Chapter 8
Perception and Attention

This final chapter is dedicated to the study of attention because perception cannot be reduced to the sole detection of stimuli. It is necessary to try to understand how what is already in the brain determines or influences what is going to be perceived. This influence was already noted on several occasions in the preceding chapters: when Helmholtz' hypothesis about unconscious inferences was referred to, or when studying form recognition or Gestalt's organization principles for accounting for visual or auditory perception.

Just for providing some idea of the impact of attention on perception, one should consider the following facts. There exists a scientific society, the Psychonomic Society, dedicated to experimental psychology and founded in the USA in 1959. This society is responsible (now with Springer) for the publication of several scientific journals. One of these journals, *Perception and Psychophysics*, was founded in the 1960s. Dedicated to research in the fields of perception and psychophysics, the journal kept the same name until 2008. Since 2009, the journal's name is *Attention, Perception, and Psychophysics*. Indeed, in 1988, 5 % of articles published in the journal were associated somehow to the study of attention; 20 years later, it was close to 50 %. Given that no important scientific journal had the word attention in its name, it has been decided to change P&P's name in order to better reflect its content. Indeed, this situation illustrates to what extent the processes linked to attention are crucial when perceiving and for understanding the mechanisms of perception.

For studying attention, it is imperative to look at its main properties. Any tentative for presenting the properties of attention will likely be incomplete given the huge amount of studies on this topic. Although the study of the attentional mechanism founded on neuroscientific approaches increased considerably in the past 30 years (see Gazzaniga, Ivry, & Mangun, 2009), the present chapter proposes only an overview of the main concepts linked to the study of attention offered by the behavioral studies and developed in cognitive psychology in the past 60 years.

8.1   What Is Attention?

Attention is the process allowing to become aware of a few things and to capture a part, admittedly very limited, of what is going on around. Indeed, it is extremely difficult to define attention precisely, although most of us probably already know what it is. We know that when concentrating on a sound source through noise, it is possible to increase chances to capture the message targeted. Also, even when driving a car becomes an easy task, we know that it is preferable, for the sake of attention, to lower the intensity level of radio for mobilizing all resources in a situation that would suddenly become more complicated (increased traffic, uncertainty about the street, direction when arriving in a new city, etc.).

Readers: "Right now, what are you paying attention to?" Well, certainly to the text you are reading. Yet, there are probably several other things in your environment that could have captured your attention. There is probably some noise, certainly some pressure exerted by your chair on you if you are in the likely sitting position for reading, and maybe even some odors coming from the kitchen. Before reading the last sentence, none of these possibilities was striking you; none captured your attention. Even so, as soon as you read about it, you asked yourself about the potential noise in the environment, and maybe you have identified more than one source of noise. As well, you have not been thinking about an iron or a mouse, but for having read these words, one or the other or even both probably occurred in your mind. That is attention. There is continuously a large amount of information at the reach of mind, or because our sensory systems give access to it, or because the information is already there, in memory.

Sometimes, stimuli from the environment capture attention; in such cases, we are talking about bottom-up processing (or data-driven processing). Sometimes, we decide to pay attention to something, which is referred to as a top-down process (concept-driven processing).

8.1.1   Blindnesses

There are two types of errors, now classic in psychology, issued from the scientific literature on attention. They are called blindness. One is change blindness and refers to the difficulty that people may have to detect what could be quite a big change on an object that is part of a scene that is being observed. Indeed, the difficulty to detect a change, for instance, from one image to another one that looks like the first one, when the presentation of these two images is alternated, depends on the magnitude of change in the context of the presented image (Rensink, 2002; Rensink, O'Regan, & Clark, 1997).

Along the same line, it is sometimes difficult to note the presence of new objects, or of new stimuli, occurring in a scene. This last case is called attentional blindness. As for change blindness, attentional blindness occurs when too much attention is allocated to a specific part of a scene. A classic example of such effect is the one

where someone is asked to count the number of passes of a ball among teammates: nearly half of the people asked to complete this relatively simple task are unable to observe the arrival of a huge stimulus, a gorilla, in the middle of the scene at some moment, through the passes between teammates. This demonstration is available on the following website: http://www.simonslab.com/videos.html.

