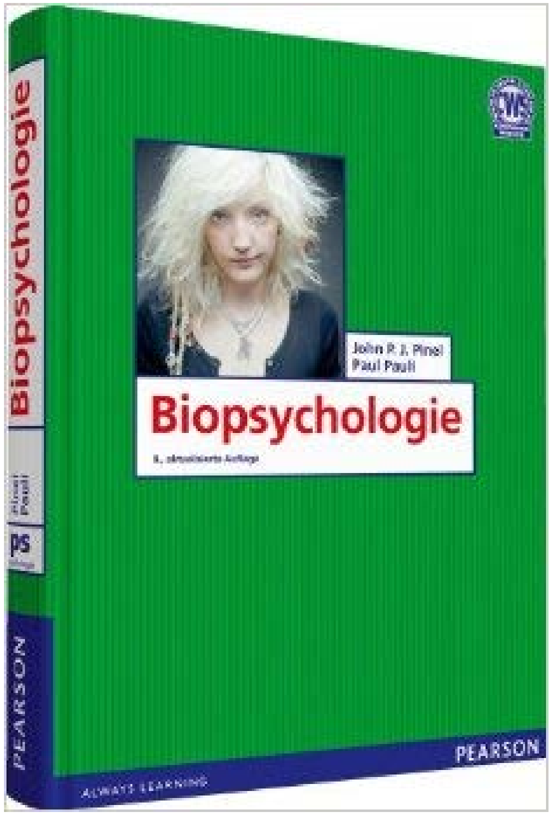
Kognitive Neuropsychologie

- 03.11. Geschichte der kognitiven Neurowissenschaft
- 10.11. Funktionelle Neuroanatomie
- 17.11. Methoden der kognitiven Neuropsychologie I
- 24.11. Methoden der kognitiven Neuropsychologie II
- 01.12. Visuelle Wahrnehmung
- 08.12. Objekterkennung
- 15.12. Auditive Wahrnehmung
- 05.01. Sprache
- **12.01. Aufmerksamkeit und Selektion**
- 19.01. Kognitive Kontrolle
- 26.01. Gedächtnis & Lernen
- 02.02. Kognitives Altern

- Definitions and theoretical models
- Neural correlates of auditory & visual attention
- Brain mechanisms and networks
- Neglect & Balint Syndrome

Literatur



Gazzaniga, M.S., Ivry, R.B. & Mangun, G.R. (2009). Cognitive Neuroscience (3rd Edition). W.W. Norton & Company: NewYork (Kap. 12)

Aufmerksamkeit und Selektion

Figure 1 | ***The Garden of Earthly Delights* by Hieronymous Bosch.** Courtesy of the Corbis Picture Library.

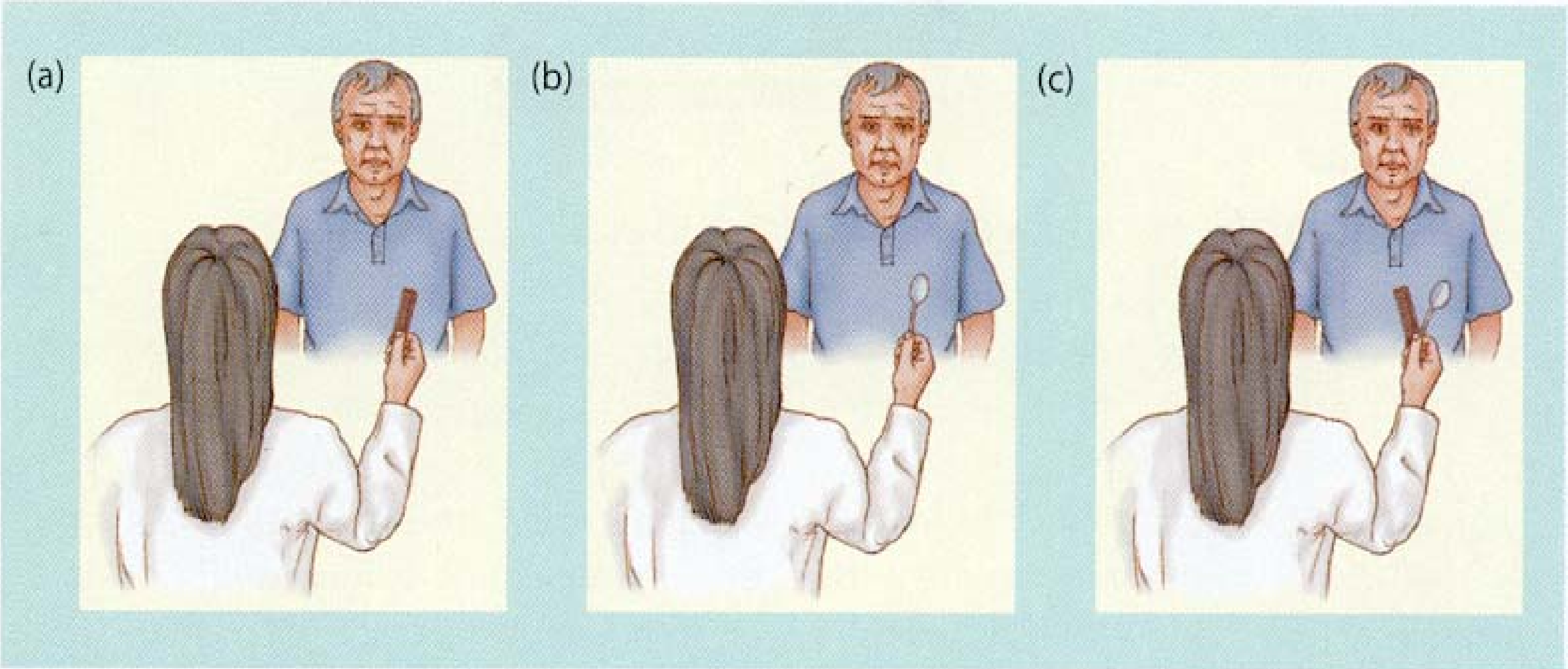
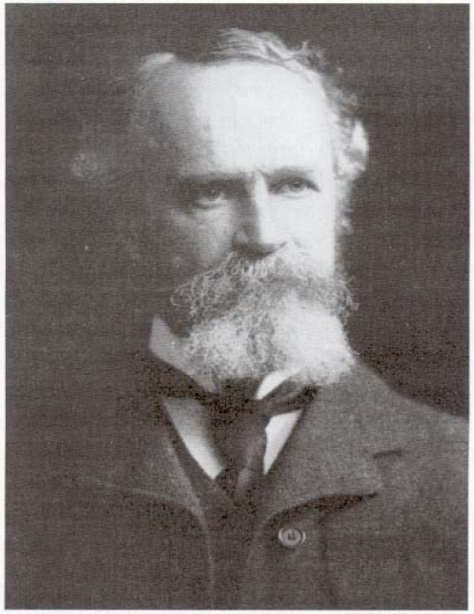


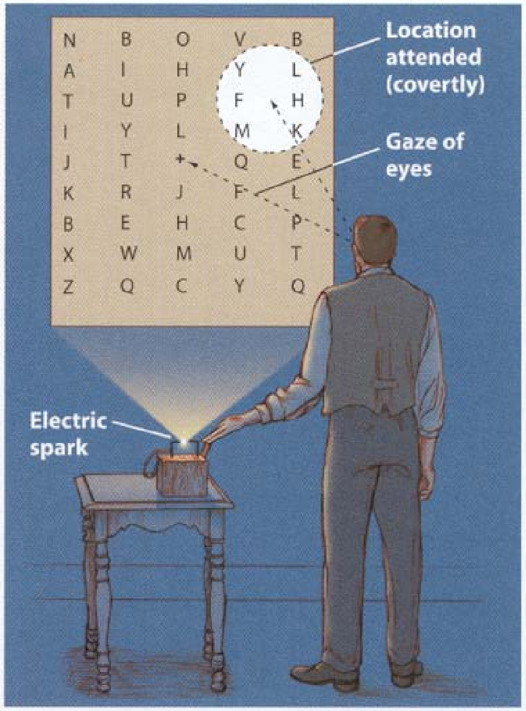
Figure 7.1 A patient is examined after recovering from a stroke affecting the cortex. **(a)** The doctor holds up a pocket comb and asks the man what he sees. The man says he sees the comb. **(b)** The doctor then holds up a spoon, and the man says he sees this too. **(c)** But when the doctor holds up both the spoon and the comb at the same time, the man says he can only see one object at a time. The patient has Balint's syndrome.

Everyone knows what attention is. It is the taking possession by the mind, in clear and vivid form of one out of what seem several simultaneously possible objects or trains of thought. Focalization, concentration of consciousness are of its essence. It implies withdrawal from some things in order to deal effectively with others, and is a condition which has a real opposite in the confused, dazed, scatterbrain state. . . .

Figure 7.2 William James, the great American psychologist (1842–1910).



Definition



Voluntionale Aufmerksamkeit (endogen, top down)

Reflexive Aufmerksamkeit (exogen, bottom up)

Das Cocktail Party Phänomen / Dichotisches Hören unterstützt Modelle früher Selektion

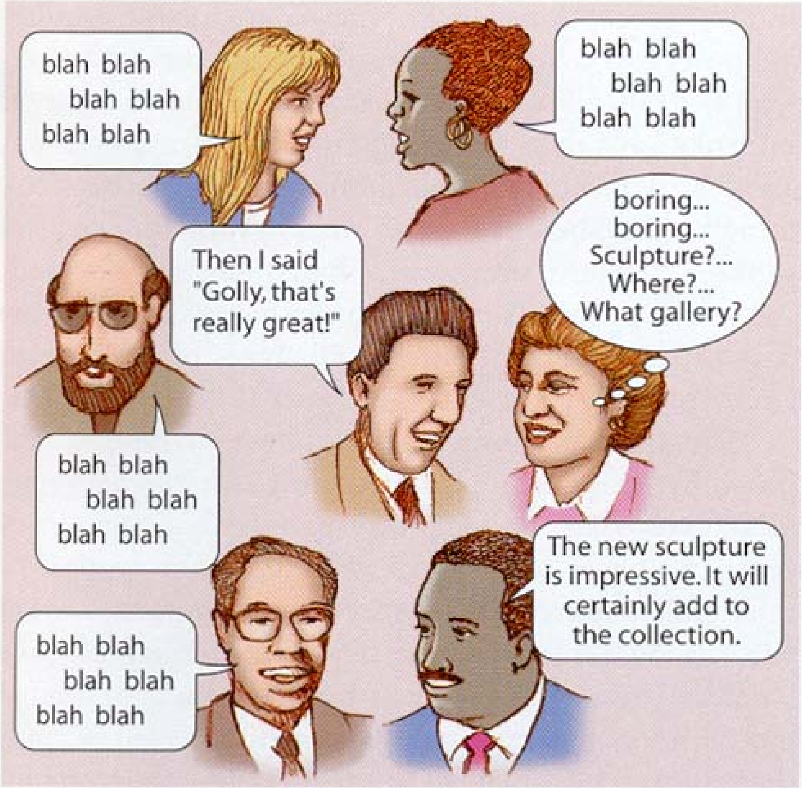
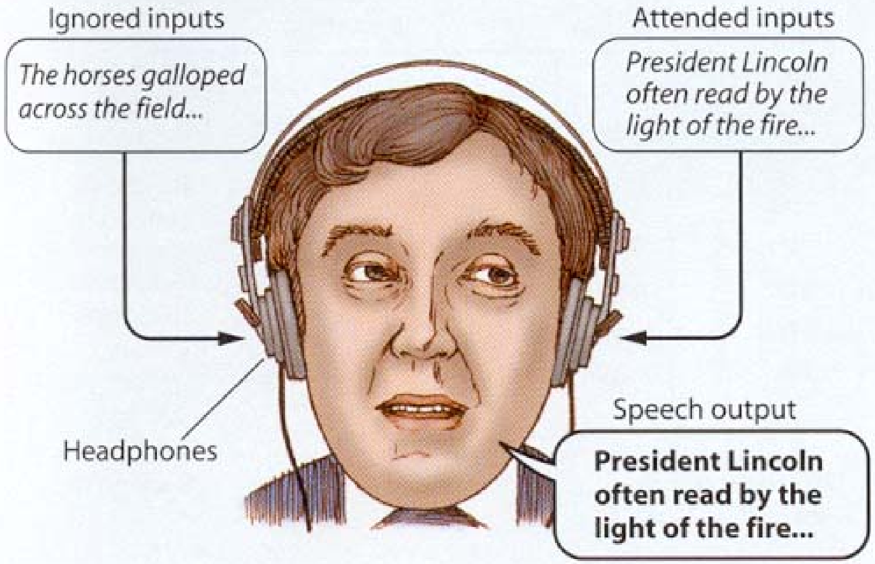
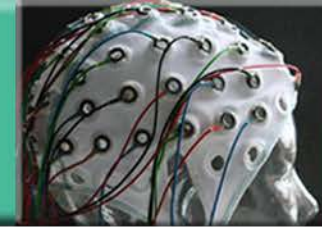


Figure 7.4 The cocktail party effect of Cherry (1953), illustrating how in the noisy confusing environment of the cocktail party, people are able to focus attention on a single conversation.

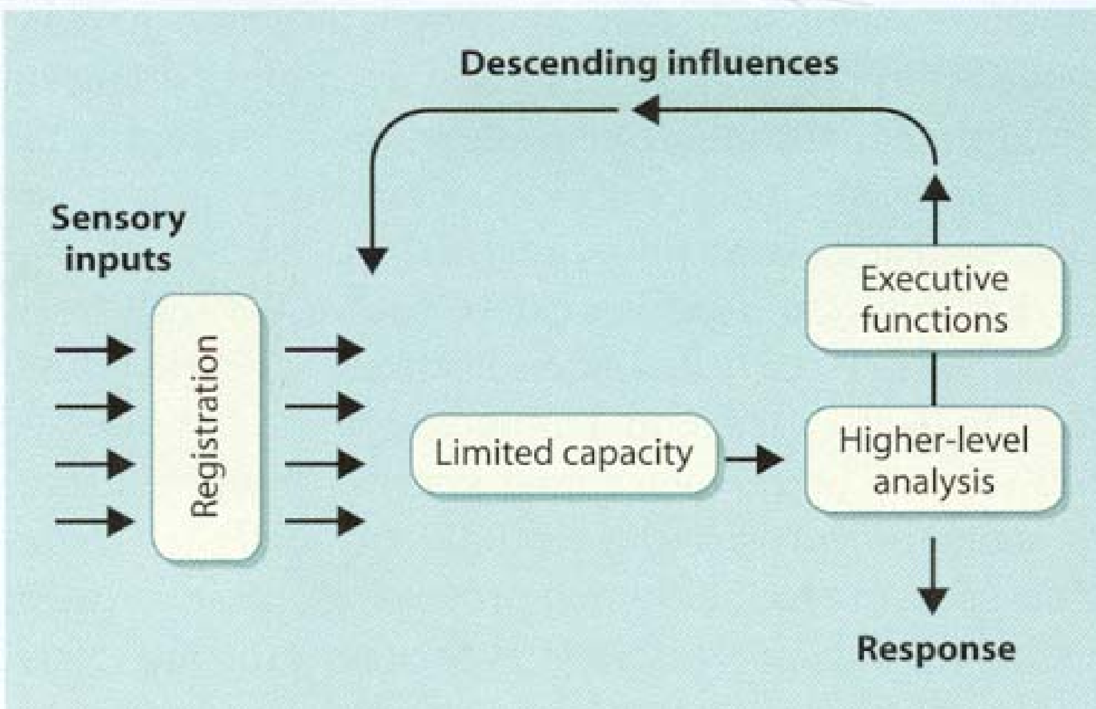
Figure 7.5 Cherry's shadowing experimental setup that presents auditory information to both ears of a subject. The subject is asked to "shadow" (immediately repeat) the auditory stimuli from one input.





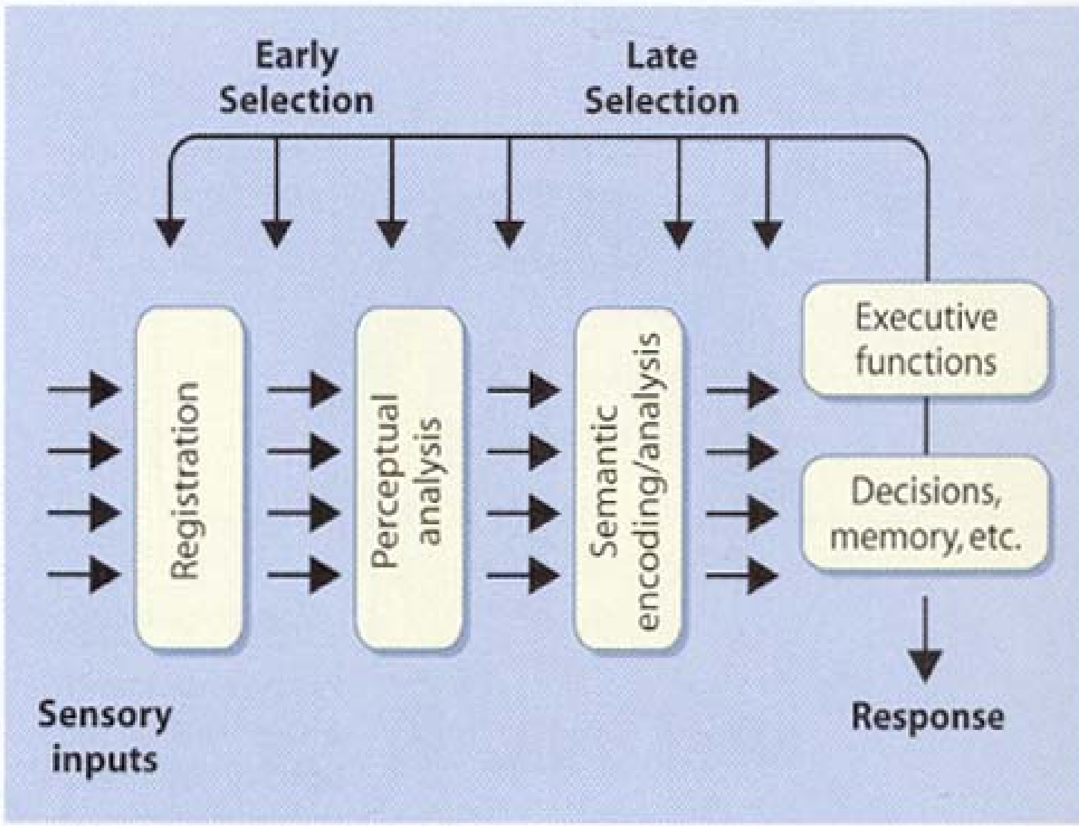
But: Donald Broadbent - Intrusion of the unattended…

Figure 7.6 Broadbent's model of selective attention. In this model, a gating mechanism determines what limited information is passed on for higher analysis. The gating mechanism shown here takes the form of top-down influences on early neural processing, under the control of voluntary, executive processes. Adapted from Broadbent (1958).



Frühe vs. späte Selektion
Bottleneck-Theorien der A.

Figure 7.7 Diagram of early versus late selection of perceptual processing. This conceptualization is concerned with the extent of processing an input signal might attain before it can be selected or rejected by internal attentional processes.



