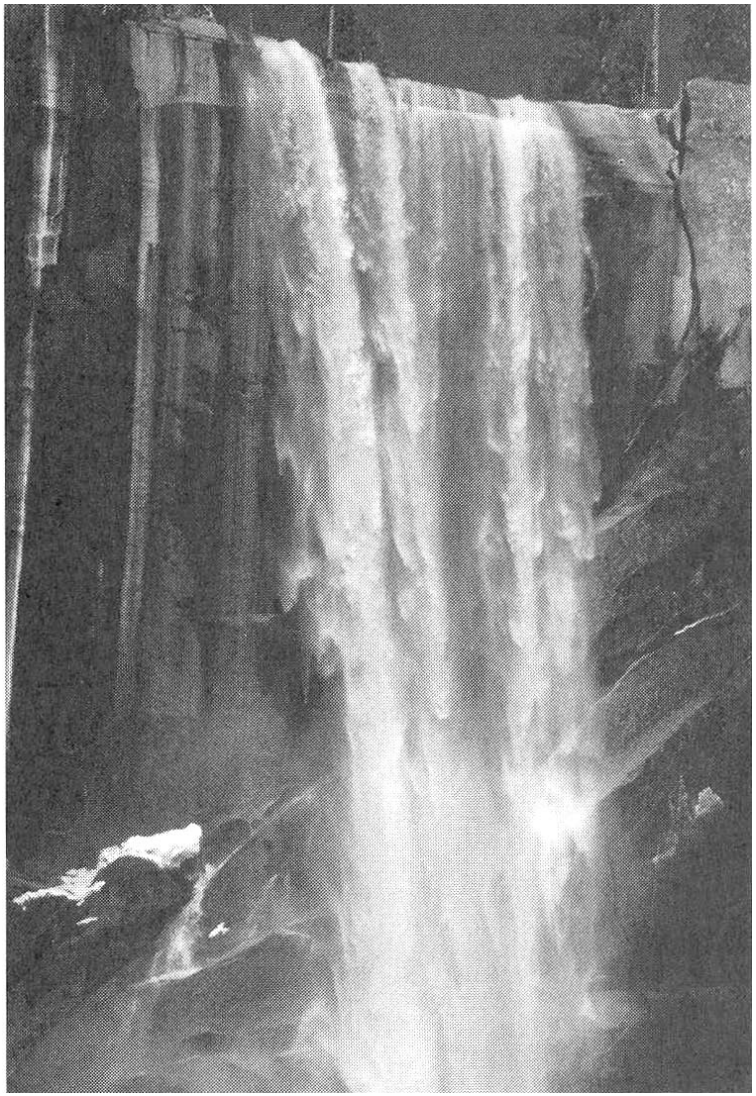
Seminar Visuelle Neurowissenschaften

Motion
04.06.2007

Wandell, B. (1995). *Foundations of Vision*, chapter 10: Motion and Depth; Sunderland: Sinauer. (p. 341-386)