A phenomenon like this one leads to believe that a conscious perception of the world is made possible only with the contribution of attention. Along the same line, there exist recent results showing that there is also attentional deafness, i.e., a difficulty to detect the presence of an auditory stimulus through other auditory dynamic stimuli (Dalton & Fraenkel, 2012). Note also that a participant asked to complete a difficult visual discrimination task is susceptible to miss the presentation of an easily detectable sound presented during this visual task (Macdonald & Lavie, 2011). It is therefore possible to induce an effect of attentional deafness with the manipulation of a difficult visual task.

The next three parts of this chapter are dedicated to three important properties of attentional processes. These properties are the capability to prepare attention in space and time, for capturing more efficiently the forthcoming information; the capability to operate a selection of the information available around, be it delivered visually or auditorily; and the capability of searching for specific information in the visual field.

8.2 Preparation and Orientation

Typically, research on attention is based on an analysis of the time necessary to provide a response (response time) in specific situations (Posner, 1978). Inferences about the mechanisms at play are based on the results issuing from various experimental situations.

8.2.1 Spatial Preparation

The study of the deployment of attentional mechanisms can be made with a classic strategy where, for instance, participants are asked to direct their gaze toward a point in the center of a computer screen in front of them. The participants need to press as rapidly as possible the appropriate key (on a keyboard) when a stimulus occurs that will be delivered on the left or on the right of the central fixation point. This first step provides an idea of the time it takes to do such a simple detection task. In a next step, a cue (for instance, a little arrow pointing in the left or in the right direction) occurs at the fixation point, indicating where the stimulus will be presented. Here, we are talking about a spatial cue. Generally, conditions are generated where the cue is valid 80% of the time; in the other 20%, the cue is misleading. With such an experimental manipulation, it is possible to show that the valid cue

allows a reduction of the response time; however, a nonvalid cue has the opposite effect, and, consequently, the time taken to hit the appropriate key is increased. Also, note that if the cue and the stimulus are presented simultaneously, there is no effect. Moreover, the cueing effect increases when the duration between the presentation of the cue and the presentation of the stimulus (*stimulus onset asynchrony*— SOA) is increased; this improvement continues up to an SOA lasting 150 ms.

Such experiments show that it is possible to prepare the attentional mechanisms for increasing efficiency in a task where a stimulus presented at different spatial locations has to be detected. It is as if it is possible to shift attention from one place to another, just like a light beam can be moved. Researchers sometimes refer to attentional spotlight and talk about attentional displacement. We do not really know if, strictly speaking, the spotlight moving is the best analogy for describing this attentional mechanism. One can rather imagine a lens with which it is possible to focus, on a point of fixation, but that would allow an enlargement of the field in such a way that it would become possible to include stimuli located on the left and on the right.

That said, there exists a phenomenon called the *inhibition of return*. Anticipating the presence of an event at a certain location allows detecting it more rapidly and with more accuracy. This inhibition of return refers to the difficulty to send attention back at the spatial location where attention was actually maintained during a brief period (Klein, 2000). More specifically, the original demonstration, by Posner and Cohen (1984), goes as follows.

Let a visual set with a central fixation point and another point located on each side where there may appear a signal. A participant has to react as rapidly as possible to the occurrence of this signal. If a cue is first given, with the illumination of one of the two points on each side, for indicating where the signal will appear, the participant takes less time to react to the occurrence of the signal if it appears at the predicted location than if it appears on the opposite side. That is a facilitation effect. Note that over the series of trials, there are catch trials where the cue is misleading. Thus, the participant cannot anticipate because this would cause an increase of false alarms and therefore a decrease of precision level.