Ein Beleg für späte Selektion: Flanker Task

Table 1
Experimental Conditions and Representative Displays

	Condition	Example
1	Noise Same as Target	H H H *H* H H H
2	Noise Response Compatible	K K K *H* K K K
3	Noise Response Incompatible	S S S *H* S S S
4	Noise Heterogeneous–Similar	N W Z *H* N W Z
5	Noise Heterogeneous–Dissimilar	G J Q *H* G J Q
6	Target Alone	H

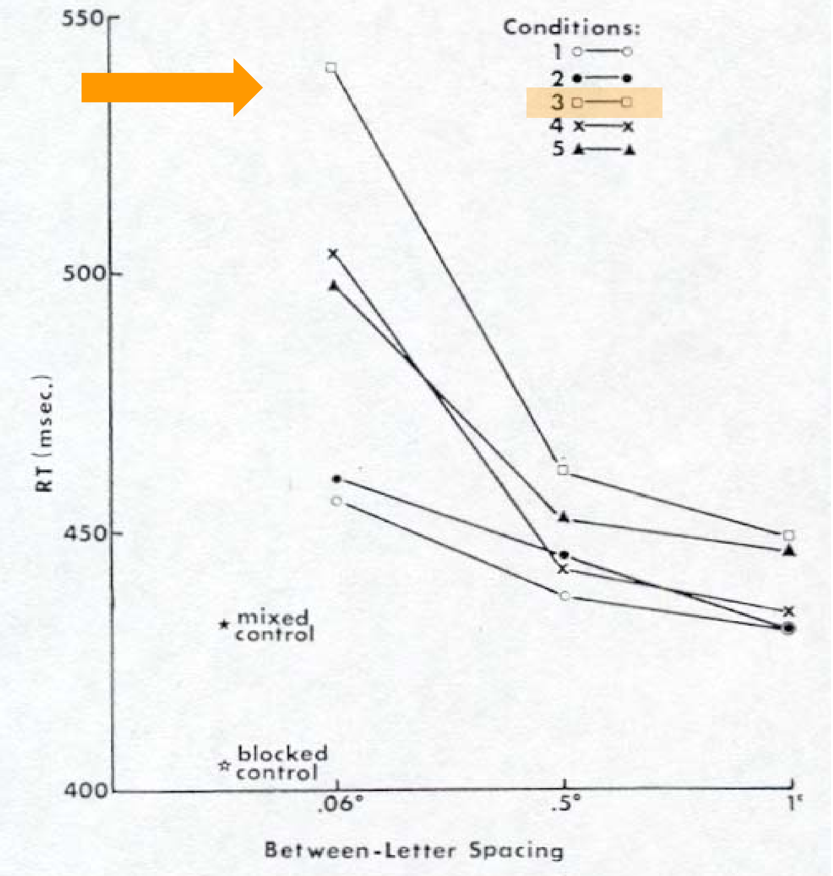
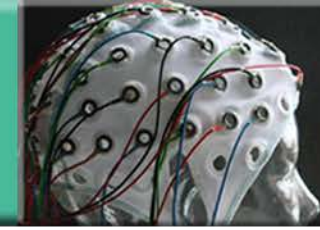


Fig. 1. Mean reaction times (RTs) as a function of spacing (six Ss combined) for the five experimental conditions and two control conditions. Experimental conditions are as follows: (1) noise same as target; (2) noise response compatible; (3) noise response incompatible; (4) noise heterogeneous similar; (5) noise heterogeneous dissimilar.

Spatial Cuing Paradigm (exogenes cuing, reflexive A)



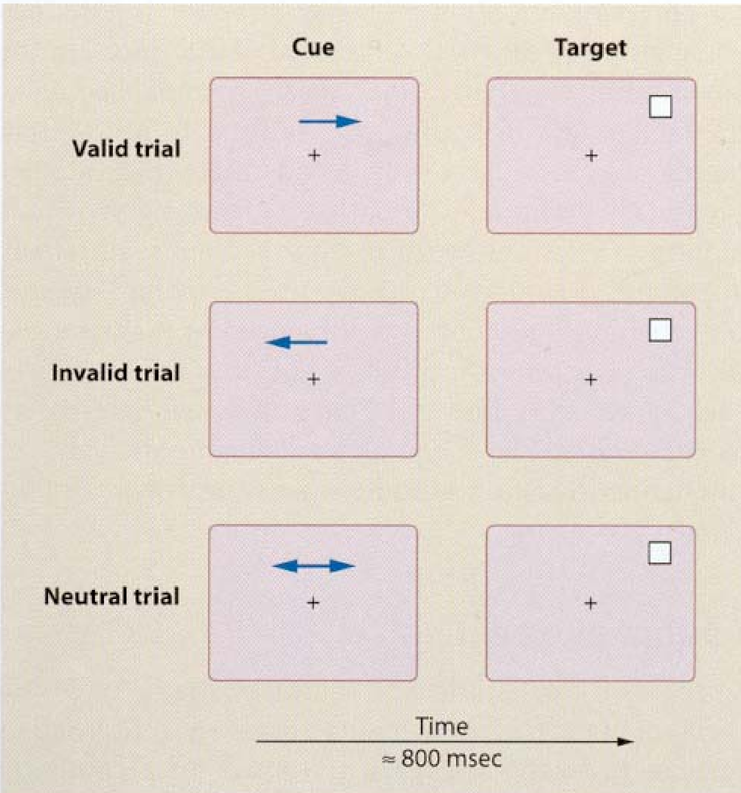


Figure 7.8 The spatial cuing paradigm of Posner and colleagues. A subject sits in front of a computer screen and fixates on the central cross. An arrow cue indicates to which visual hemifield the subject is to covertly attend. The cue is then followed by a target in either the correctly or the incorrectly cued location.

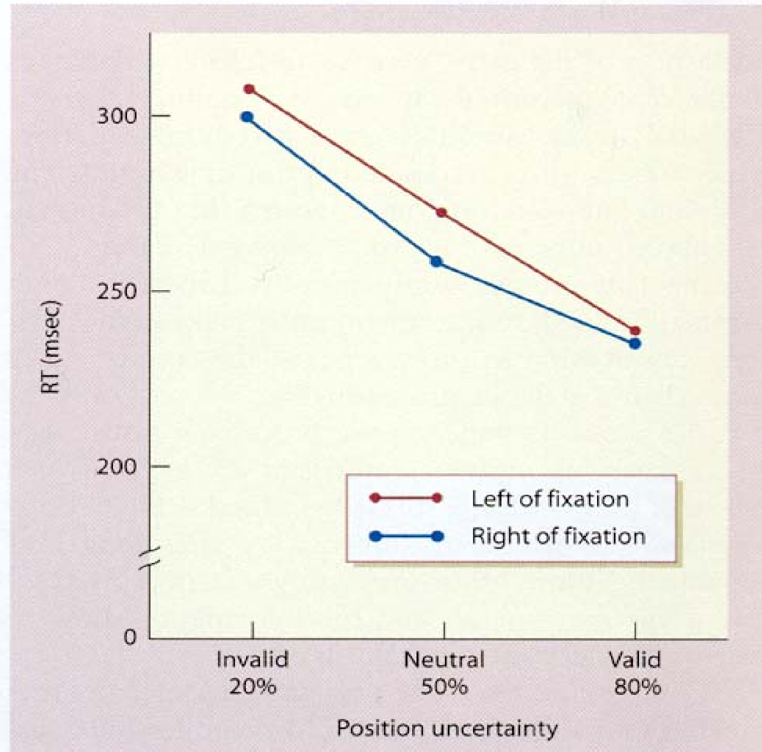
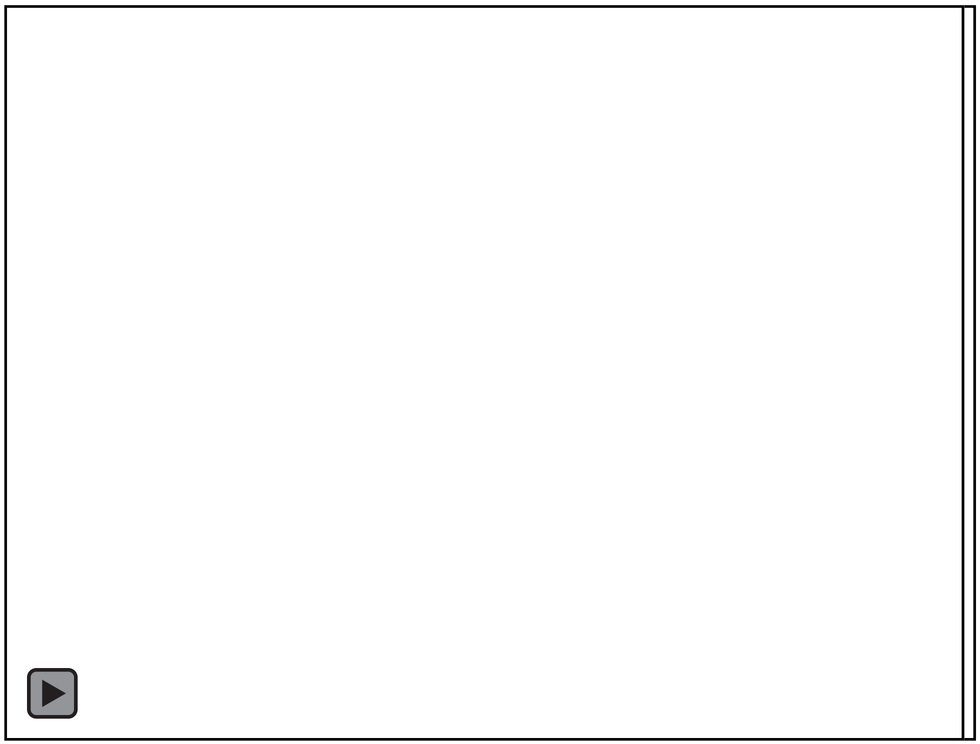
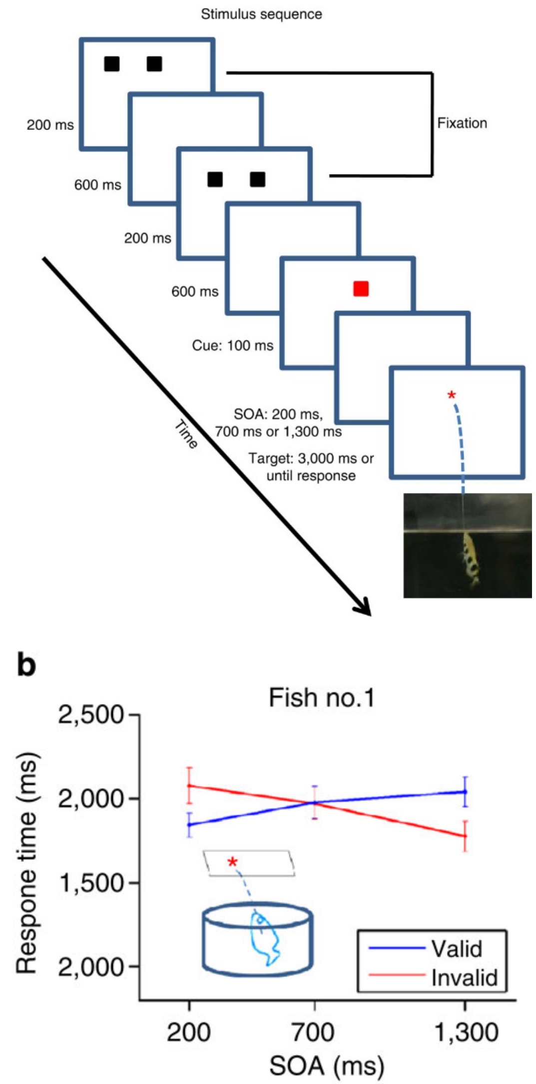


Figure 7.9 Results of the study by Posner and colleagues, as shown by reaction times (RT) to unexpected, neutral, and expected targets for the right and left visual hemifields. Reaction times for expected locations are significantly faster than those for neutral or unexpected targets. Adapted from Posner et al. (1980).

Exogenous (reflexive) Cuing
Inhibition of Return

Archer Fish





Visuelle Suche

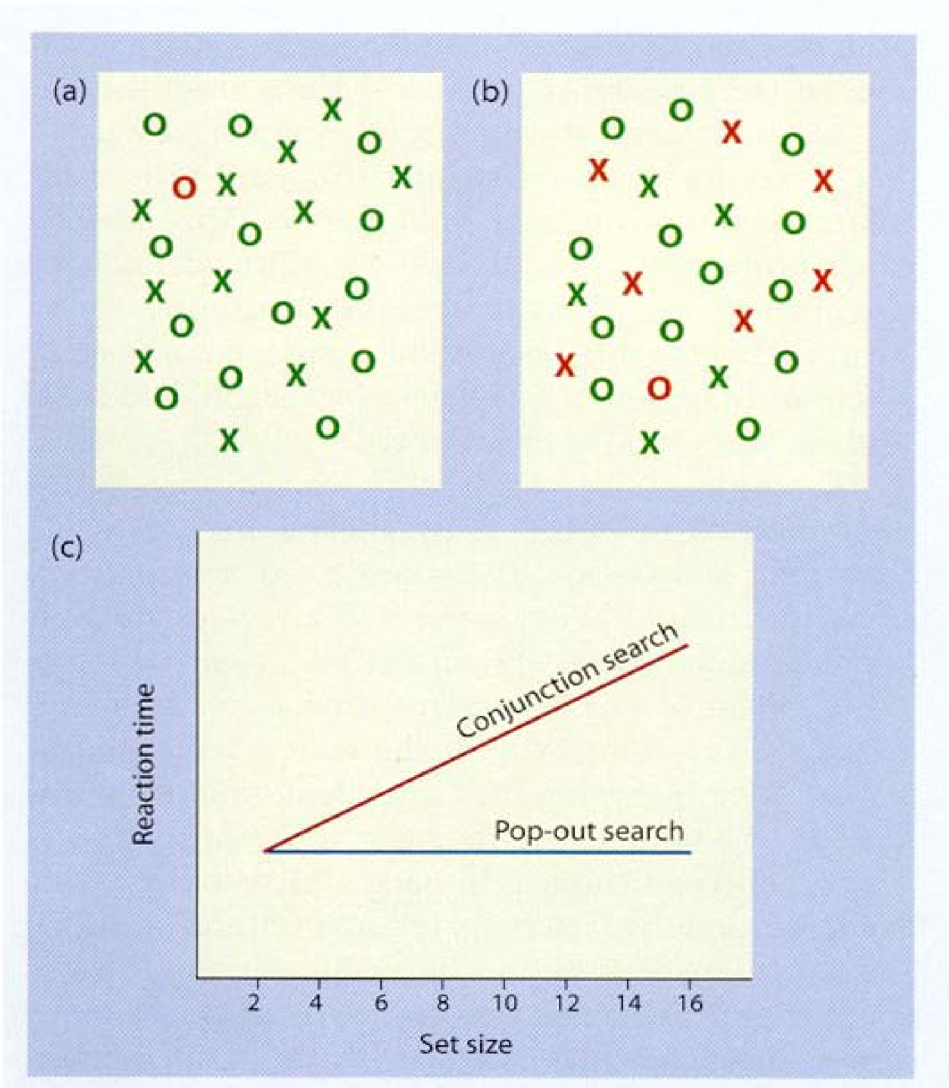
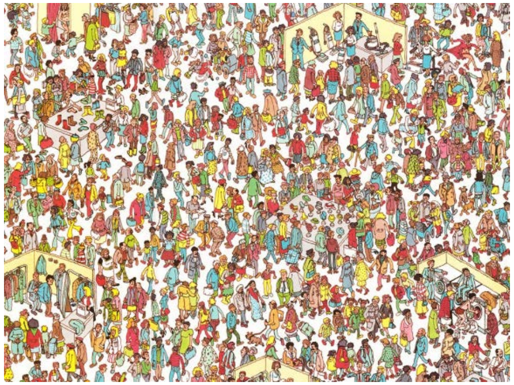


Figure 7.10 Searching for the targets among distracters. **(a)** Example of a search array with a pop-out target (red O). Stimuli are said to pop out when they differ from distracters by simple single features and the observer does not need to search the entire array to find the target. **(b)** Example of a search array where the target is defined by a conjunction of features shared with the distracters. **(c)** Idealized plot of reaction times as a function of set size (the number of items in the array) during visual search for pop-out stimuli versus feature conjunction stimuli. In pop-out searches, where an item differs from distracters by a single feature, the subjects' reaction times do not increase as much as a function of set size as they do in conjunction searches.



- Neural correlates of auditory & visual attention

Auditive selektive Aufmerksamkeit: Der N1 Effekt

Figure 7.12 Early work by Hernandez-Peon and colleagues attempted to relate single-cell recordings in cats to auditory attention. By recording from subcortical structures while the cat attended or ignored sounds, Hernandez-Peon and colleagues initially observed modulations at the subcortical level of processing. This was later shown to be due to differential orienting of the cat's ears rather than auditory attention.

