to damage than is the mature brain.

Q4B  T  F  B. The psychological and behavioral problems that Mick, Mack, and Marie have following the damage show the damaged part normally does.

Q4C  T  F  C. Mack's mental and behavioral deficits are more severe than Marie's. This different shows that other factors modify the deficits that brain damage produces.

Because the psychological and behavioral deficits that follow brain damage are hard to interpret, other methods must be used to get an adequate picture of the functions of different parts of the brain. Several such methods now exist. Some require complex, expensive instruments, such as the various scanning methods (CAT, PET, fMRI, etc.), but differences in hemispheric function can be tested behaviorally in normal people. Figure 3-4d shows a PET scan of a normal human brain during ordinary narrative (−telling) speech.

For example, as described above, people with damage in parts of the right hemisphere are likely to have difficulty understanding and/or expression emotional signals. People without brain damage also show differences between the hemispheres in their emotional reactions. In one experiment, observers viewed cartoons through contact lenses that restricted vision to the left or right visual fields. They rated the cartoons as funnier when they appeared in the left field (which goes to the right hemisphere) than in the right (Dimond et al., 1979).

Another difference appears in the way the face shows

Figure 3-4d. PET scan showing activation during narrative (−telling) speech. The left hemisphere is on the right side of the figure; the right hemisphere is on the left side. The upper pair shows the medial surfaces (inner surfaces that face each other) of the two hemispheres; the lower pair shows the lateral (outer side). Notice that the left hemisphere shows much more activation (yellow and orange) than does the right. Notice also that the activation occurs far outside Broca's and Wernicke's areas.

Source: http://www.nih.gov/nidcd/nrtrum/sabs/figures/sabs.htm
emotional expression. **Natural facial expressions are often asymmetric: the left side of the face usually expresses emotion more strongly than does the right.** This was demonstrated by taking pictures of faces showing different emotions, splitting them down the middle, and creating mirror images of each side. The normal and mirror image of each side were put together into a whole face. Observers judged the face made of the left side and its mirror image more emotional on the average than the right side of the same face and its mirror image. This finding shows that the right hemisphere (which controls the left fact) has more effect on emotional expressions.

Q5. We know that the right hemisphere is especially important in emotion because
A. damage in the right hemisphere can reduce emotional responding
B. damage in the right hemisphere can disturb recognizing emotional signals
C. stimuli restricted to left field are perceived more emotionally
D. the left side of the face is more expressive
E. all of the above are correct

The "split-brain" syndrome (Sperry, 1968, 1982) lets researchers study the function of both hemispheres independently in the same person, because the (relatively) normal hemispheres are disconnected. This syndrome is the result of a rare brain operation to treat cases of potentially life-threatening epilepsy ("brain seizures") that medication could not control. (Medication does control most cases adequately.)

In these patients, the source of epileptic seizure activity is in one side of the brain, often in the temporal lobe. Repeated seizures to affect the other hemisphere, so it is important to prevent this from happening. To do this, surgeons cut the **commissures** (large bundles of axons ["nerve fibers"]) that connect the two hemispheres. The main bundle is called the **corpus callosum**. Figure 3-4d shows the top of the brain and the targets of the "split-brain" surgery: the commissures between the two hemispheres. Figure 4-4d shows the cut surface corpus callosum on the medial (inner) surface of the left cerebral hemisphere.

The surgery was quite successful: not only did it prevent an area of seizure activity from developing on the normal side of the brain, but it often reduced the seizure activity on the originally abnormal side.

Q6. The split brain operation cuts a group of brain structures called the commissures. The main commissure is called the corpus callosum. The effect of this operation is to
A. isolate the cerebral hemispheres from each other
B. let the hemispheres move independently in the skull
C. keep seizures that disturb one hemisphere from affecting the other
D. keep the cerebral hemispheres from disturbing each other's functions
E. A and C are both correct
F. A and D are both correct

To identify the effects of the "split-brain" operation, the hemisphere that receives information and the hemisphere that guides responding must be well controlled. The "split-brain" operation had surprisingly few other effects under ordinary testing conditions. Patients reported poorer memory, not...
dreaming, and some difficulty coordinating the two hands. The two hands sometimes seemed to work against each other. Sometimes while getting dressed, the right hand buttoned up the shirt, and the left hand sometimes followed along and unbuttoned it, as if a separate motive controlled it. One patient reported that during a family argument one hand kept the other from hitting his spouse.