The facilitation effect, measured with the difference of reaction time to the signal target according to the fact that the signal occurs where the cue was located or on the opposite side, is observed however only if the time difference between the arrival of the cue and the arrival of the signal target is very small (from 0 to 100 ms). With a 200-ms difference, reaction time is about the same, whether the target stimulus is presented on the same side as the cue or on the opposite side (Fig. 8.1). But when this difference is increased, the results become quite fascinating. With a 300- to 500-ms difference between the cue and target, it takes less time to react to the signal target if it is presented on the side opposite to the one where the cue occurred. These results are explained by the fact that attention was oriented toward a precise location and then disengaged from this location. This orientation and the disengagement prevent a new engagement of attention at the original location. Some researchers claim that this inhibition of return is due to the involvement of mechanisms responsible for eye movement (Rafal, Calabresi, Brennan, & Sciolto, 1989).
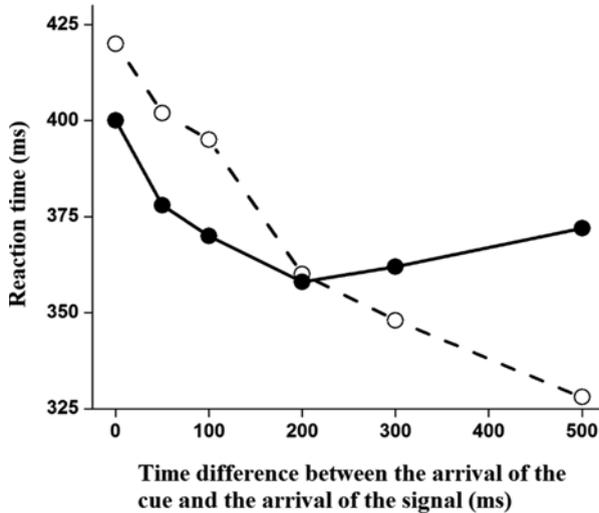
Fig. 8.1 Results from Posner and Cohen (1984) showing the *inhibition-of-return* effect; *black dots*, target with cues; *white dots*, target without cue

8.2.2   Temporal Preparation

Just like it is possible to be prepared to shift attention as a function of the arrival of a stimulus in space, it is possible to be prepared for the arrival of a stimulus at a given moment in time. So it is possible to learn to read the links between events in order to get ready at the moment something occurs. Reading the warning signs allows to increasing the efficiency of the response to give. For instance, when driving a car, the occurrence of a yellow light (in North America) means that one should be prepared to stop.

Once again, one can use the response time to study how we prepare in time. It is important to understand that a simple task such as responding to the arrival of a signal requires the contribution of a series of processing steps. The stimulus must be detected and identified; the appropriate response must be chosen; and the motor programming that the response requires has to be engaged. In this context, the preparation means to try to do in advance what is preceding the response. In the following description, we will stick to cases involving simple reaction times (Niemi & Näätänen, 1981).

Thus, a typical experiment for studying this preparation is to use a warning signal before the presentation of a target stimulus to which a participant must react as quickly as possible. This signal can reduce the uncertainty related to the moment of occurrence of the target stimulus. After the appearance of the warning signal, the more time passes, the more the arrival of the target stimulus becomes likely. This information alone has the effect of reducing the reaction time when the stimulus occurs. The interval between the warning signal and the target stimulus is called the preparatory period. This period allows being oriented in time.

The effect of temporal preparation depends on the specific experimental conditions under which a participant has to perform. We can carry out blocks of trials where the preparatory period remains the same (constant condition) or vary the duration of this period from trial to trial (variable condition), using periods identical to what is used in the constant condition. In the constant condition, the longer the preparatory period, the slower the reaction time (Bausenhart, Rolke, & Ulrich, 2008). In contrast in the variable condition, the longer the preparatory period, the shorter the reaction time. This applies to all kinds of durations of preparatory periods.

This effect, in the variable condition, is explained by the following principle: the more time passes, the more likely becomes the arrival of the target stimulus, and, consequently, one tends to increase the preparation according to this probability. In the constant condition, the probability is fixed; there is no change of likelihood being tested. One probably needs to rely on the simple calculation of the period preceding the stimulus, after the arrival of the signal, this calculation involving more variability as the duration increases.

8.3   Selectivity

Since a multitude of environmental stimuli constantly reach our sensory receptors, there is, within our reach, a wealth of information. What is brought to consciousness depends on where the focus is. It is not possible to hear everything and see everything at the same time. We must somehow choose and this choice is made through attentional selectivity. It is possible to focus on a specific source of information. For example, all students know that it is possible to simulate listening in class, but actually watching from the corner of the eye (to direct attention to) another person of the class! Similarly, it is not because the person in front of you looks at you in the eye at a dinner at the restaurant that he or she is not trying to follow the conversation at the next table! In the following paragraphs, we will describe how the study of selectivity in different sensory modalities, visual and auditory, is conducted.