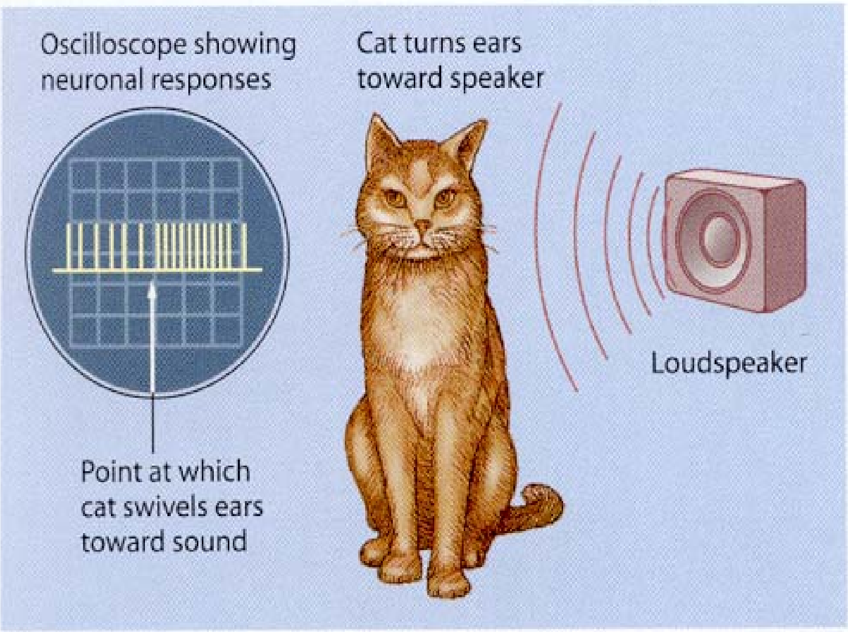
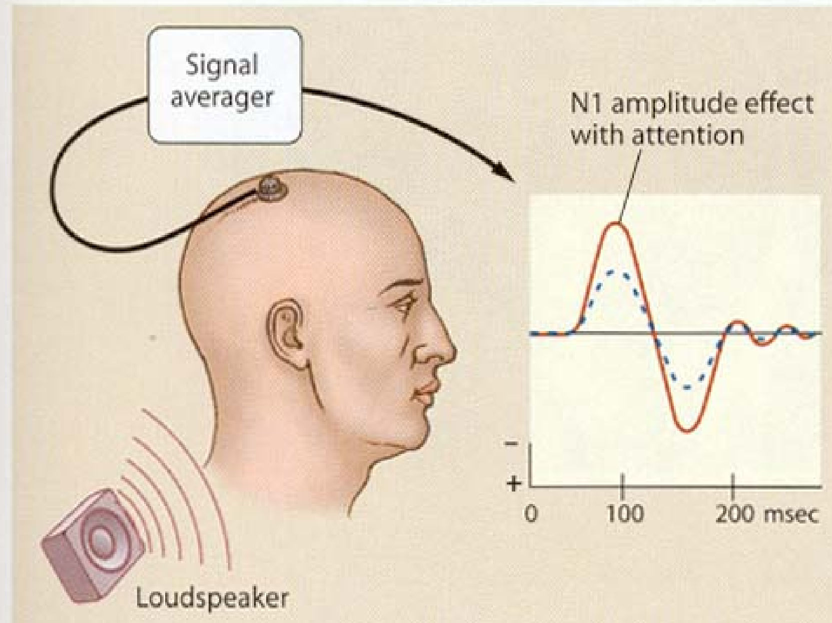
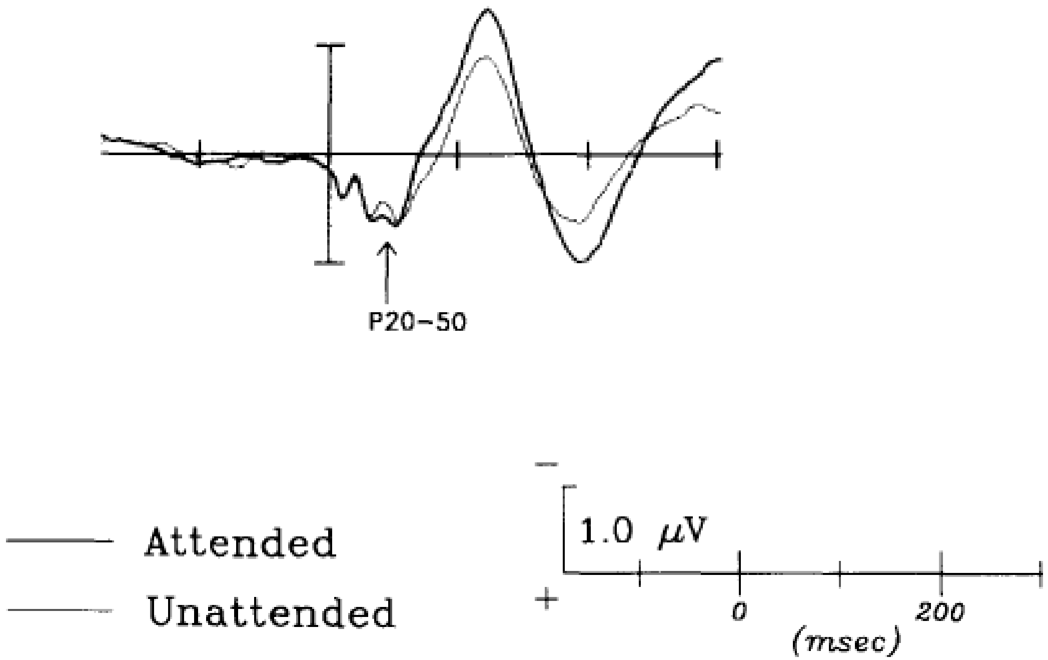


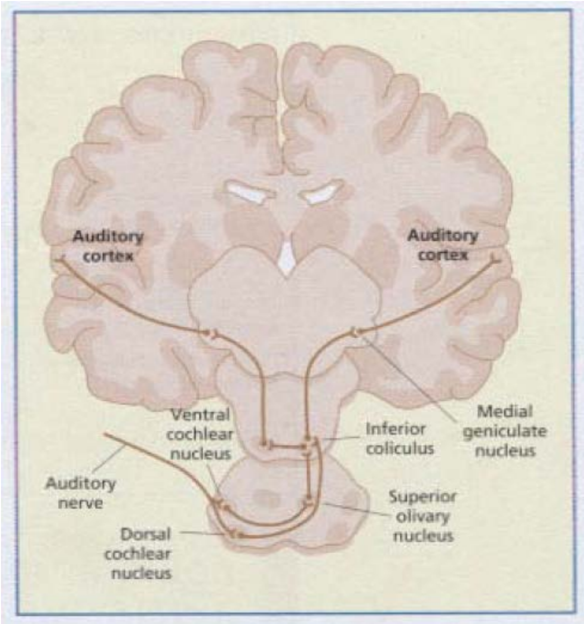
Figure 7.13 Event-related potentials (ERPs) in a dichotic listening task. The solid line represents the average voltage response to an attended input over time, and the dashed line to an unattended input. Hillyard and colleagues found that the amplitude of the N1 component was enhanced with attention as compared to when ignored. Adapted from Hillyard et al. (1973).



Auditive selektive Aufmerksamkeit: P20-50 als Beleg für frühe Selektion

sequences of rapidly presented tone pips in one ear while ignoring tone pips of a different pitch in the opposite ear.





Auditive selektive Aufmerksamkeit:
Generatoren des M20-50 Effekts im primären auditorischen Cortex

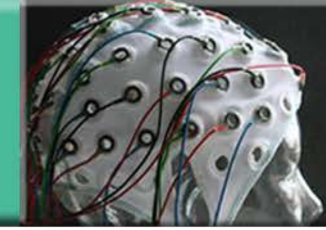
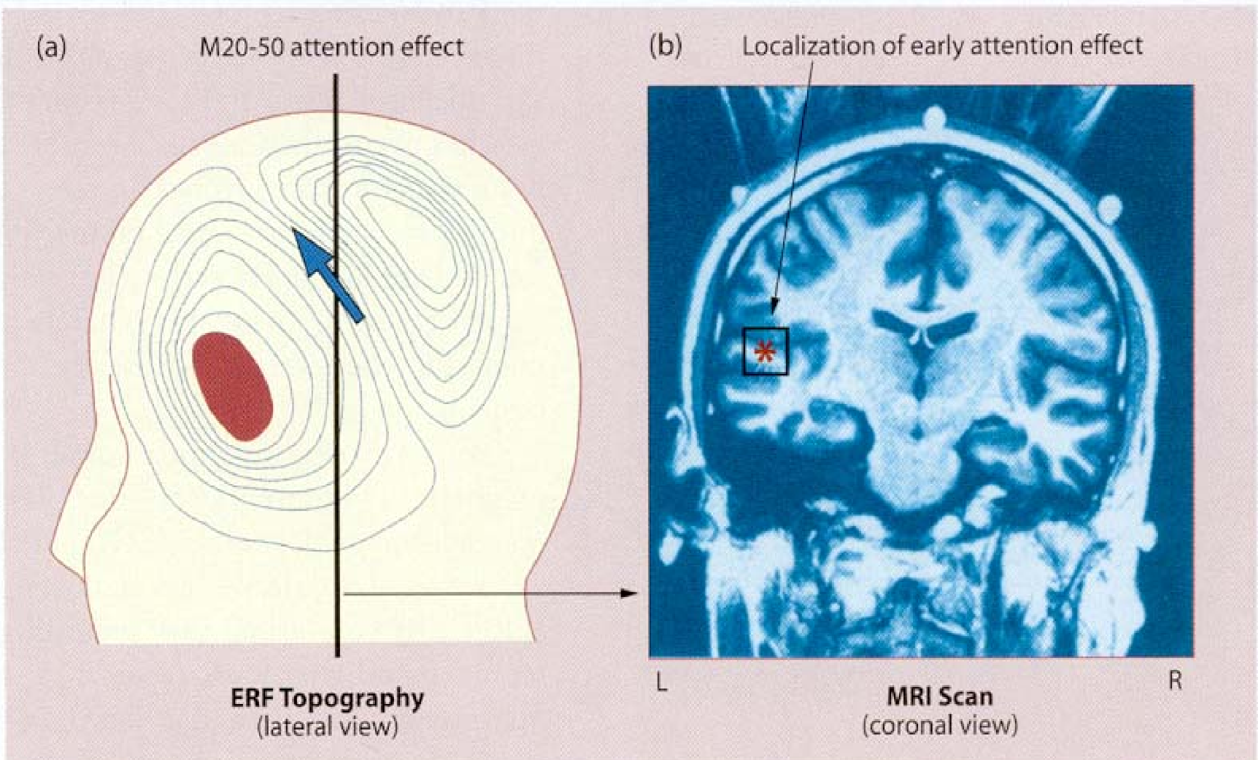
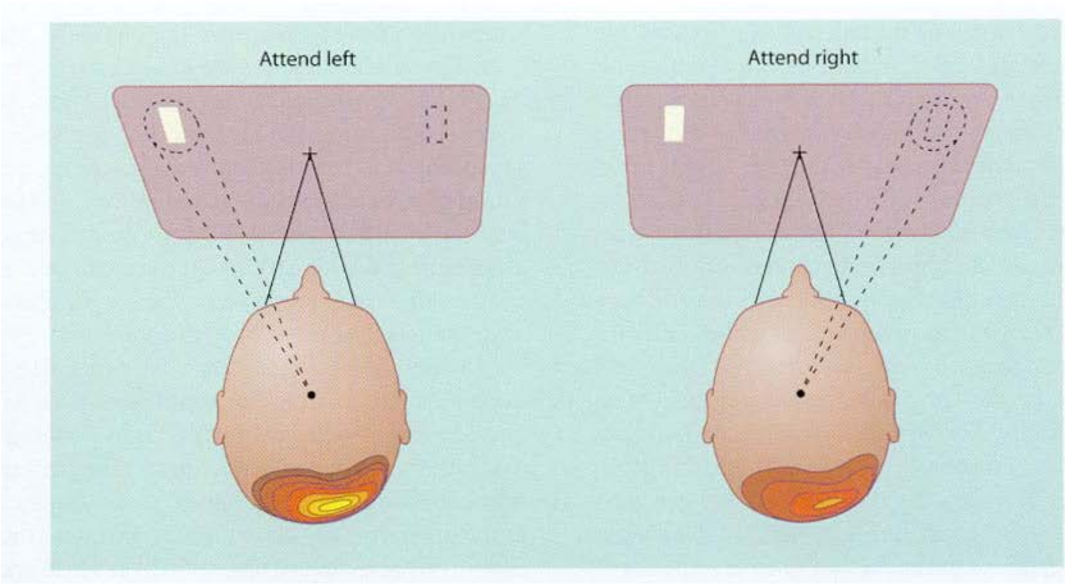
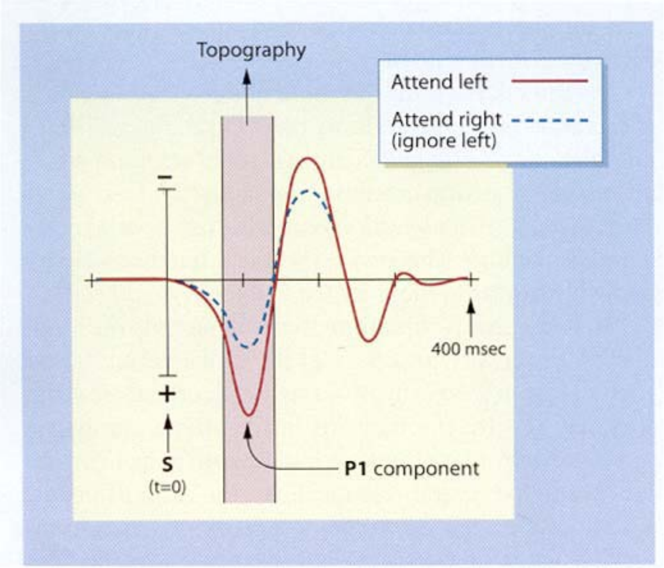


Figure 7.14 **(a)** Topographic map of magnetic event-related fields (ERFs) that are associated with auditory attention in a selective listening paradigm. The field map was created by subtracting the field elicited by unattended tones (in the 20–50-msec time range after stimulus onset) from the field elicited by the same tones when they were attended. The arrow indicates the location and orientation of a model dipolar neural generator that best explains the surface field. **(b)** The localization of the P20-50 attention effect in the brain. When the three-dimensional location of this model dipolar generator (red asterisk) was mapped onto a structural magnetic resonance imaging (MRI) scan (after coregistration of the data sets), the activity was found to originate in the primary auditory cortex, in Heschl's gyri in the supratemporal plane. Adapted from Woldorff et al. (1993).

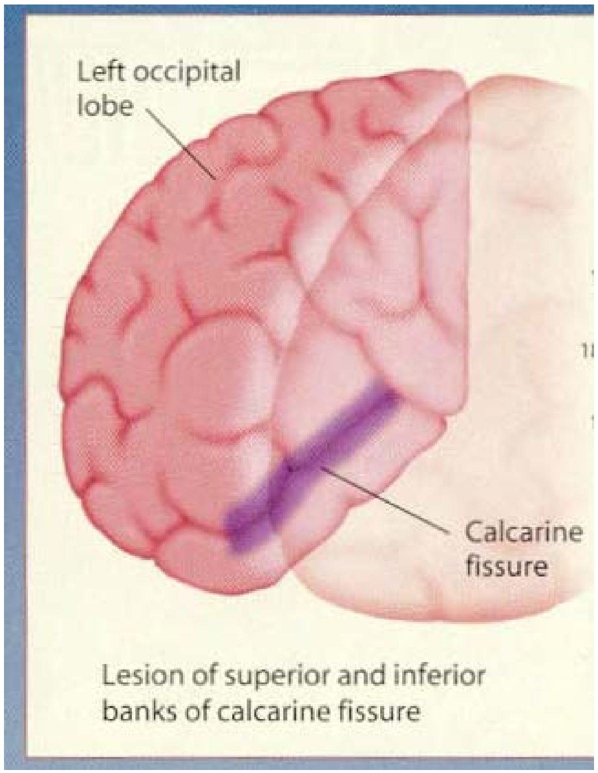


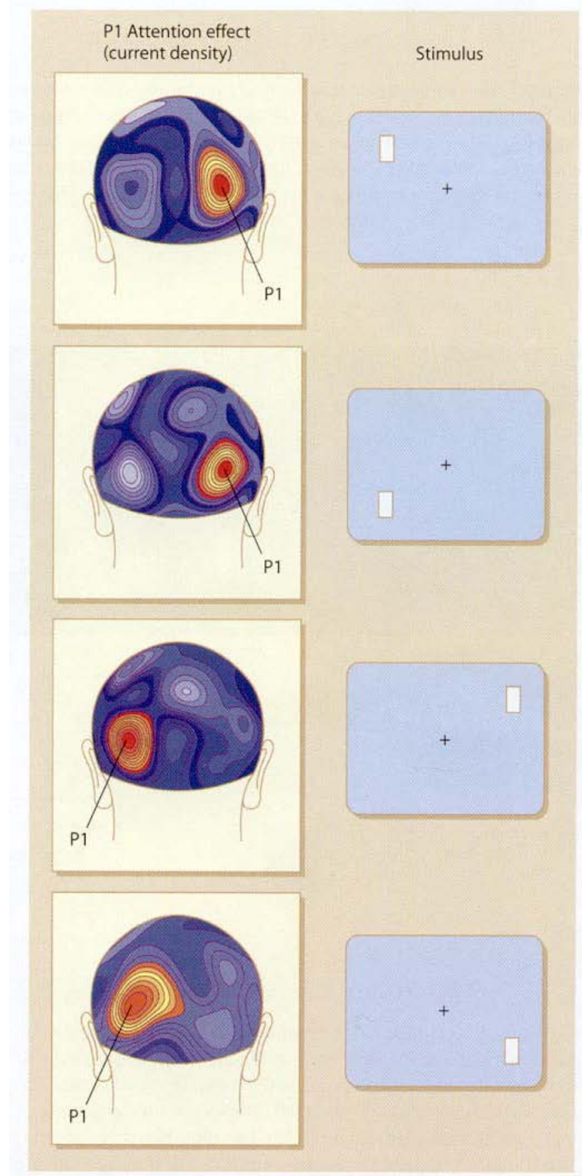
Visuelle selektive Aufmerksamkeit: Der P1 Effekt der räumlichen Aufm.



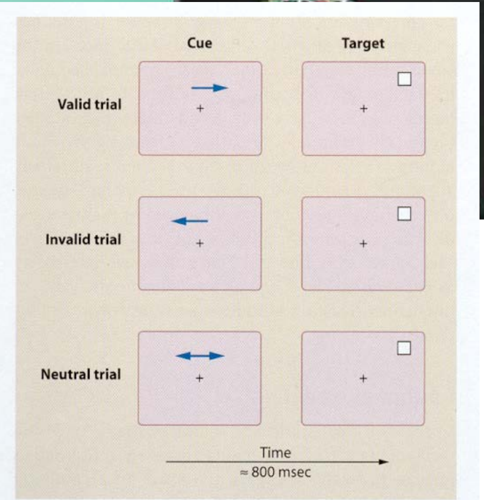


P1 Effekt ist kortikaler Herkunft und zeigt ein retinotopes Muster





P1 Effekt und spatial cueing (endogenes cuing)



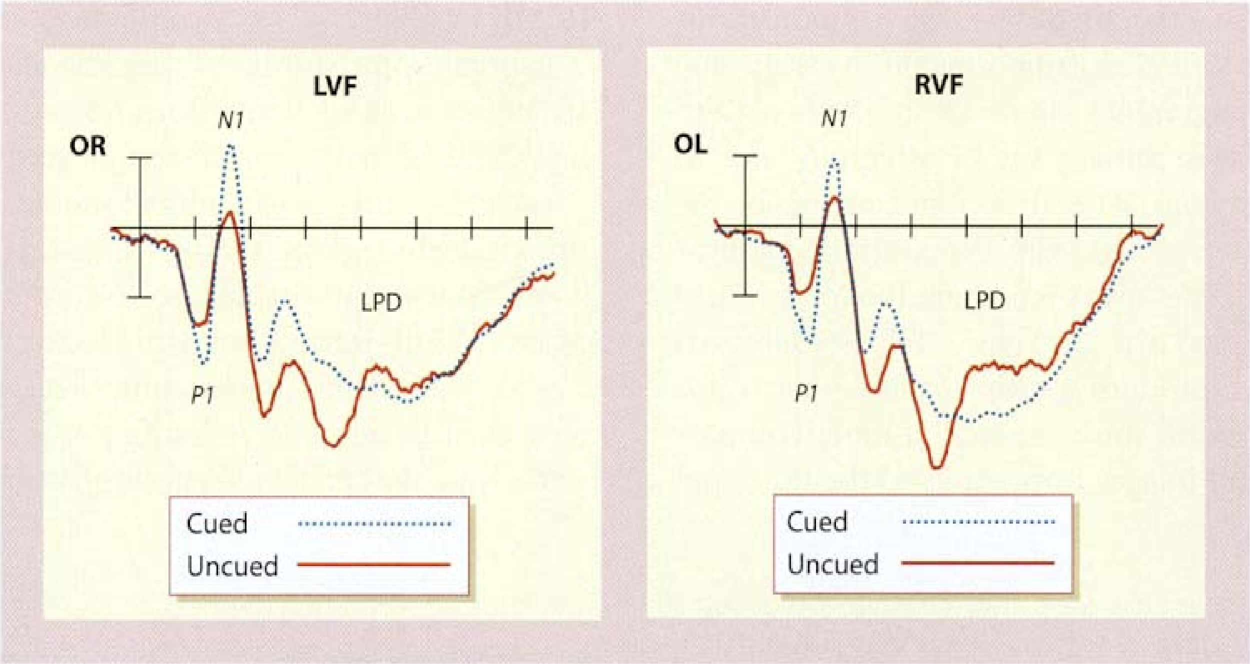


Figure 7.18 ERP waveforms averaged over fourteen persons performing a spatial cuing task like that depicted in Figure 7.8. Shown are modulations of the sensory evoked P1 and N1 ERPs to visual stimuli. The dotted traces show the responses to left-field (LVF) and right-field (RVF) targets when cued (i.e., valid trials), and the solid red traces show the responses elicited by the same stimuli when uncued (i.e., invalid trials). These recordings were taken at lateral occipital scalp sites contralateral to the stimulus—that is, at a right occipital site (OR) for left stimuli and at a left occipital site (OL) for right stimuli. Adapted from Mangun and Hillyard (1991).