Motion Aftereffect / Waterfall illusion



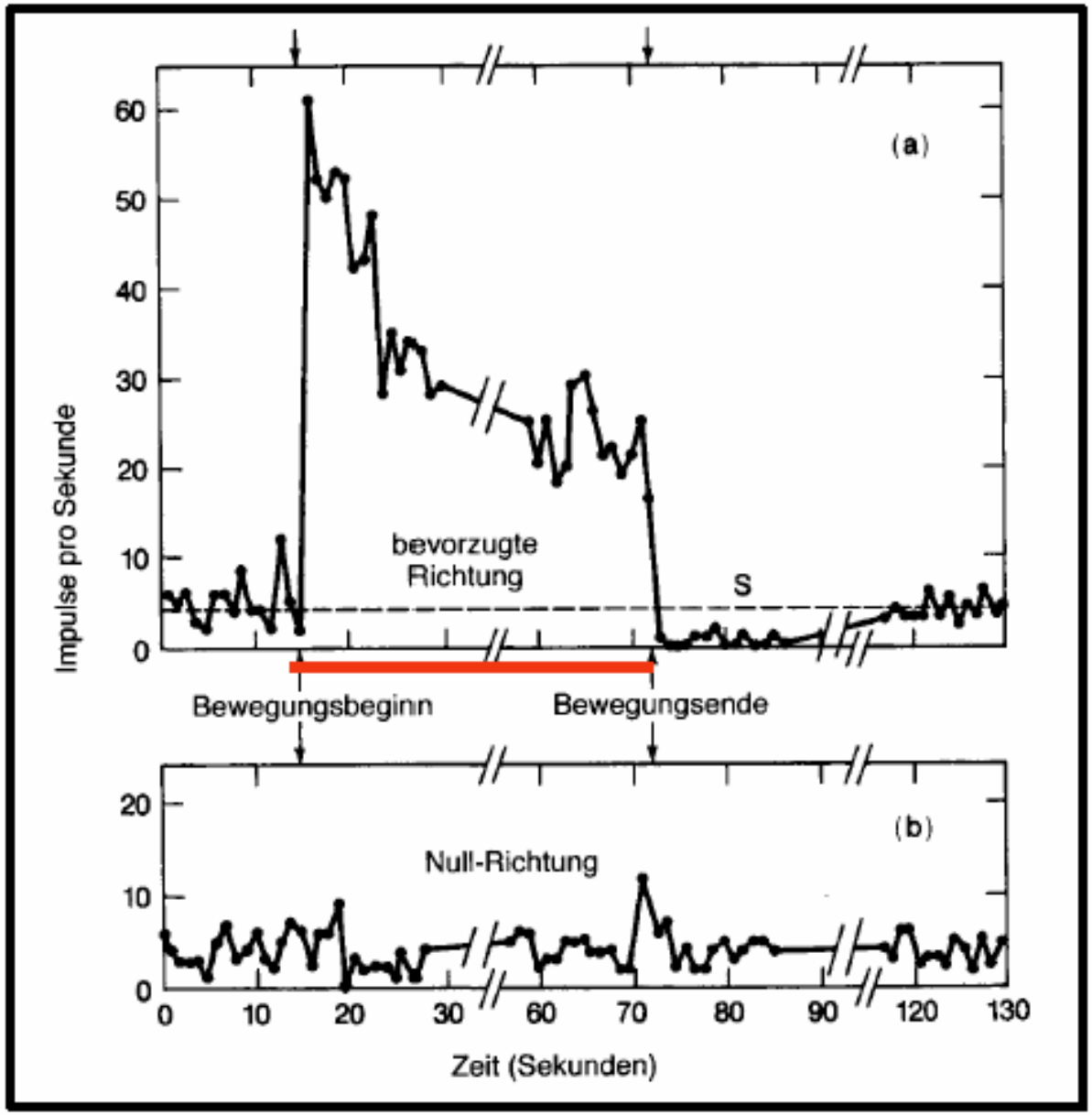
Aftereffect following viewing of uniformly moving stimulus

Effect transfers from left adapted to right unadapted eye.