8.3.1   Visual Selectivity

The stimuli reaching the retina are not only numerous, but they sometimes succeed at a high speed, when reading, for example, or when looking outside by the side window when moving by car. Also, as we have seen when studying the perception of form, the trace left by the stimuli on the retina persists for some time. Playing with the selectivity of attentional processes, it is possible to investigate the duration and the properties of this information on the retina.

The technique of partial report, developed by George Sperling, allows studying these properties. Let us consider the following situation. A series of 12 letters are presented simultaneously to participants on a screen and this, during 50 ms. Those letters are arranged in three rows of four. During some trials, participants are asked to report as many letters as they can. Generally, in such conditions (full report), participants will report four or five letters. The question that arises is why are there only four or five of the 12 letters that are recalled? One answer may lie on the fact that we can capture no more than four or five letters at the same time, which would reveal some perceptual limit in our way of capturing information. Another explanation could be the following one. Maybe all the information (the 12 letters) is available for a short time, but while the first letters are recalled, the others disappear.

It is in order to test this second explanation that Sperling (1960) has developed his clever strategy, the partial report. This technique is based on the idea of a pairing between a sound and a row of letters. Thus, high-, medium-, and low-frequency sounds are associated with the rows of four letters from the top, middle, and bottom, which is the 12-letter set on the screen. Immediately after the short presentation of letters, a sound is presented to the participant. This sound indicates which letters, specifically, should be reported. If the sound is most acute (high frequency), one must report the letters arranged on the top row. If the failure to report more than four or five letters, on average, in a global report is related to a limit on the number of letters perceived, one should report only one or two letters per row, on average, during the partial report. However, if all the information is available for a brief period before the information is erased, one should report more than one or two letters per row, on average.

It appears that during the partial report, participants are much better. They can report on average at least three letters per row. In other words, the information is there for a short time, and, if one directs attention immediately to the information, we have access to it. It is important to specify that the sound is presented only after the presentation of the letters is completed. This means that participants cannot direct in advance their attention on a row.

It is when the sound signal is presented immediately at the end of the visual presentation that the partial report shows the most benefits (more letters recalled on average). In fact, Sperling has shown that the introduction of a gap between the end of the presentation of the letters and the sound nullified the benefits associated with the partial report. With an interval of 150 or even 300 ms, more letters are reminded on average than with a global report, but this effect disappears completely if the delay lasts 1 s. In short, the information is really there, available, but only for a short period.

In terms of cognitive psychology, we call sensory register—a kind of very short-term memory—the initial stage of information processing where this information persists for a short period after the disappearance of the physical stimulus. The neural activity does not stop with the end of a stimulus; it stretches slightly over time (Di Lollo & Bischof, 1995; Loftus & Irwin, 1998; Nisly & Wasserman, 1989). Sometimes the term iconic memory is used for referring to the sensory register in the visual modality (as opposed to the echoic memory for auditory modality).

In addition, another property of attentional processes that may affect the ability to perceive is called the attentional blink (Dux & Marois, 2009; Martensa & Wybleb, 2010). We can demonstrate this effect using a procedure where there are presented successively, in one place, a series of visual stimuli rather than deploying stimuli at different locations on the retina. If one asks a participant to report the presence of a digit through a series of letters presented rapidly, this participant will succeed without difficulty if the stimuli are not presented too quickly. For example, if the participant is presented with eight to ten items per second, the task will be completed with success and without too much difficulty. If asked to detect a letter of a given color, rather than a number, the participant will once again make it without difficulty. However, if asked to detect two targets, for example, a letter of a given color and a digit, the ability to detect the second target will depend on how long before the first target was presented. If the second target comes between 200 and 500 ms after the presentation of the first target, the performance is affected. In fact, this reduction occurs only if the first target has been detected. Performance will be particularly affected if the second target arrives from 200 to 300 ms after the first. The attentional blink phenomenon is exactly this difficulty to detect the second target, after having paid attention to a first target. The attention required for the processing of the first target would not be available for the processing of the second.

It is important to note that if the second target occurs about 100 ms after the first, there will be no decrease of the ability to capture the second, as if both targets could be captured together, before the blink. In brief, this attentional blink phenomenon teaches the deployment over time of processes linked to selective attention.