P1 Effekt und spatial cueing: Exogenes cueing

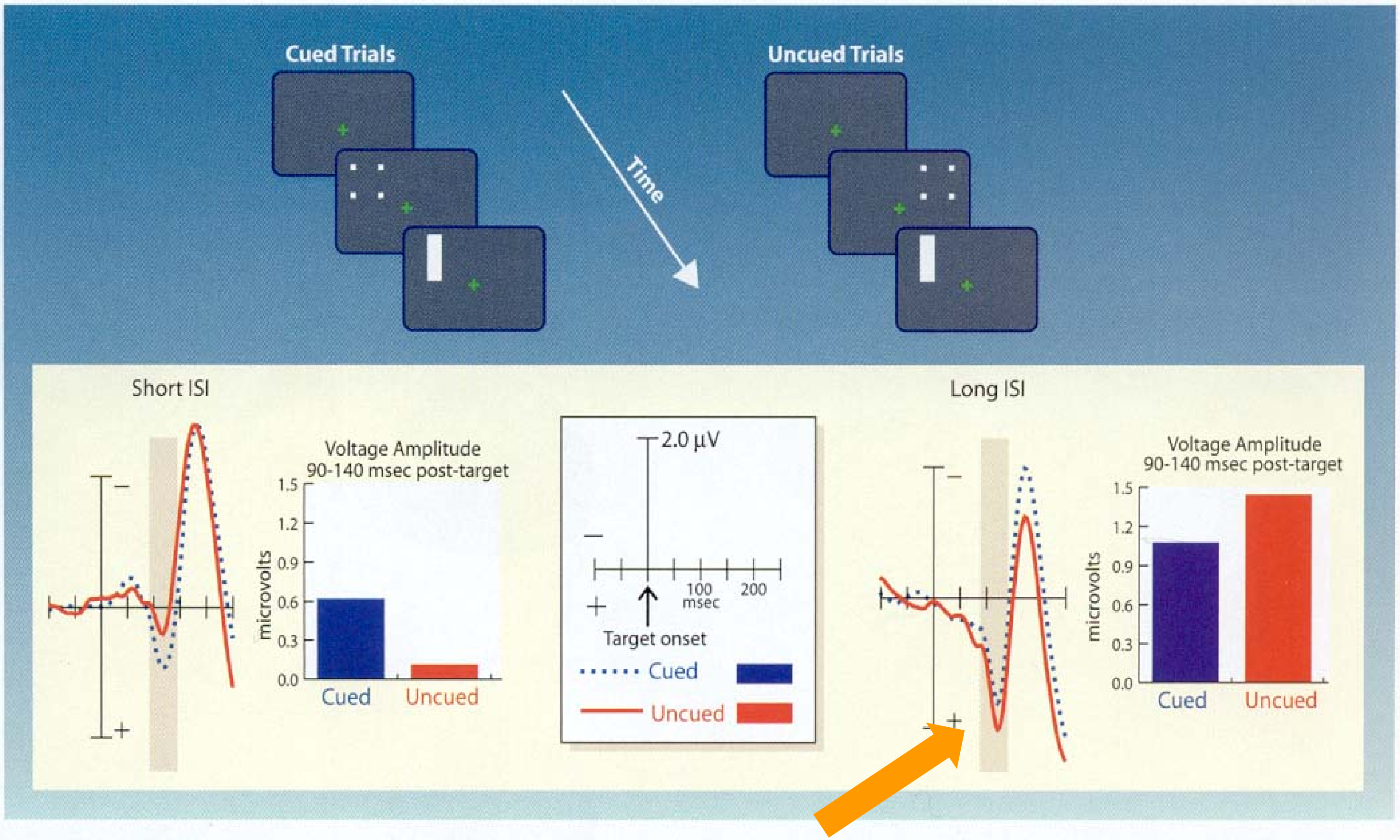


Figure 7.19 **(a) Top:** When attention is attracted to a location by abrupt onset of a visual stimulus, reaction times to subsequent targets are facilitated for short periods of time, as described earlier in this chapter. **Bottom:** When ERPs are measured to these targets, the same extrastriate cortical response (P1 wave) that is affected by voluntary spatial attention appears to be enhanced by reflexive attention (dotted versus solid lines at left) at short cue-to-target interstimulus intervals (ISIs). The time course of this reflexive attention effect is not the same as that for voluntary cuing, but rather is similar to the pattern observed in reaction times during reflexive cuing. The enhanced response is replaced within a few hundred milliseconds by a relative inhibition of the response (at right).

P1 Effekt und exogenes spatial cueing: Reflexive Aufmerksamkeit

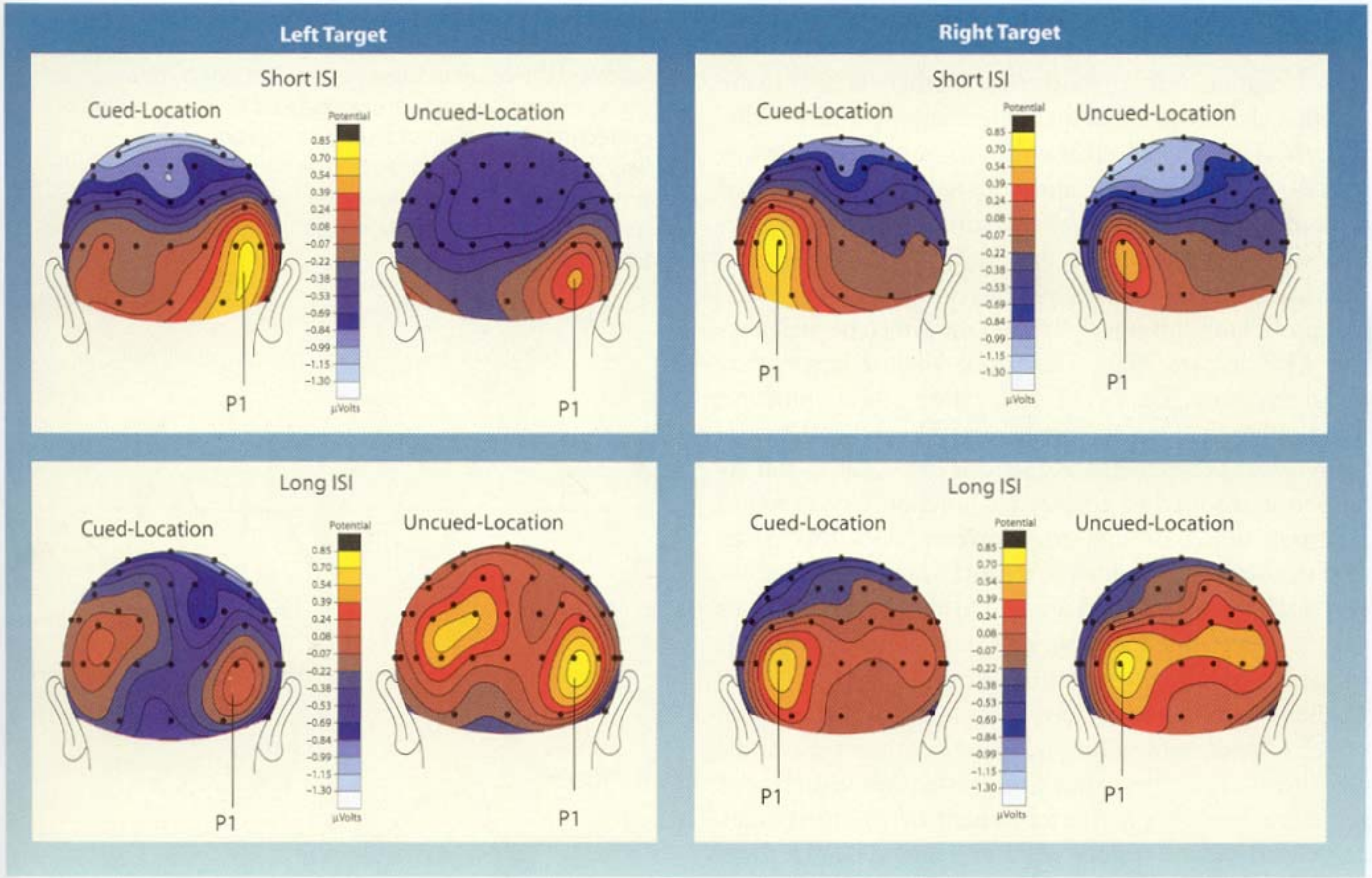
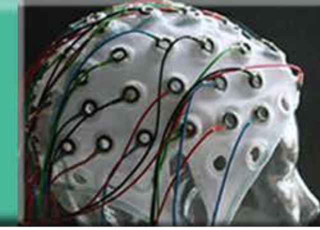
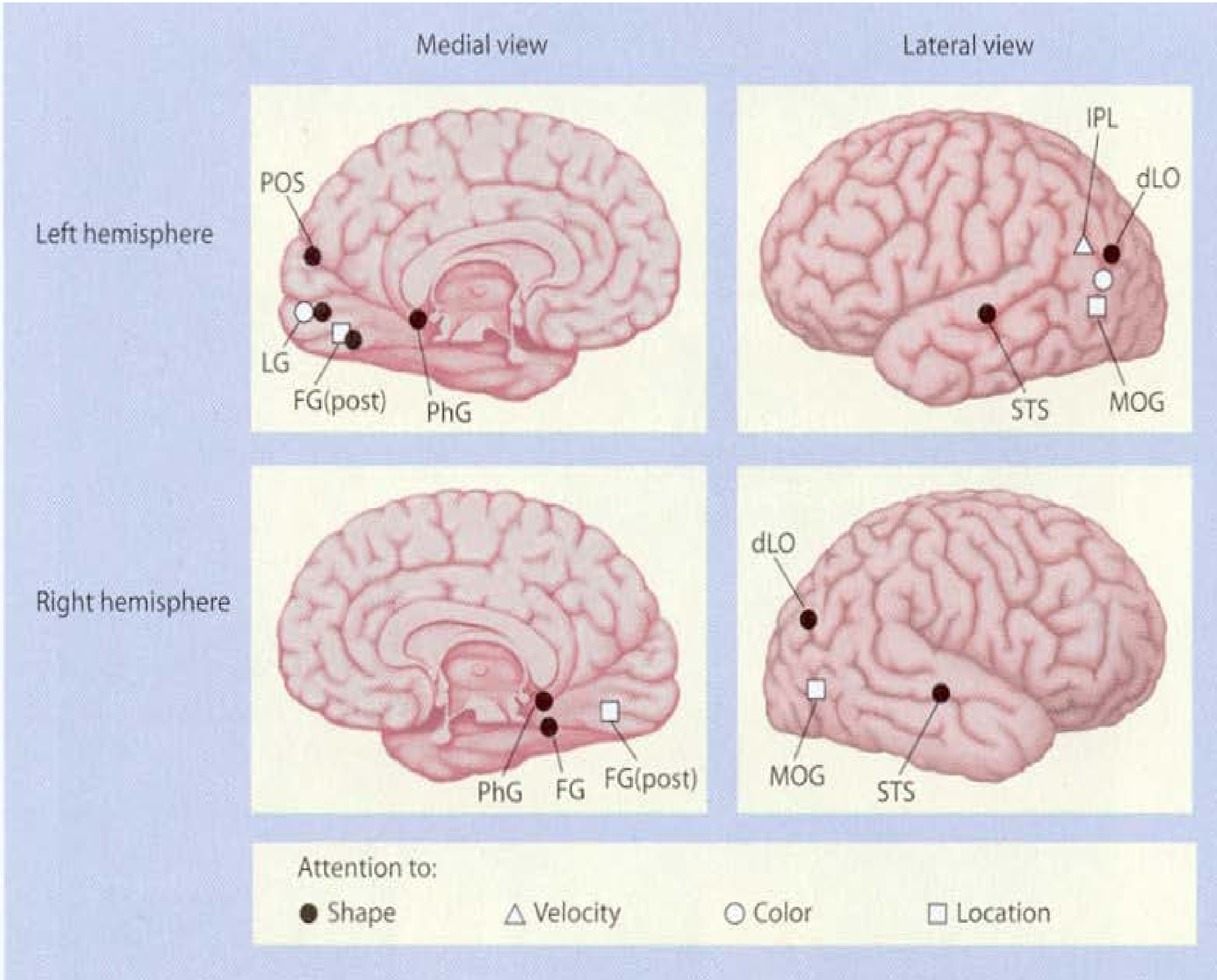


Figure 7.19 con't **(b) Top:** These reflexive attention effects show the same scalp distribution as the P1 attention effect to voluntary cues. The topographic maps show the enhanced responses over contralateral occipital scalp sites for cued-location targets versus uncued-location targets at short cue-to-target intervals. The increased peak amplitudes (labeled P1) are indicated in the topographic maps and are represented by areas of yellow. **Bottom:** At longer cue-to-target ISIs, this facilitated response declines and may be replaced by slight inhibition such that cued-location responses are now smaller than uncued-location responses (especially noticeable for right-field targets in the long ISI condition—bottom right of figure). This physiological finding parallels that observed with reaction time and provides a neuronal mechanism for the behavioral findings. After Hopfinger and Mangun (1998).

Funktionelle Bildgebung und selektive Aufmerksamkeit





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Integration von PET und EKP Daten zur räumlichen Aufmerksamkeit

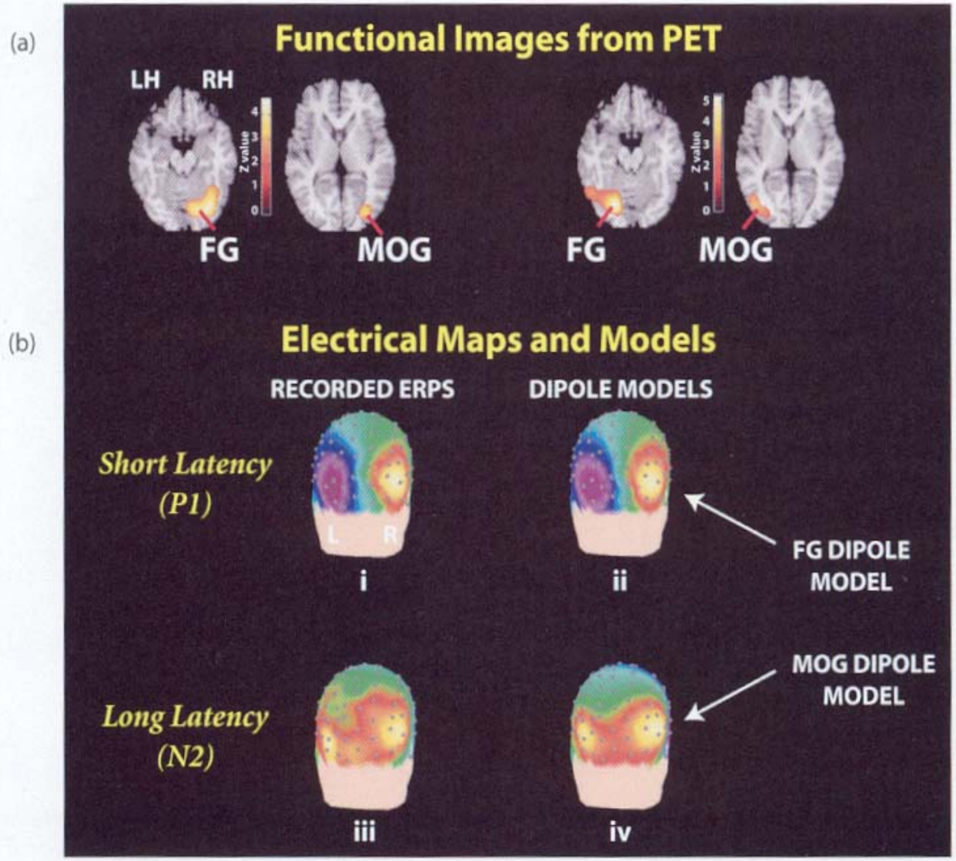
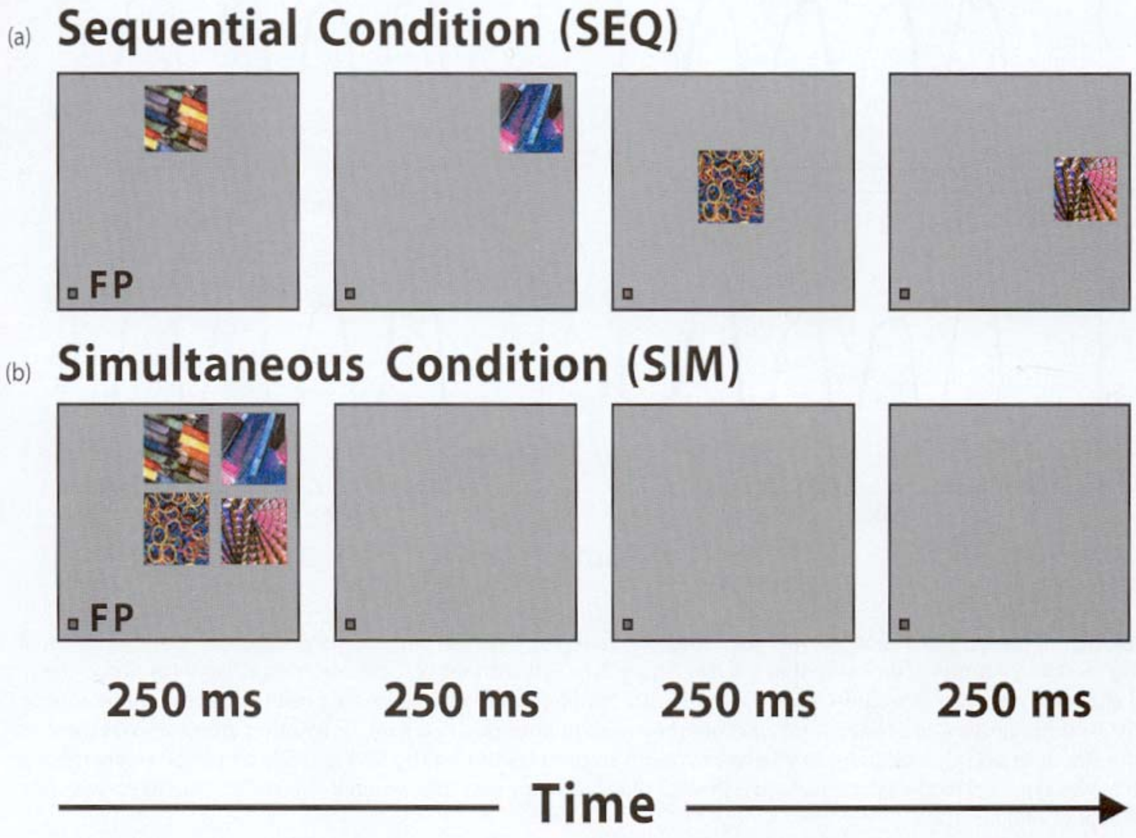


Figure 7.23 Integration of PET and ERP data from studies of attention. **(a)** PET scans show contralateral activations with spatial attention in the posterior fusiform gyrus (FG) and the middle occipital gyrus (MOG). **(b)** Attention effects (attend left minus attend right) as recorded by ERPs and models of the ERPs in realistic head simulations. The relationship between the recorded and modeled data is illustrated in **i** and **ii** for the P1 latency range, and in **iii** and **iv** for the longer latency N2 range. The recorded and model data are shown as topographic voltage maps on the surface of the realistic head model viewed from the rear (left side of brain and head on left side of figure). Topographies of the model data are much more similar to those of the recorded data in the P1 time range when the dipoles were seeded to (placed in) the areas of the FG activation (compare i to ii) than when placed in the MOG. In contrast, for the longer latency N2 effects (260–300 msec) dipoles placed in MOG produced a better fit for the 260- to 300-msec ERP effects (compare iii to iv) than when they were placed in the more medial, fusiform location. Adapted from Mangun et al. (1997).