At the same time Roger Sperry had been working with split brain cats (Sperry, 1961) for completely different reasons. To test the abilities of one hemisphere alone in these cats he restricted the test stimulus to that one hemisphere and used a response system that the tested hemisphere could control. He applied this approach to testing split brain patients and discovered marked differences between the abilities of the two hemispheres. He shared the 1981 Nobel Prize in Physiology or Medicine for this work.

Q7. Sperry revealed the differences between the two cerebral hemispheres in the split brain patient that ordinary testing missed. He was successful because he

A. measured brain activity directly instead of indirectly  
B. restricted response control to one hemisphere  
C. restricted stimuli to one hemisphere  
D. observed the patients more carefully under normal conditions  
E. B and C are both correct  
F. A, B, C, and D are all correct

Q1. To test each hemisphere independently of the other, Sperry had to get information into only one hemisphere at a time. To test each hemisphere, he had to use the _____ on the opposite side of the body.

T F A. hand  
T F B. eye  
T F C. visual field  
T F D. half of what you see

Information from an object in the left hand or in the left visual field directly reaches only the right hemisphere. In most people the language capacity of the right hemisphere is limited. Therefore, to gain access to the language system, the right hemisphere transfers its information to the left hemisphere through the corpus callosum and other commissures (~connections). This happens very quickly in normal people.

Because these commissures are cut in "split-brain" patients, they cannot talk about what is in the left half of the world. Nevertheless, they can follow verbal instruction involving the left half of the world, showing that the right hemisphere must do some level of language understanding. Other methods besides verbal report must be used to test the mental functions of the right hemisphere. Developing these methods was essential for understanding the right hemisphere's capacities in these patients. These methods depend on matching or pointing with the left hand.

For example, the patient's left hand can match an object that it has felt previously or that the right hemisphere sees in the left visual field. Nevertheless, s/he cannot describe verbally it. S/he can only guess, because the speaking left hemisphere has no access to the information in the body's left side. The right hemisphere also can control the direction of looking and pointing, especially with the left hand. So split-brain patients point correctly to an object they have just felt, especially with the left arm.

Q2. [Mark EACH item True (T) or False (F)] A spoon is placed a split-brain patient's RIGHT hand. S/he can

T F A. name it  
T F B. match it with the right hand  
T F C. match it with the left hand  
T F D. point to it with the right hand
The terms "focused" and "diffuse" (Semmes, 1968) describe an overall functional property of each hemisphere that seems important for the things each hemisphere does better. The left hemisphere does better on detail, for example. Small time differences in "neighbor-ing" speech sounds, like /b/ and /p/, tell the difference between them. The right hemisphere does better on overall relations, like relation among parts in a drawing or the overall meaning of speech rather than individual words, etc.

This difference shows up in many ways. One example shows particularly well the difference between the two hemispheres and how independent they become after "split-brain surgery. A film shows a split brain patient putting blocks together to match a pattern. His left hand, controlled by his right, "diffuse" hemisphere, did well, because it knew how to deal with the relation among all the parts. His right hand, controlled by his left, "focused" hemisphere did very poorly because it could not see the overall pattern, necessary for constructing the pattern. Instead, it responded using local features, like corners and edges. His right hemisphere knew how to make it, so the left hand came up to help out. The patient had to sit on his left hand to stop it. Finally, both hands worked on the block pattern. His left hand put the blocks together in proper position, and his right took them apart.
Q4. The terms “focused” and “diffuse” are better than other labels for the different capacities of the left and right hemisphere because they
A. is correct
B. is the best description of the behaviors that each hemisphere controls more
C. describes a process that is important in the mental and behavioral capacity of each hemisphere
D. explains why the left hemisphere is usually in charge in normal and “split-brain” patients
E. B and C are both correct

Sperry and others have claimed that both of a “split-brain” patient’s hemispheres have their own, separate consciousness. Others claim that only the left (talking) hemisphere is conscious. Which view is correct depends a lot on how you define consciousness -- a very difficult idea to define (see asgn4a).

If you equate consciousness with language function, then the left hemisphere has consciousness. Nevertheless, the right hemisphere clearly understands language and can respond to questions and requests. So you define consciousness as any kind of abstract mental processing, then the right hemisphere is quite as conscious as the left.

Q5. Whether or not the right hemisphere has consciousness depends on
A. whether it is connected to the left hemisphere
B. whether it can control or develop control of language
C. how you define consciousness
D. whether consciousness can be subdivided or is a unitary whole