8.3.2 Auditory Selectivity

When one pays attention to a precise source of information, what other information available in the environment can be captured? Is it possible to extract anything else? Yes, probably. For instance, during celebrations in a room where there are multiple conversations in parallel, it is usually possible to follow efficiently the conversation where the attention is directed at. Although it is not possible to follow another conversation, it is likely that you will react if someone around mentions your name.

Researchers interested in attentional selectivity often used a procedure called dichotic listening. In a dichotic-listening task, a participant hears through headphones two messages at a time, one in each ear. The experimenter asks a participant to follow specifically the message sent to one ear, the left or the right one, and to ignore the other. The participant is asked to repeat aloud the message that is followed, just to make sure that it is actually well followed.

The work by Cherry (1953) indicates that there is a minimum of information coming from the ear receiving no attention that remains available. The participant is able to determine if, in this ear, a voice was heard, and when it is actually a voice, it is possible to extract some physical features (for instance, was it a low or high voice), but not to understand the meaning of the message. Also, if a series of digits

are delivered simultaneously in each ear and no priority for left or right ear is assigned to participants, they will report information coming from both ears, not in a chronological order of arrival, but ear by ear.

This type of studies raises the question about the level where attention plays a role in the sequence of information processing. Broadbent (1958) proposed the idea that there exists an attentional filter, a kind of Y-shaped tube that can only let a limited quantity of information passing through. Indeed, according to this researcher, a central information processing system is responsible for the reception of information from different sensory channels for eventually determining the meaning on the basis of what is already stored in memory. By letting only stimuli having some specific features to enter, the filter would serve to avoid an overload of work to this central system. The filter does not allow shifting from one channel to another. If that would be the case, it would become possible to listen to more than one conversation at a time. The selectivity would then operate early, i.e., at the level of acoustical features. Therefore, the selectivity of information would occur at a low level, before any semantic analysis would be made.

Following Broadbent's findings, studies like the ones by Gray and Wedderburn (1960) showed that the attentional filter would rather operate a late selection. In one study, participants heard simultaneously in each ear, for instance, messages like the following ones:

In the left ear	Hy—2—gen
In the right ear	6—dro—9

It was therefore possible to hear simultaneously "Hy 6," "2 dro," and "gen 9." When participants were asked to follow what is reported in the left ear, to ignore what is reported in the right ear, and then to report what was heard, they reported "Hy-dro-gen." In other words, participants' attention was shifted from one ear to the other and this, as a function of the meaning of the words. In brief, if it was once thought that the attentional selection was made rapidly in the information processing sequence, it was henceforth necessary to believe that selection occurs at an ulterior stage of processing given that there must have been some understanding of the meaning for explaining the shifting from one ear to the other in Gray and Wedderburn's study.

Anne Treisman also used dichotic listening, but rather presented segments of sentences in each ear. Once again, the results showed that participants follow the meaning of the message from one ear to the other, rather than to stick with the task requiring to following what is sent to one ear specifically. These results support the idea that there is a late filter (see Deutsch & Deutsch, 1963) or, in the terms of Treisman (1960), the idea that it would rather be an attenuator instead of a filter.

Instead of searching for the location of the filter or attenuator in the information processing sequence, researchers in the field of attention eventually preferred to emphasize the distinction between automatic processes and processes based on controlled attention (Johnston & Dark, 1986). Generally speaking, this approach shows a concern

for attentional capacities, i.e., for the distribution of attentional resources in different tasks. This approach goes far beyond the scope of the present book, which is focused on perceptual processes. Attentional resources being limited, researchers in this study field wanted to know the mental load of different cognitive tasks, to what extent these tasks solicit or not the same resources, and how these tasks can reach some automaticity. Nowadays, in a society where everyone seems to search for time to the point of combining tasks like using a cell phone and driving a car, it is easy to understand the importance of knowing the attentional load imposed by tasks (Strayer & Johnston, 2001).