Brain Mechanisms and Networks of Spatial Attention

Das „biased competition“ Model

Figure 7.26 Task and fMRI effects for attention to competing stimuli. Panels **(a)** and **(b)** show the task design. Competing stimuli were presented either simultaneously or sequentially. During the attention condition, covert attention was directed to the stimulus closest to the point of fixation, and the others were merely distracters.



Das „biased competition“ Model

Competition

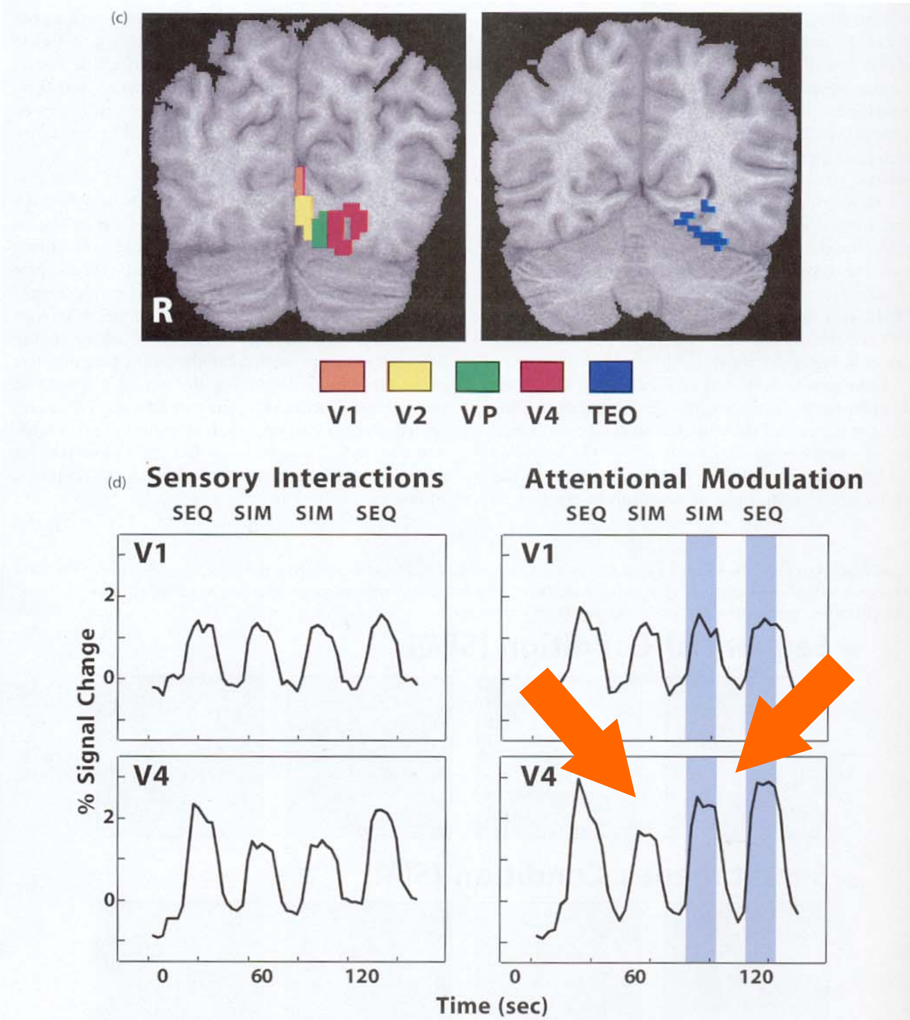


Figure 7.26 con't Panel **(c)** shows coronal MRI sections in one subject, with the pure sensory responses in multiple visual areas mapped using meridian mapping (similar to that used in Figure 7.23, but without cortical unfolding). Panel **(d)** shows the percentage of signal changes over time in areas V1 and V4 as a function of whether the stimuli were presented in the simultaneous (SIM) or sequential (SEQ) condition, and as a function of whether they were unattended (left side) or whether attention was directed to the target stimulus (far right side shaded blue). In V4 especially, the amplitudes during the SEQ and SIM conditions were more similar when attention was directed to the target stimulus (shaded blue areas at right) than when it was not (unshaded areas). Adapted from Kastner et al. (1999).

Biased competition

Objektbasierte Aufmerksamkeit

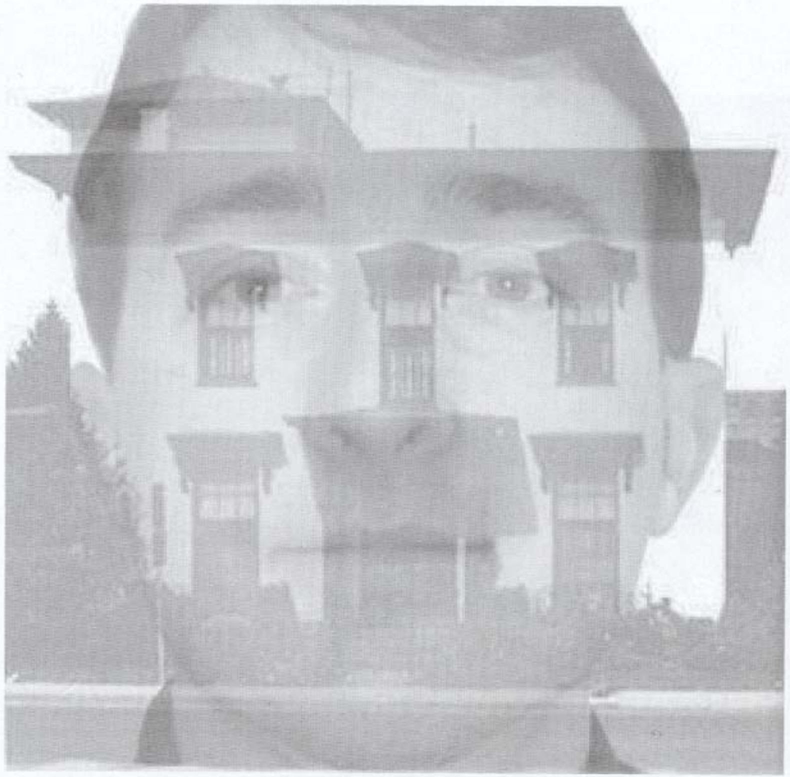
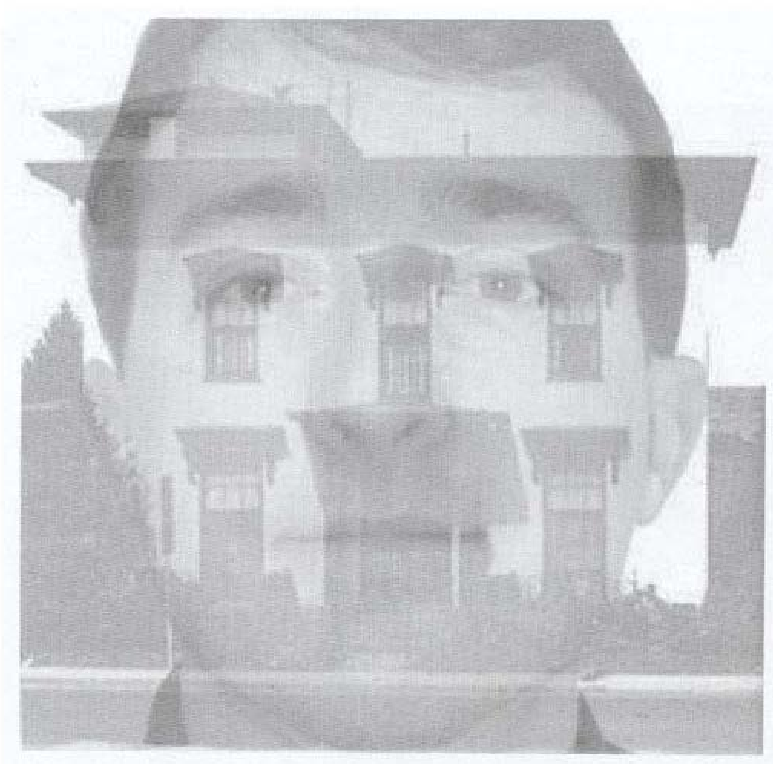
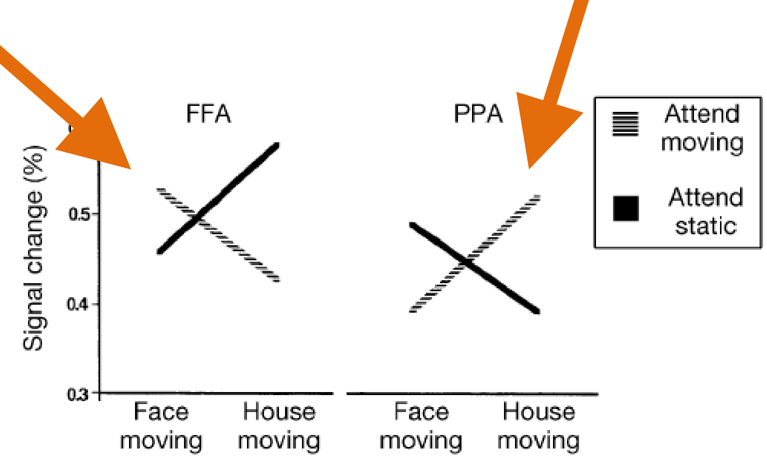
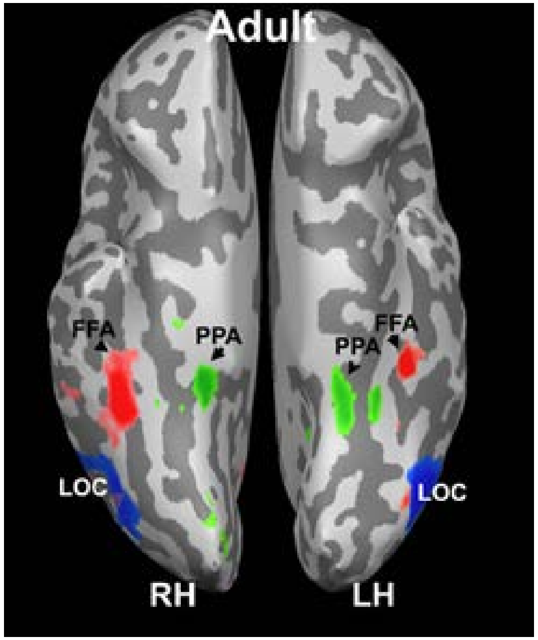


Figure 7.25 Example of stimuli in an fMRI study of object-based attention. Houses and faces were superimposed transparently to create stimuli that could not be attended to using spatial mechanisms. From O'Craven et al. (1999).

Objektbasierte Aufmerksamkeit: Effekte in der FFA und PPA







Sources of Attention: Attentional control networks

Figure 7.27 Corbetta and colleagues found that regional cerebral blood flow in the posterior parietal cortex increased when attention was switched from one location to another, in order to detect a relevant target. This same area was activated when attention was moved through the visual field during visual search. RVF = right visual field; LVF = left visual field. Adapted from Corbetta et al. (1993).

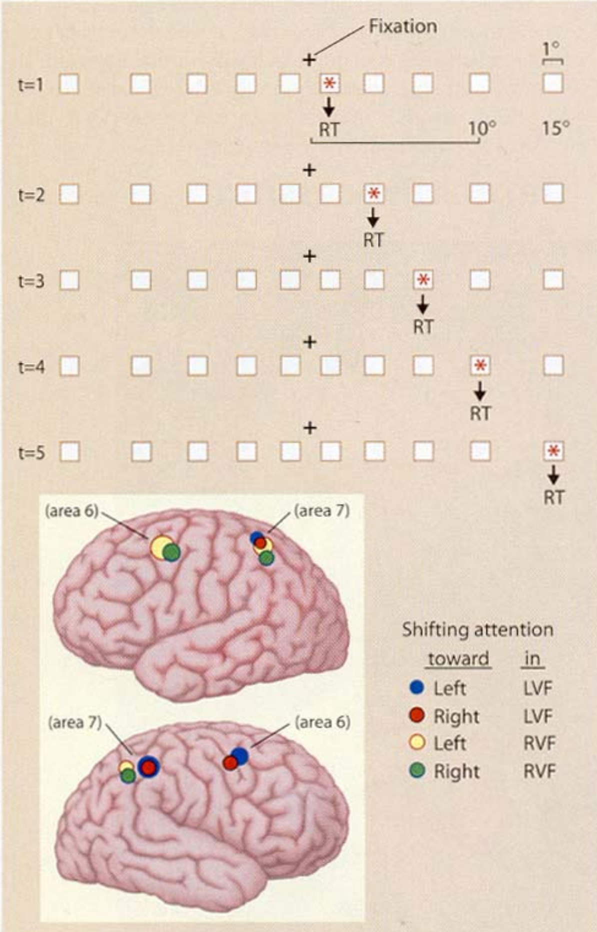
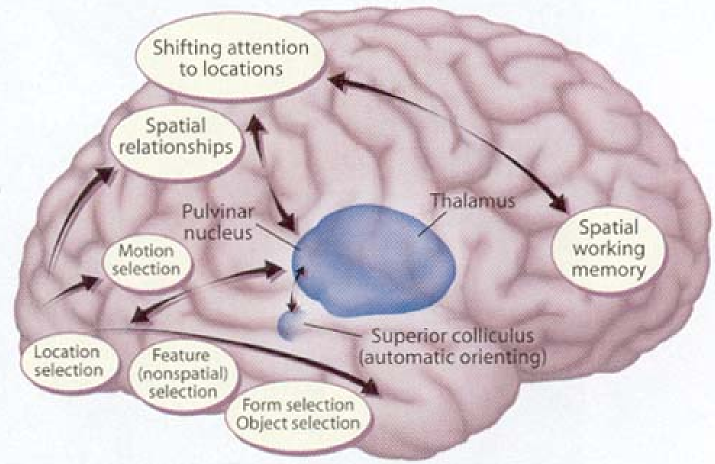


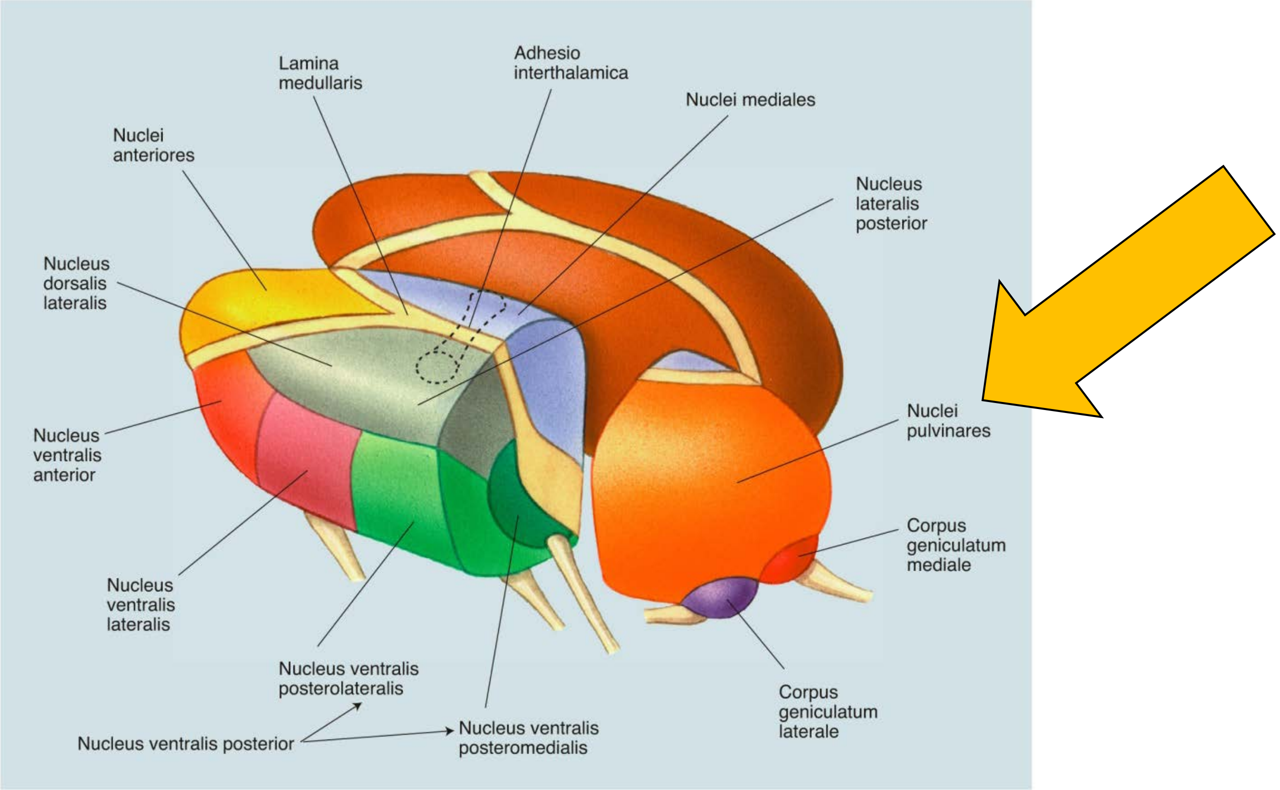
Figure 7.28 Model of executive control systems and the way in which extrastriate cortex processing is affected by a network of brain areas.