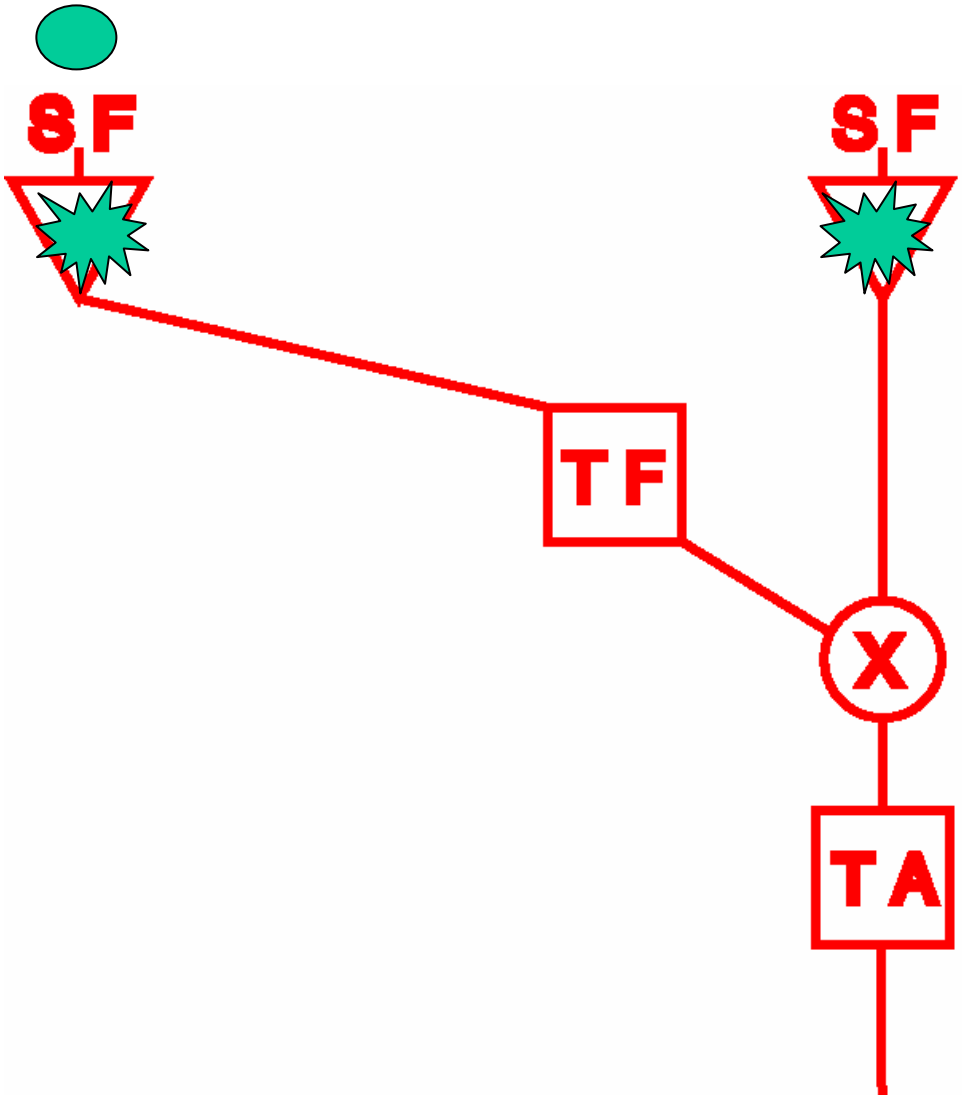
-> Video

Motion Aftereffect

Responses of direction selective retinal rabbit cells (Barlow & Hill, 1963)