Being exposed to the Stroop effect rapidly provides an idea of what the automatic activation of a process looks like (MacLeod, 1991; Stroop, 1935). This effect appears when one tries to name the color with which each word is written, each word designating a color actually. It is very difficult to ignore the meaning of the word (the color designated when reading) when trying to simply name the color used to write the word. Reading is not required in this task; just naming the color is required. Nevertheless, reading imposes itself automatically and, consequently, causes interference. Just to catch the strength of this effect, go to Fig. 8.2 and try see
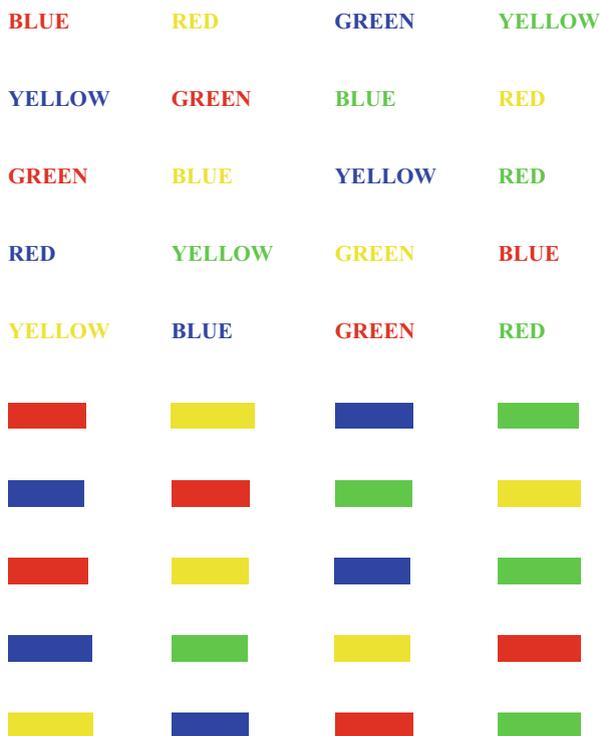

Fig. 8.2 Example of a Stroop effect. Naming the color (*lower set*) of each of the 20 *rectangles* (five rows of four colors) takes much less time than naming the color (*upper set*) used for writing each of the words. This demonstration illustrates an interference effect caused by the automatic activation of word reading

how much time you need for naming each color in the lower series (colors without letters). Then, see how much time it takes for naming each color in the upper series (colors with letters). There should quite a large difference (several seconds). You may also try to simply read each word of the series of words. Once again, you should observe that it takes much less time to complete this task than it takes to name the colors in the same series.

8.4   Visual Search

The tasks used in the preceding part of the chapter on attentional selectivity are somewhat artificial. For instance, in the case of visual selectivity, participants are asked in advance where to look. In everyday life, one rather needs to search actively for something in a set of stimuli. Indeed, being able to extract visually something from the environment does not rely on the sole stimulation of the retina. When several elements are at the reach of sight, one has to search for a specific item for seeing it (Wolfe & Horowitz, 2004).

A part of the study of attentional mechanisms is dedicated to visual search. Typical tasks to complete in this research field involve the presentation of a series of items to a participant who is asked to find a specific item (a target).

In an experiment where a letter must be found among many others, the specific features of these letters will determine how easy or difficult it is to spot the target letter. Figure 8.3 illustrates visual sets like the ones used by Neisser (1964). It is much easier to detect letter Z in the left set given the numerous features Z shares with letters in the right set.

There are cases where the number of items determines the time needed for detecting a target and cases where this number has no impact. For instance, in Fig. 8.4, it is possible to detect rapidly, in the upper set (five letters), letter Z or even both letters O. However, spotting Z in the lower left set is much easier than spotting O in the lower right set. Indeed, increasing the number of items in conditions like the one in the lower right set results in longer time for detecting the target letter (O). However, increasing the number of items (O or Q) in the left set would not change the time needed to detect letter Z: the target simply pops out. It is the fact that a target shares more or less features with other items that determines the possibility that a target pops out or not.

Researchers have also been interested in visual search of features besides the strict letter framework. Different features were used like rectangles being presented horizontally or vertically or presented in different colors. Usually, participants are asked to detect a target on the basis of only one feature. Sometimes, the task gets a little more complicated, as in a conjunction search where participants are asked to detect a target involving at least two types of features.