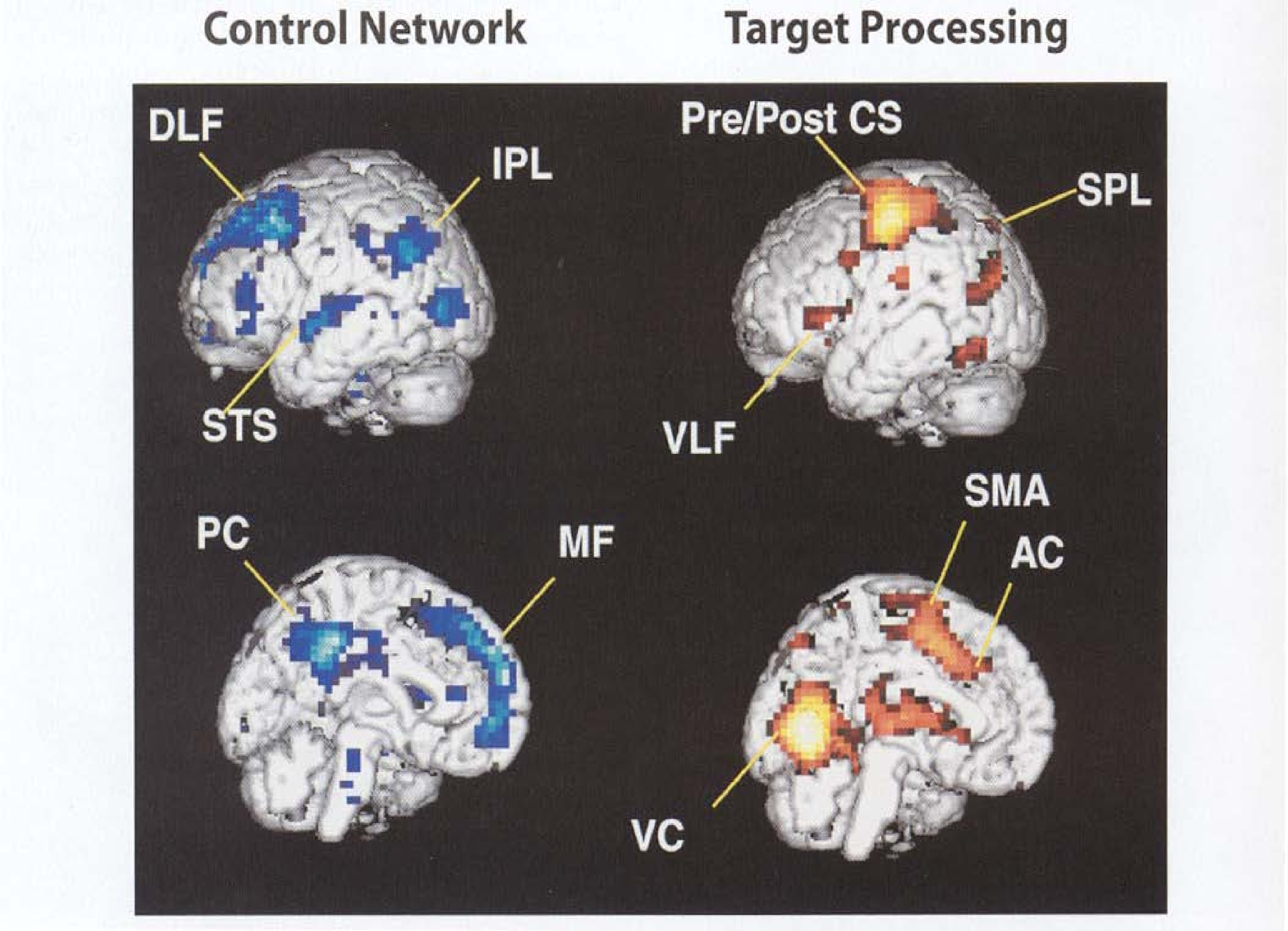
Der Nucleus Pulvinaris, der posteriore parietale Cortex und der dorsolaterale PFC regulieren die Erregbarkeit des extra-striatären Cortex als Funktion der Aufmerksamkeit.

Nuclei pulvinares des Thalamus

Nuclei pulvinares, dorsolateraler PFC und posteriorer parietaler Cortex regulieren die Erregbarkeit extrastriataler Areale bei A-Allokation

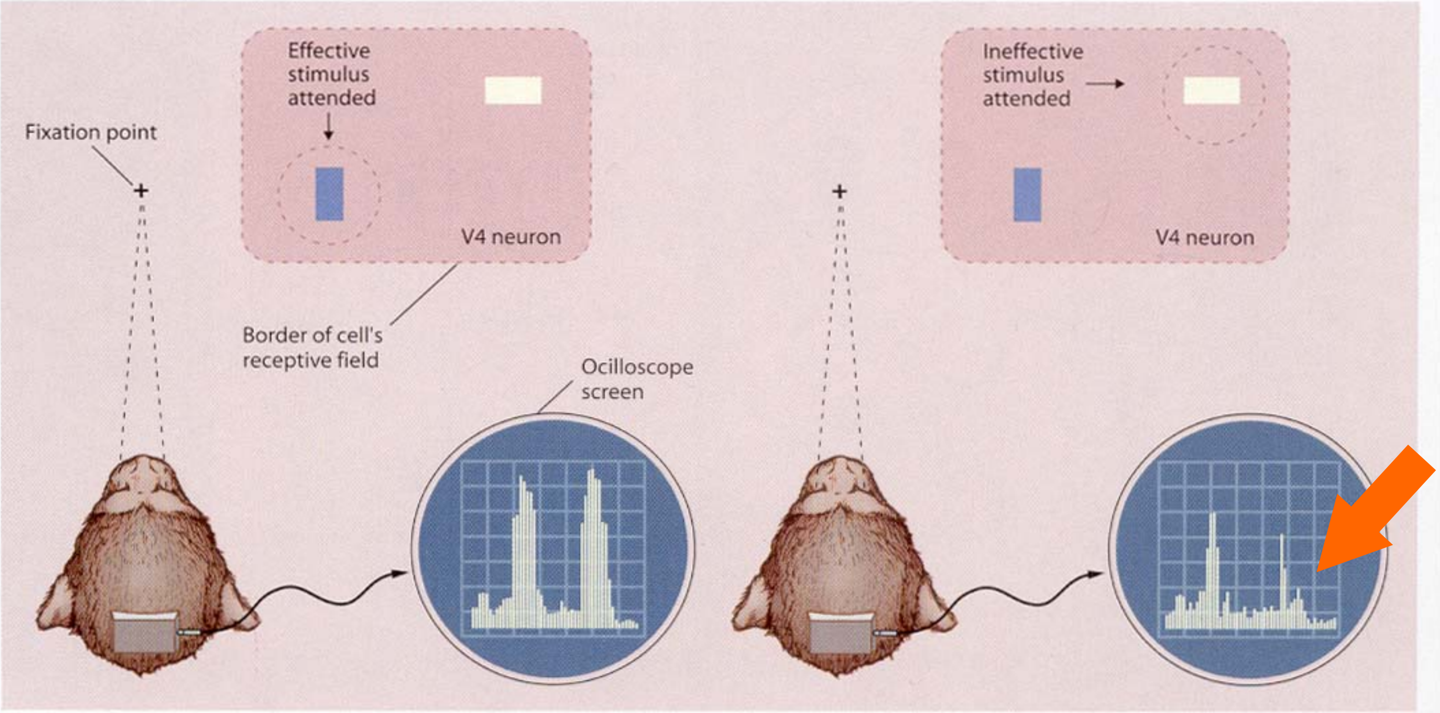


Das attentionale Kontrollnetzwerk: Cuing Paradigma



V4 Neurone: Aufmerksamkeit wird durch rezeptive Felder moduliert

Figure 7.32 Desimone and associates studied the effect of selective attention on the responses of a neuron in area V4 of macaque monkeys. The areas that are circled in broken lines indicate the attended locations for each trial. Bars in blue are effective sensory stimuli and bars without color are ineffective sensory stimuli for this neuron. When the animal attended to effective sensory stimuli, the V4 neuron gave a good response, whereas a poor response was generated when the animal attended to the ineffective sensory stimuli. Since both stimuli were presented simultaneously, this effect can be attributed only to the change in the focus of attention from one stimulus to the other; the animal was precued where to attend. The neuronal firing rates are shown to the right of each monkey head. The first burst of activity is to the cue, but the second burst in each image is to the target array, and here the reduction can be observed when the animals attend the ineffective stimulus (right). Adapted from Moran and Desimone (1985).



Die Rolle des posterioren parietalen Cortex : Räumlich selektive, voluntionale A-Allokation

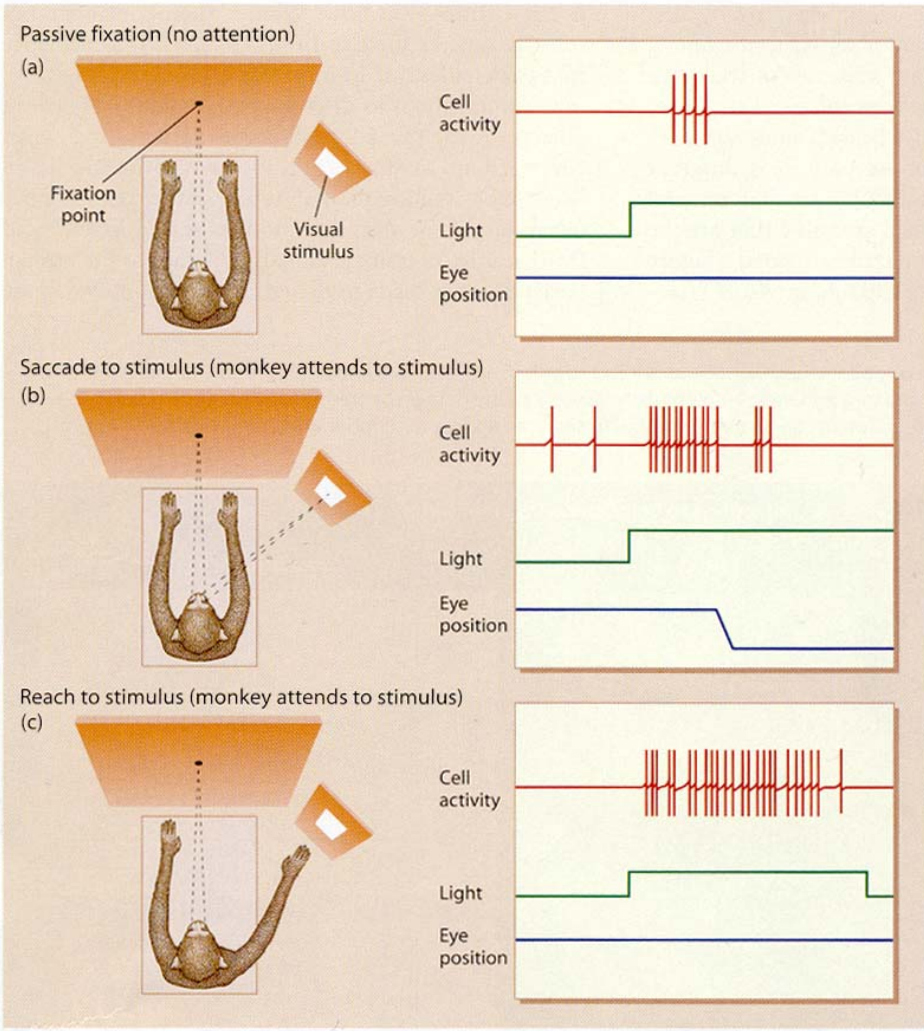


Figure 7.38 Properties of parietal neurons in visual attention. Three conditions are shown. **(a)** The monkey passively fixates while a lateral field stimulus is presented, generating some action potentials from the neuron **(right)**. **(b)** The monkey has the task of making a saccadic eye movement to the target when it appears, and this increases the rate of neuron firing. **(c)** The neuron increases its firing rate to targets that are presented and covertly attended, when the animal must keep its eyes fixated straight ahead but is required to reach to the target. This demonstrates that the neuron is spatially selective, a sign of covert attention. Adapted from Wurtz et al. (1982).

Neglect & Balint Syndrome

Neglect

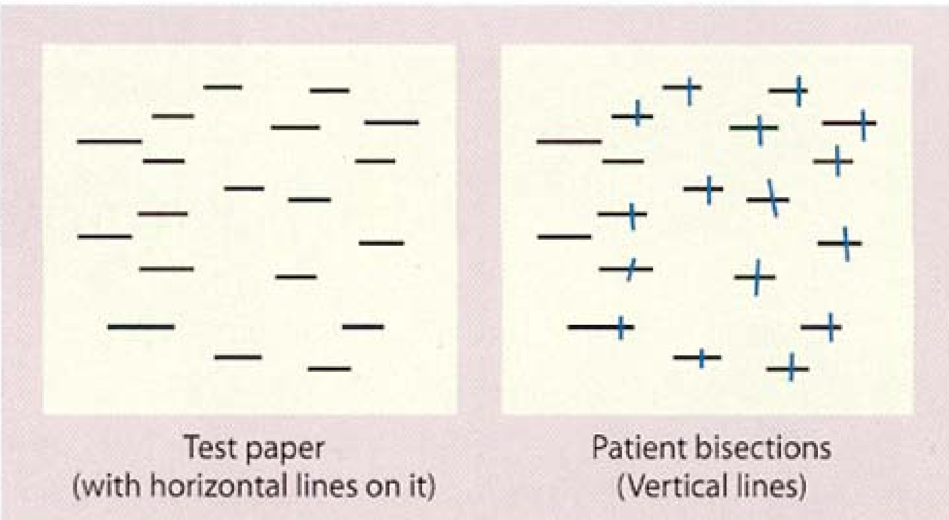


Figure 7.40 Patients suffering from neglect are given a sheet of paper containing many horizontal lines and asked under free-viewing conditions to bisect the lines precisely in the middle with a vertical line. They tend to bisect the lines to the right (for a right-hemisphere lesion) of midline, owing to neglect for contralesional space.

Figure 7.41 The late German artist Anton Raederscheidt's self-portraits painted at different times following a severe stroke, which left him with neglect to contralesional space.

Neglect: IPL und TPJ (rechts)

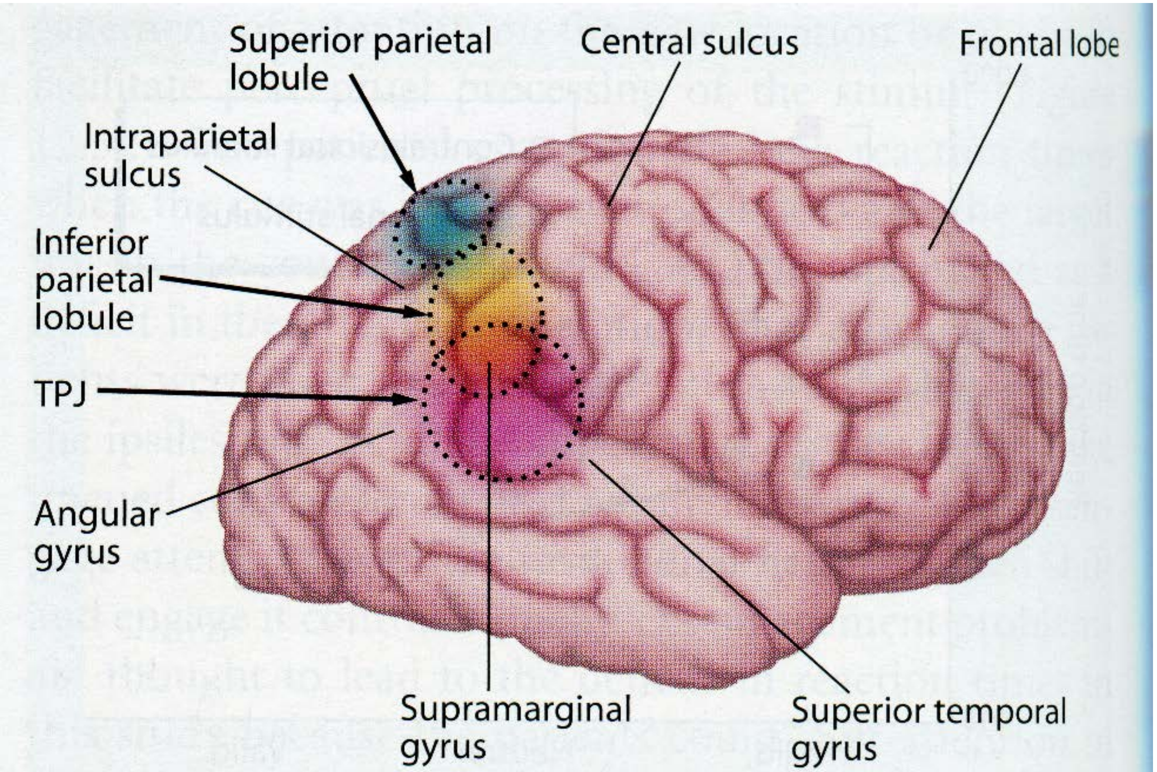
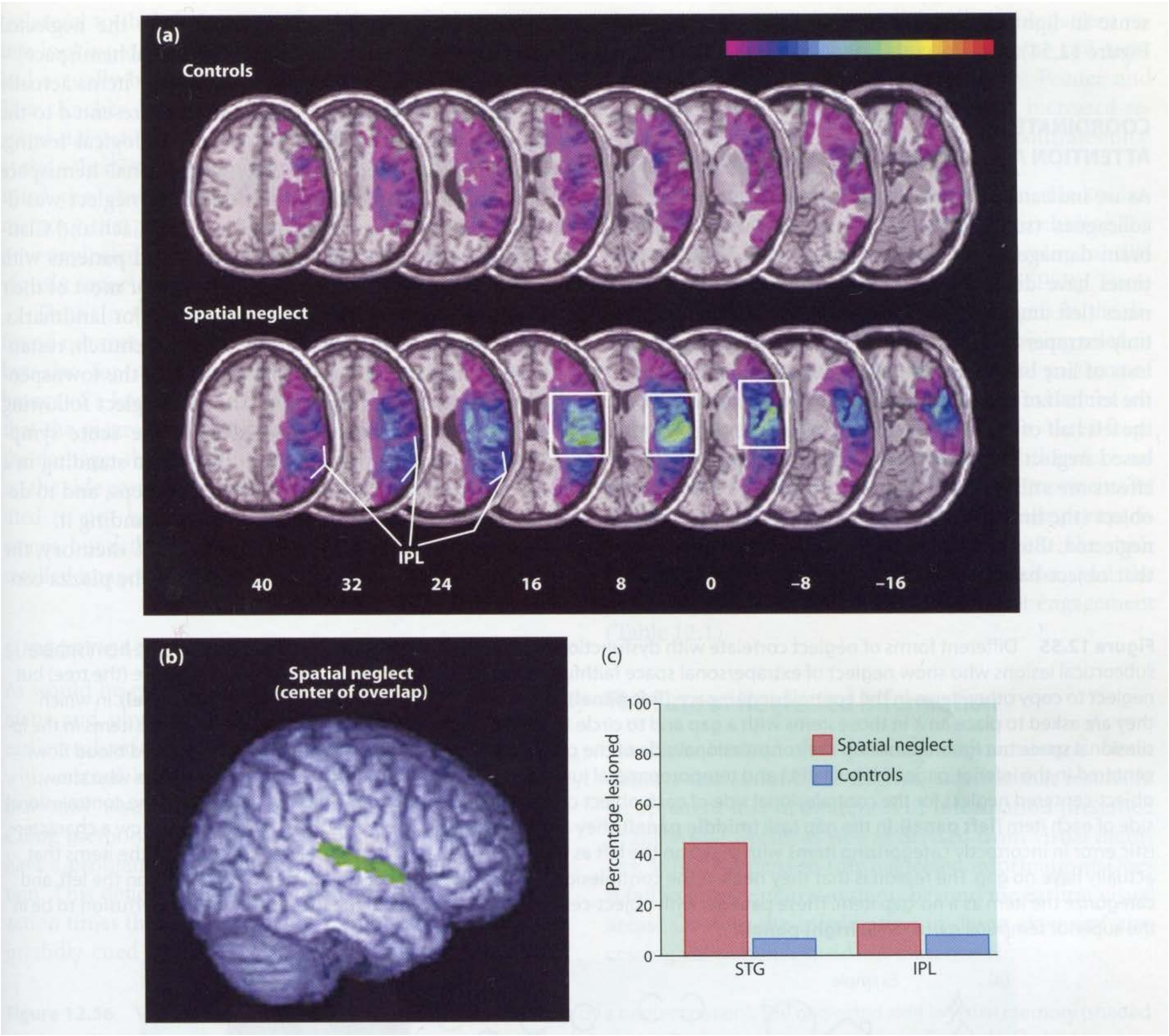


Figure 12.53 Lateral view of the right hemisphere, showing the major anatomical regions implicated in neglect, including the temporoparietal junction (TPJ), angular gyrus, supramarginal gyrus, and superior temporal gyrus. The parietal lobe is colored bluish, frontal lobe pink, temporal lobe orange, and occipital lobe green.

Neglect: High relevance of the Superior Temporal Gyrus (STG)



Neglect: Effects on spatial cuing

Figure 7.42 Diagrammatic representation of the extinction-like reaction time pattern in patients with unilateral lesions of the parietal cortex. Reaction times to precued (valid) targets contralateral to the lesion were almost "normal"; that is, while being slower than reaction times produced by healthy control subjects, they were not much slower than the patients' reaction times to targets that occurred in the ipsilesional hemifield when that field was cued. When the patients were cued to expect the target stimulus in the field ipsilateral to the lesion (e.g., right visual field for a right parietal lesion), they were unusually slow to respond to the target when it occurred in the opposite field (invalid trials). Adapted from Posner et al. (1984).

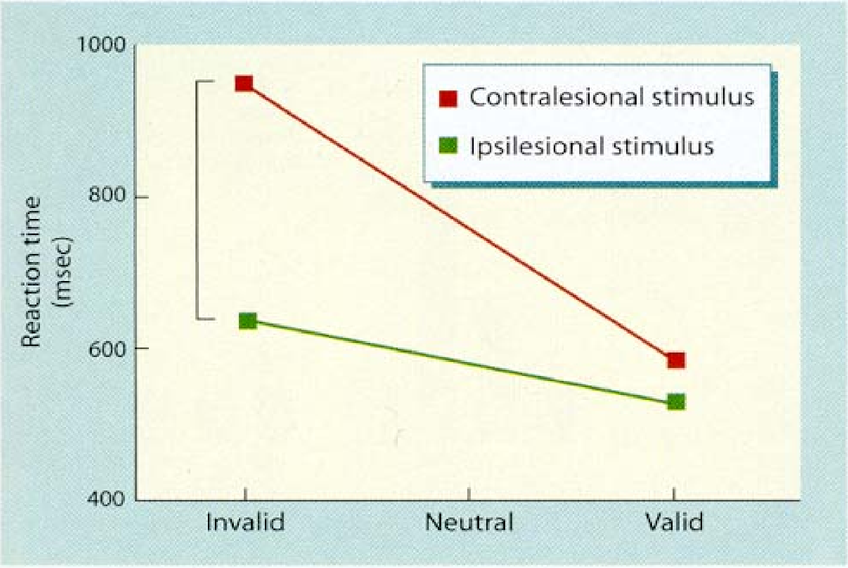
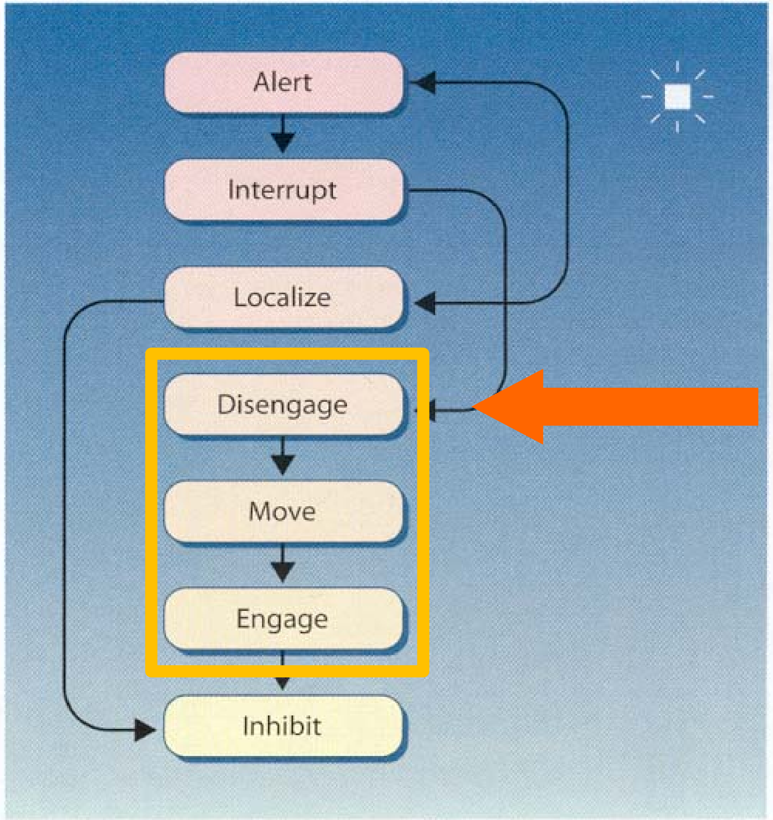


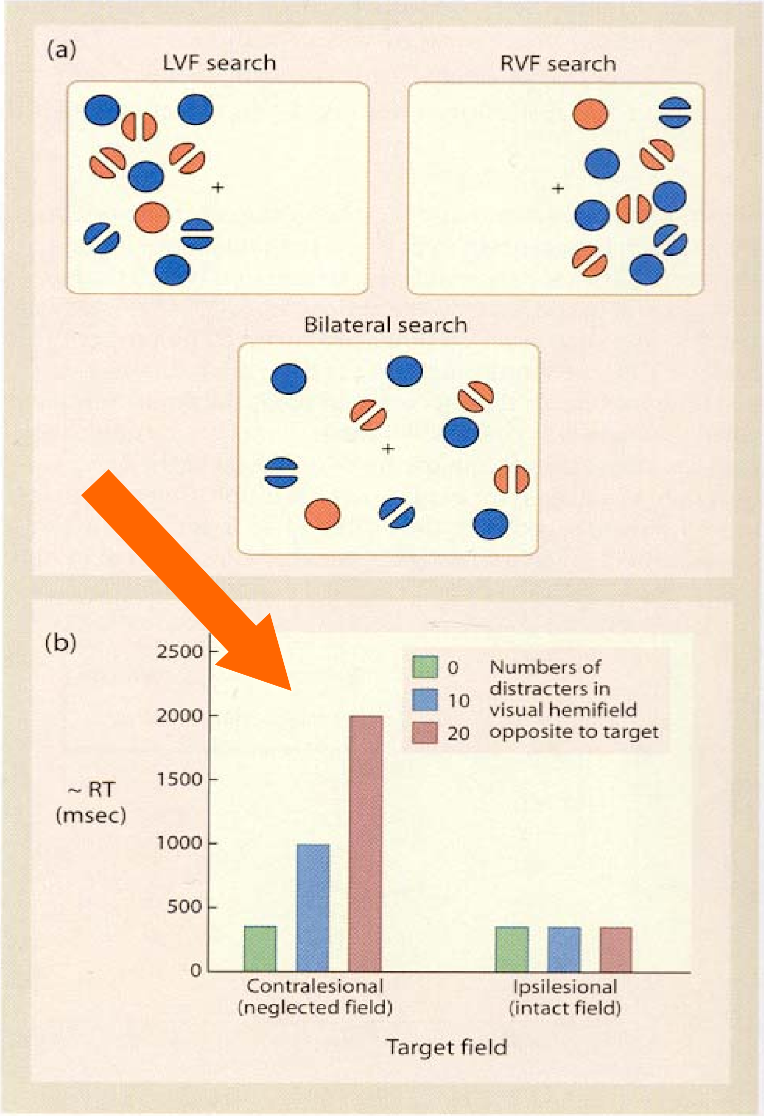
Figure 7.43 The three-stage model of attention of Posner and colleagues (1984). A sensory event generates a signal that produces localization of the event spatially. Thereupon attention disengages from the current focus, moves to the location of the event, and engages the stimulus. Attentional engagement may be followed by inhibition if this is purely reflexive orienting to the sensory event—the phenomena of inhibition of return.



Neglect

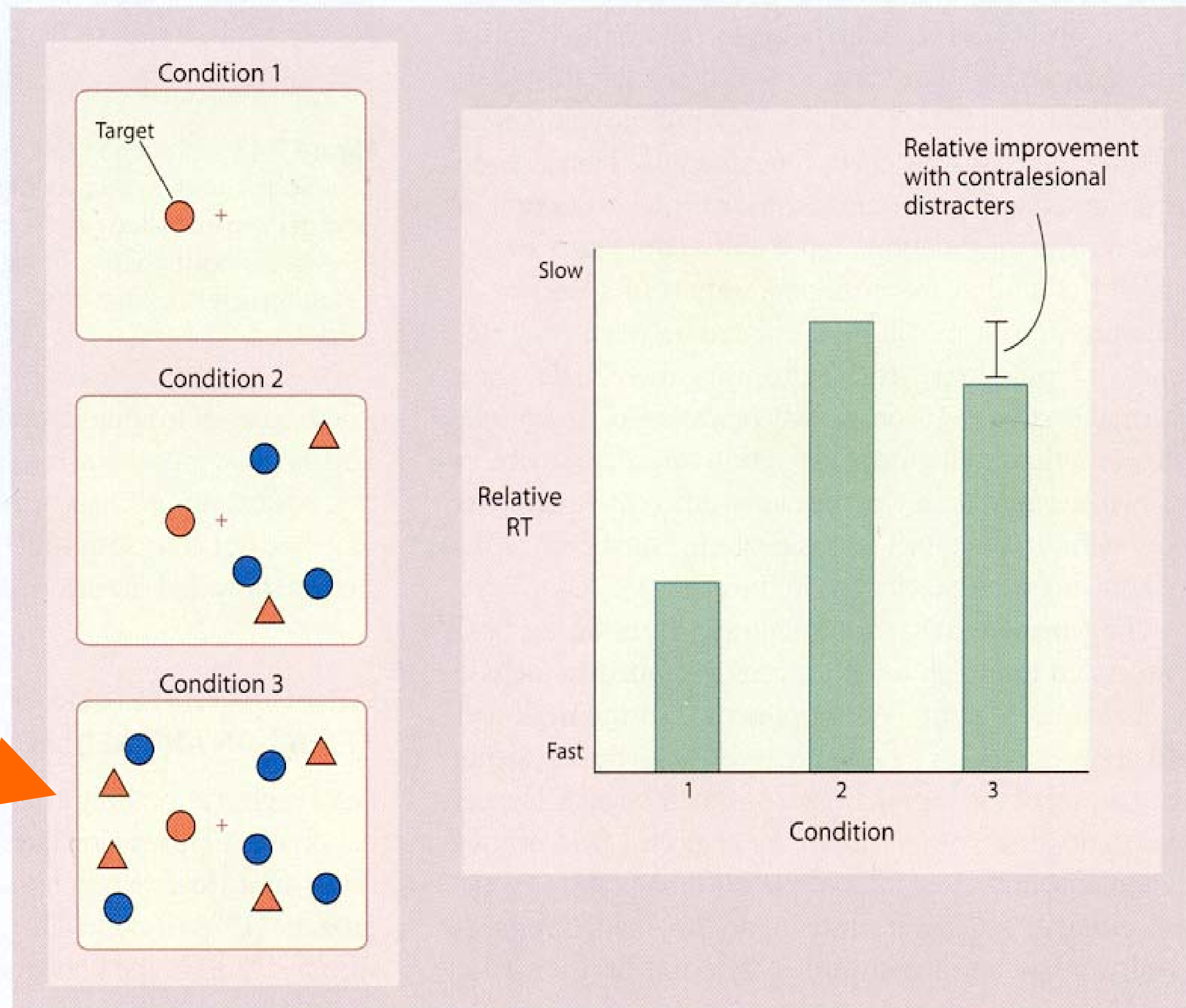
Impaired disengagement from the ipsilesional field

Figure 7.45 The effect of damage to parietal and temporal cortex on visual search for bilateral versus unilateral arrays. **(a)** Visual stimulus arrays in the left (LVF search) or right hemifield (RVF search) and arrays spanning both hemifields (Bilateral search). **(b)** The graph summarizes the changes in reaction times (RT) for targets as a function of the numbers of distracters present in the hemifield opposite to that in which the targets appear (see text for details). Adapted from Eglin et al. (1989).



Neglect:
Contra-lesional distractors facilitate target processing

Figure 7.46 The bias toward the field ipsilateral to the lesion in unilateral neglect patients can be reduced by the presentation of target or distracter items in the neglected hemifield. This reduction in bias is indicated by the improvement in the detection of the target near the midline (i.e., in the direction of the neglected field) in the good hemifield. The logic for this effect is described in the text. Adapted from Grabowecky et al. (1993).



Neglect

Extinction depends on object similarity

High similarity: full extinction
Low similarity: less extinction

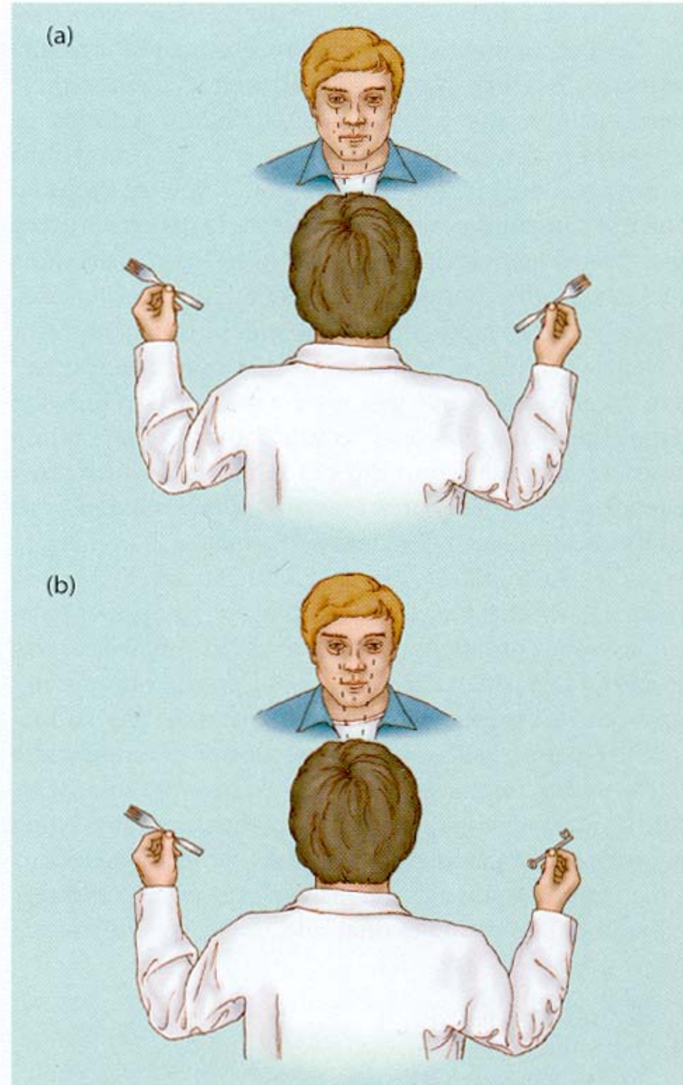


Figure 7.47 Extinction test in a patient with neglect. **(a)** A neurologist holding up two identical items in two hemifields (and getting extinction of the item on the neglected side). **(b)** A neurologist holding up different items in the two fields (resulting in less extinction).

Neglect für Items im Langzeitgedächtnis: Auch die A-Allokation auf Gedächtnisinhalte ist beeinträchtigt

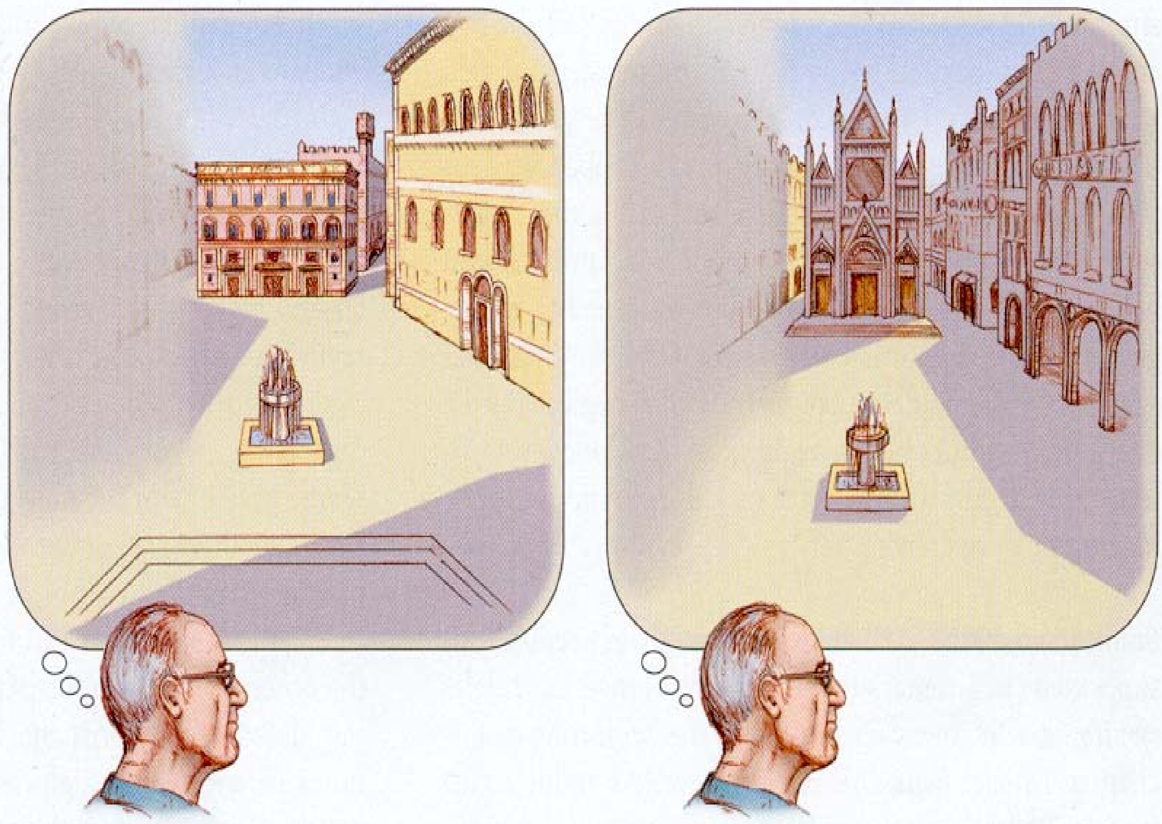
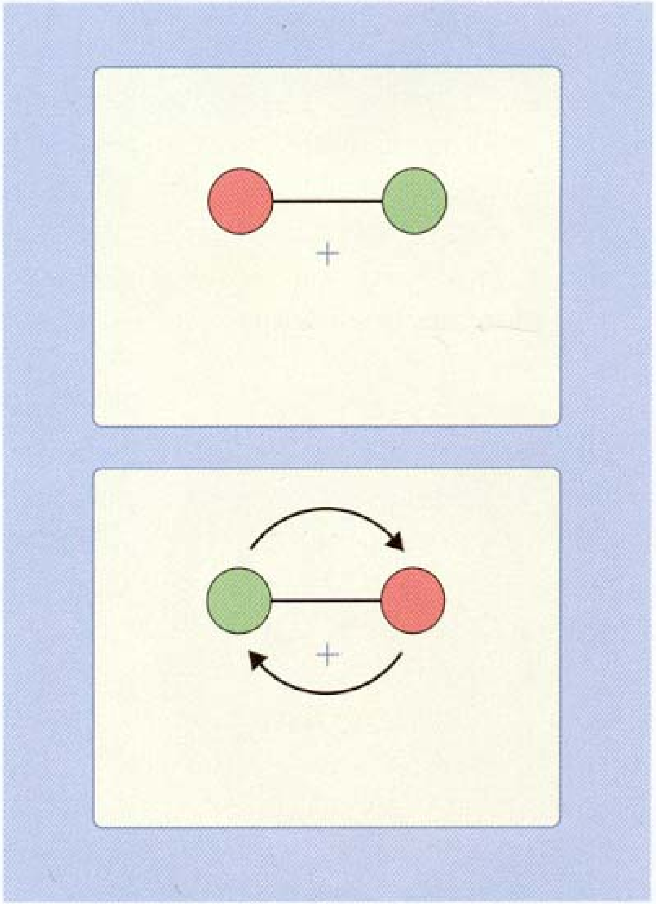


Figure 7.48 Diagram of a neglect patient recollecting visual memory from two ends of a piazza. The neglected side in visual memory (shaded gray) was contralateral to the side with cortical damage. From Bisiach and Luzzatti (1978).