A classic explanation of the functioning of visual search is the feature integration theory (Treisman & Gelade, 1980). This theory of visual attention is based on the idea that processing an object or a visual scene involves two steps. First, at a preattentive

Fig. 8.3 Example of
visual sets used by Neisser
(1964)

ODUGQR	IVMXEW
QCDUGO	EWVMIX
CQOGRD	EXWMVI
QUGCDR	IXEMWV
URDGQO	VXWEMI
GRUQDO	MXVEWI
DUZGRO	XVWMEI
UCGROD	MWXVIE
DQRCGU	VIMEXW
QDOCGU	EXVWIM
CGUROQ	VWMIEX
OCDURQ	VMWIEX
UOCGQD	XVWMEI
RGQCOU	WXVEMI
GRUDQO	XMEWIV
GODUCQ	MXIVEW
QCURDO	VEWMIX
DUCOQG	EMVXWI
CGRDQU	IVWMEX
UDRCOQ	IEVMWX
GQCORU	WVZMXE
GOQUCD	XEMIWV
GDQUOC	WXIMEV
URDCGO	EMWIVX
GODRQC	IVEMXW

stage, an object is processed as a function of its features. It is then possible to proceed
to the analysis of a certain number of features because they are processed in parallel,
i.e., in an automatic way, without the contribution of attentional resources. The theory
also posits a second stage where it is necessary to link features to objects: that is
referred to as the *binding* problem (Treisman, 1996). This processing stage requires
attentional resources, attention being directed toward one item at a time. The idea that
there exist two processing stages, i.e., that there are, on the one hand, features per se
constituting an object and, on the other hand, a need to link these features, is supported
by what is observed when participants are placed in very difficult conditions.
Presenting illusory conjunctions generates such difficult conditions (Treisman &
Schmidt, 1982). These illusory conjunctions are errors occurring when one reports
having seen, in a visual set, a letter of a certain color. This letter was presented, and
the color reported too, but this exact letter in this exact color was not presented.
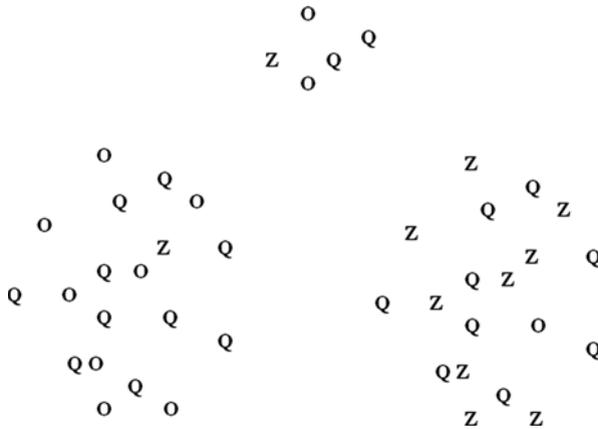
O
Z   Q   Q
O

O
Q   Z
Q   O
O
Z   Q
Q   O
Q   O
Q   Q
Q
Q O
Q
O   O

Z
Q
Q   Z
Z
Z   Q
Q   Z
Z   O
Q
Q Z
Q
Z   Z

Fig. 8.4 If one searches for letter Z in a stimulus set like the one on the *lower left part*, the size of the visual set has no impact; however, if one searches letter O in a stimulus set like the one on the *lower right part*, the size of the set becomes critical. In the former case, Z emerges spontaneously (pop-out phenomenon)

8.5   Clinical Aspects

There exist different attentional problems having impact on perception. One of these is called hemineglect. Someone suffering from parietal cortex damage might well experience problems with visual attention. More specifically, if a lesion is on the right cerebral hemisphere, the patient will not be able to pay attention to all material located on the contralateral (opposite) side, i.e., to anything located at the left of a fixation point. A special case of hemineglect is called extinction. A patient with such a deficit would be able to see an object located on the contralateral side, but only if there is no object at the corresponding location in the other visual hemifield (i.e., on the ipsilateral side).

Sometimes, parietal lesions can be bilateral. In these rare cases, a patient suffers from a problem called the Balint syndrome. Different symptoms may result from this problem. For instance, a patient seems able to see only one object at the time. It is as if everything around the object one is paying attention to simply does not exist anymore. This incapacity to perceive more than a single object at a time is sometimes referred to as simultagnosia.

Finally, there are cases where, following cerebral lesions, patients report being unable to see some objects (Weiskrantz, 1986). However, they do "guess correctly" their location if one insists for having them pointing where they are. This phenomenon, called *blindsight*, reveals the fact that it does not look necessary to consciously see something for acting or reacting to this thing.