Objektbasieter Neglect

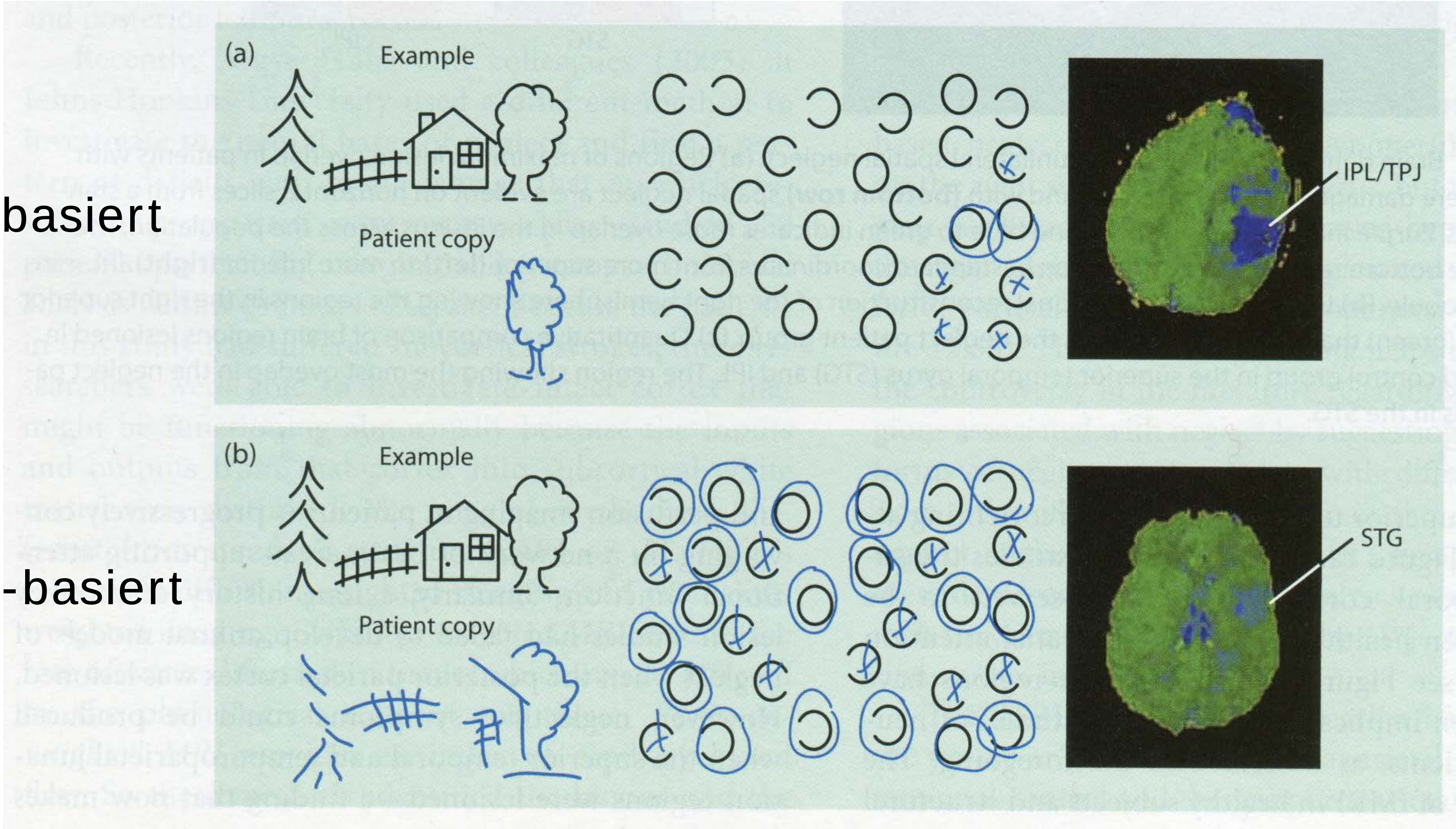
Figure 7.49 Behrmann and Tipper's rotating dumbbell experiment showing that neglect can be object based (see text for details). After Behrmann and Tipper (1994).



Raum- vs objektbasieter Neglect nach IPL bzw. STG Läsionen

Raum-basiert

Objekt-basiert



Das Balint Syndrom (Simultanagnosie)

Figure 7.50 Diagrams showing unilateral parietal lesions **(a)** typical of neglect, and bilateral posterior pariental/lateral occipital lesions **(b)** typical of Balint's syndrome.

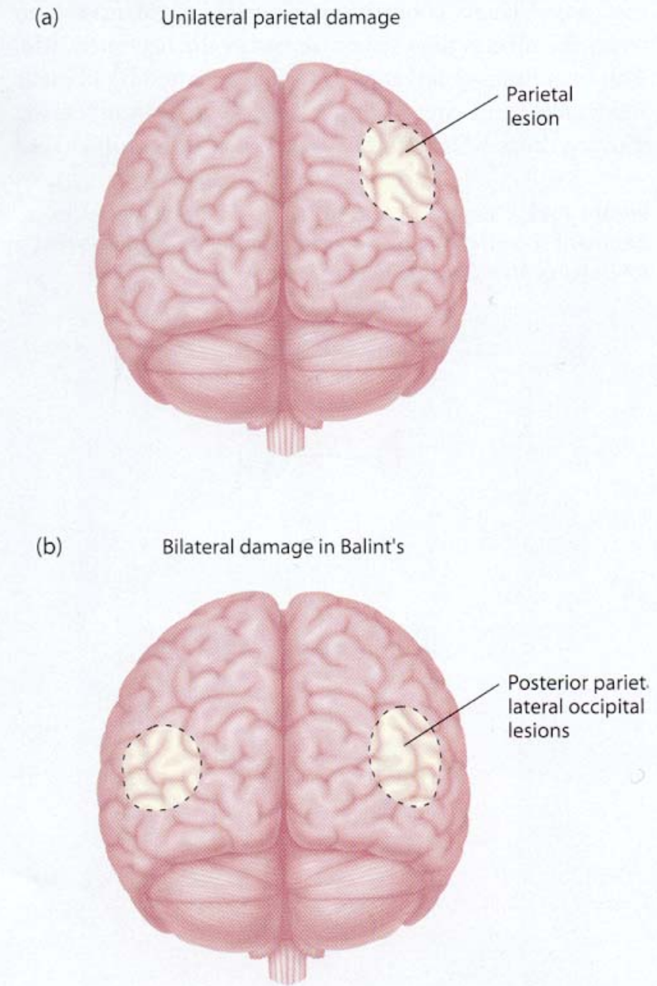
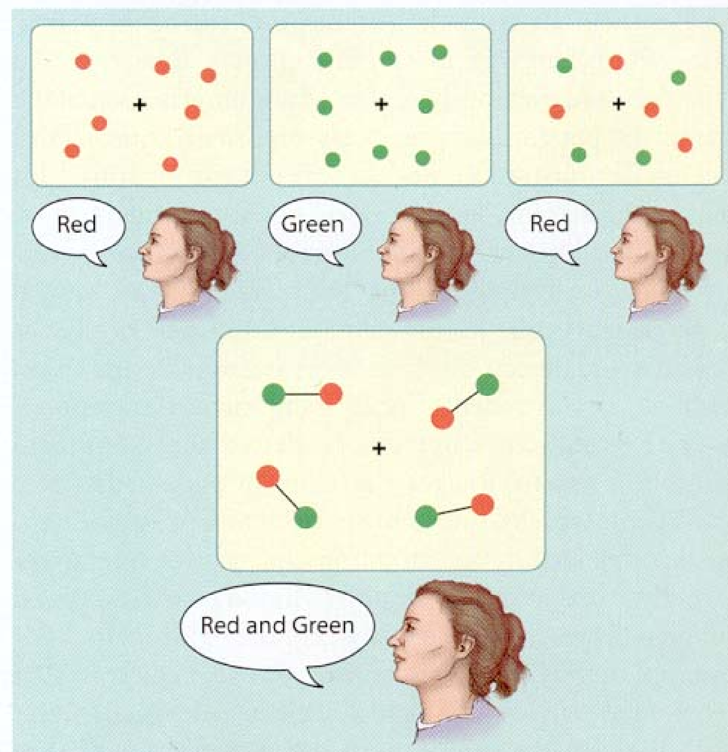


Figure 7.51 Stimuli used to test object attention in Balint's patients. Colored circles were presented in two conditions: with and without connecting lines. When the circles were not connected, these patients would only report the color of one object at a time, but when the circles were connected to form one object, the patients could report both colors of the new object. After Humphreys and Riddoch (1992).



CONTROL OF GOAL-DIRECTED AND STIMULUS-DRIVEN ATTENTION IN THE BRAIN

Maurizio Corbetta and Gordon L. Shulman

We review evidence for partially segregated networks of brain areas that carry out different attentional functions. One system, which includes parts of the intraparietal cortex and superior frontal cortex, is involved in preparing and applying goal-directed (top-down) selection for stimuli and responses. This system is also modulated by the detection of stimuli. The other system, which includes the temporoparietal cortex and inferior frontal cortex, and is largely lateralized to the right hemisphere, is not involved in top-down selection. Instead, this system is specialized for the detection of behaviourally relevant stimuli, particularly when they are salient or unexpected. This ventral frontoparietal network works as a 'circuit breaker' for the dorsal system, directing attention to salient events. Both attentional systems interact during normal vision, and both are disrupted in unilateral spatial neglect.

TOP-DOWN PROCESSING
The flow of information from 'higher' to 'lower' centres, conveying knowledge derived from previous experience rather than sensory stimulation.

BOTTOM-UP PROCESSING
Information processing that proceeds in a single direction from sensory input, through perceptual analysis, towards motor output, without involving feedback information flowing backwards from 'higher' centres to 'lower' centres.

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Picture yourself at the Museum El Prado in Madrid while a guide explains the painting *The Garden of Earthly Delights* by the fifteenth-century Flemish painter Hieronymous Bosch (FIG. 1). Bosch depicts a fantastic, surreal and satirical world, which is in stark contrast to anything else represented until that time. The guide's words cue us to attend to different aspects of the painting, such as its colour, spatial configuration or meaning. For example, if he notes "a small animal playing a musical instrument", we can use this information to spot the rabbit playing the horn near a black-and-white dice. Knowledge and expectations allow us to focus on elements, parts or details of a visual scene that we might otherwise have missed. Cognition aids vision by enabling the brain to create, maintain and change a representation of what is important while we scan a visual scene.

At the other extreme, visual perception can be dominated by external events. Initially, our eyes might have been drawn to the more salient objects in the painting, such as the large wooden musical instrument (a lute in construction) at the centre of the scene, rather than to more subtle aspects of the painting that are discussed by the guide. An event might even distract us from the painting altogether. If an alarm system started to ring and flash in a nearby room, everyone's attention would instantly be drawn towards the source of the alarm. Unexpected, novel, salient and potentially dangerous events take high priority in the brain, and are processed at the expense of ongoing behaviour and neural activity.

In everyday life, visual attention is controlled by both cognitive (TOP-DOWN) factors, such as knowledge, expectation and current goals, and BOTTOM-UP factors that reflect sensory stimulation. Other factors that affect attention, such as novelty and unexpectedness, reflect an interaction between cognitive and sensory influences. The dynamic interaction of these factors controls where, how and to what we pay attention in the visual environment. In this review, we propose that visual attention is controlled by two partially segregated neural systems. One system, which is centred on the dorsal posterior parietal and frontal cortex, is involved in the cognitive selection of sensory information and responses. The second system, which is largely lateralized to the right hemisphere and is centred on the temporoparietal and ventral frontal cortex, is recruited during the detection of behaviourally relevant sensory events, particularly when they

Ein neuroanatomisches Model attentionaler Kontrolle

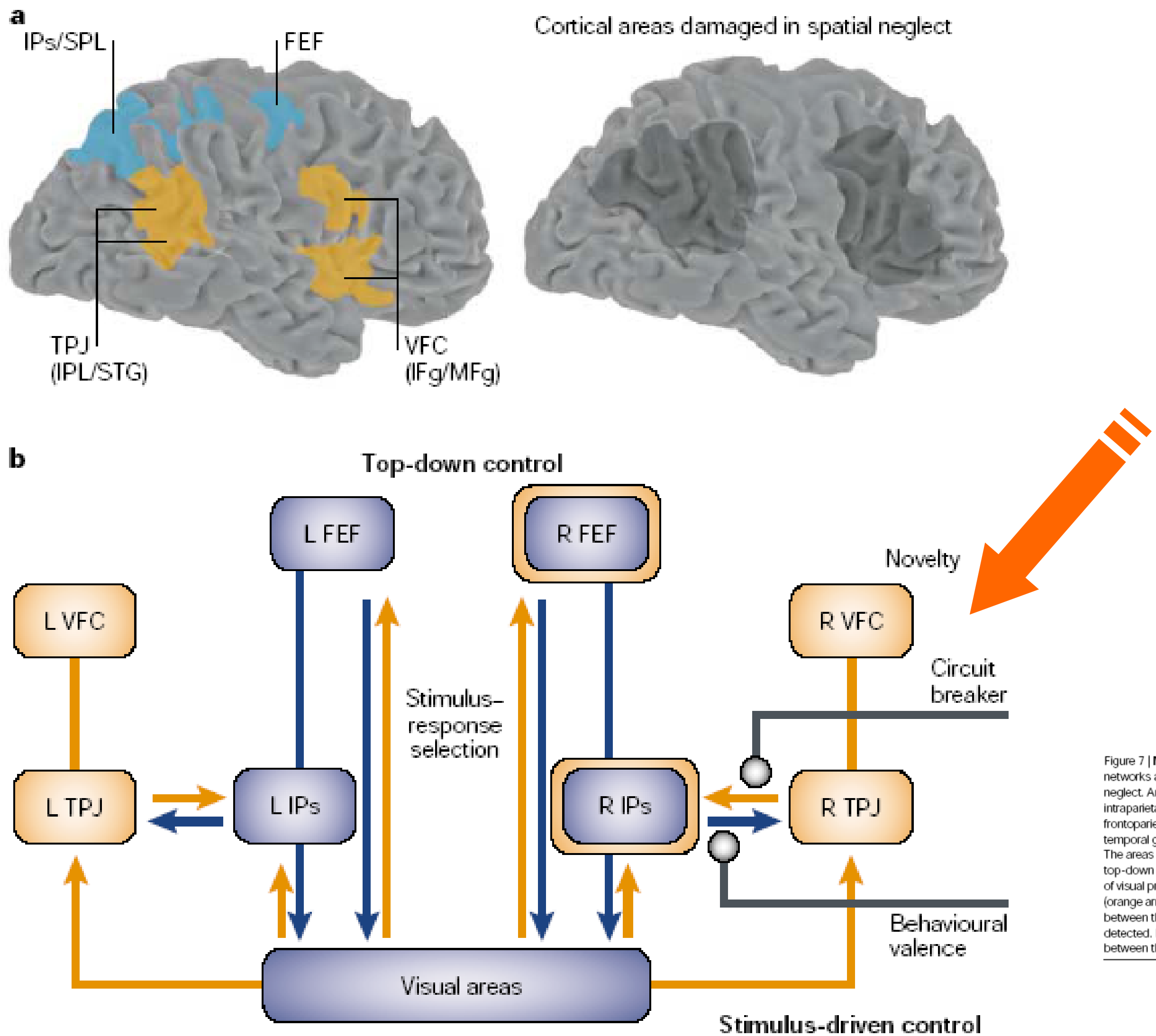

Figure 7 | **Neuroanatomical model of attentional control. a** | Dorsal and ventral frontoparietal networks and their anatomical relationship with regions of damage in patients with unilateral neglect. Areas in blue indicate the dorsal frontoparietal network. FEF, frontal eye field; IPs/SPL, intraparietal sulcus/superior parietal lobule. Areas in orange indicate the stimulus-driven ventral frontoparietal network. TPJ, temporoparietal junction (IPL/STG, inferior parietal lobule/superior temporal gyrus); VFC, ventral frontal cortex (IFg/MFg, inferior frontal gyrus/middle frontal gyrus). The areas damaged in neglect (right) better match the ventral network. **b** | Anatomical model of top-down and stimulus-driven control. The IPs–FEF network is involved in the top-down control of visual processing (blue arrows). The TPJ–VFC network is involved in stimulus-driven control (orange arrows). The IPs and FEF are also modulated by stimulus-driven control. Connections between the TPJ and IPs interrupt ongoing top-down control when unattended stimuli are detected. Behavioural relevance is mediated by direct or indirect (not shown) connections between the IPs and TPJ. The VFC might be involved in novelty detection. L, left; R, right.


Danke für Ihre
Aufmerksamkeit!