Motion-Detector



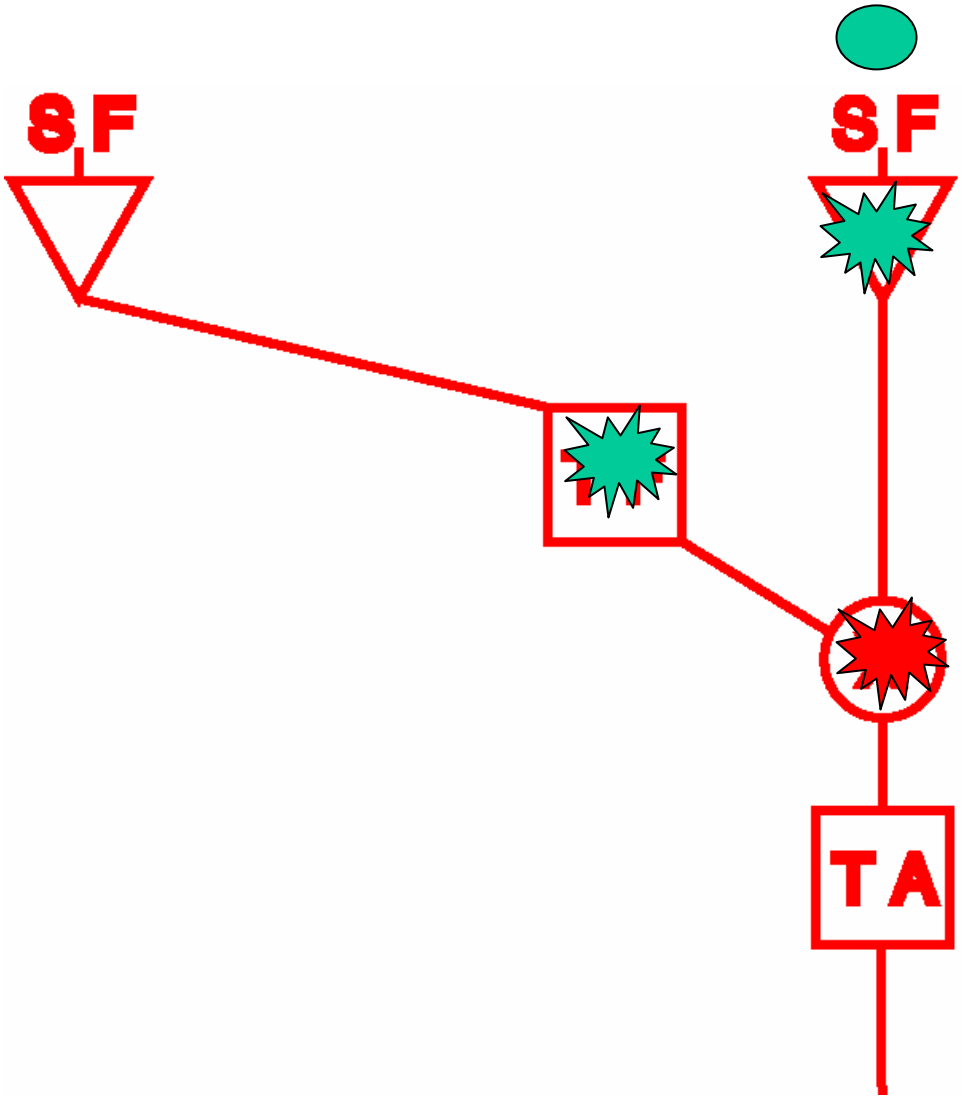
Räumliches Filter

Zeitliches Filter

Multiplizierer

Durchschnitt
über die Zeit

Motion-Detector



Räumliches Filter

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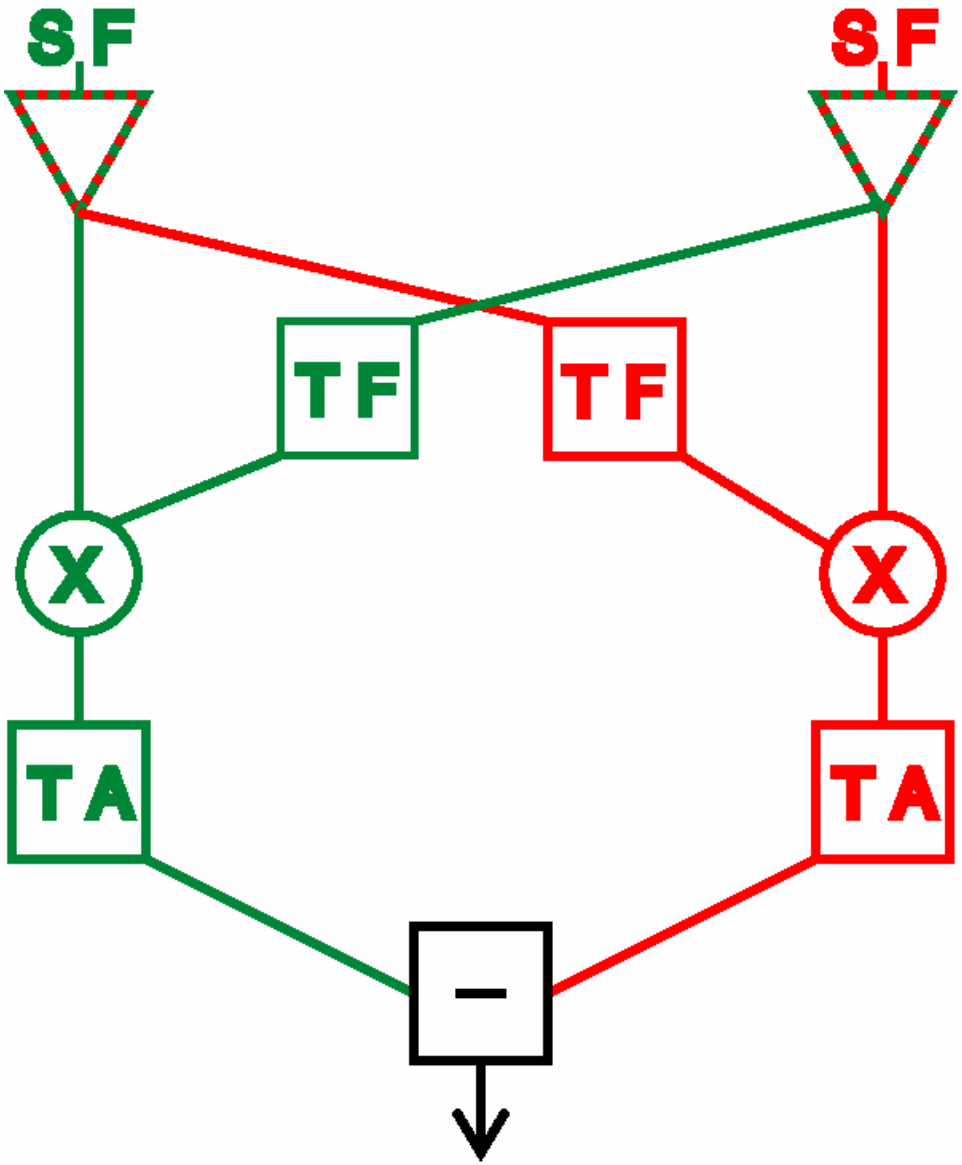
Durchschnitt
über die Zeit

Reichardt -Detector



Räumliches Filter

Zeitliches Filter

Multiplizierer

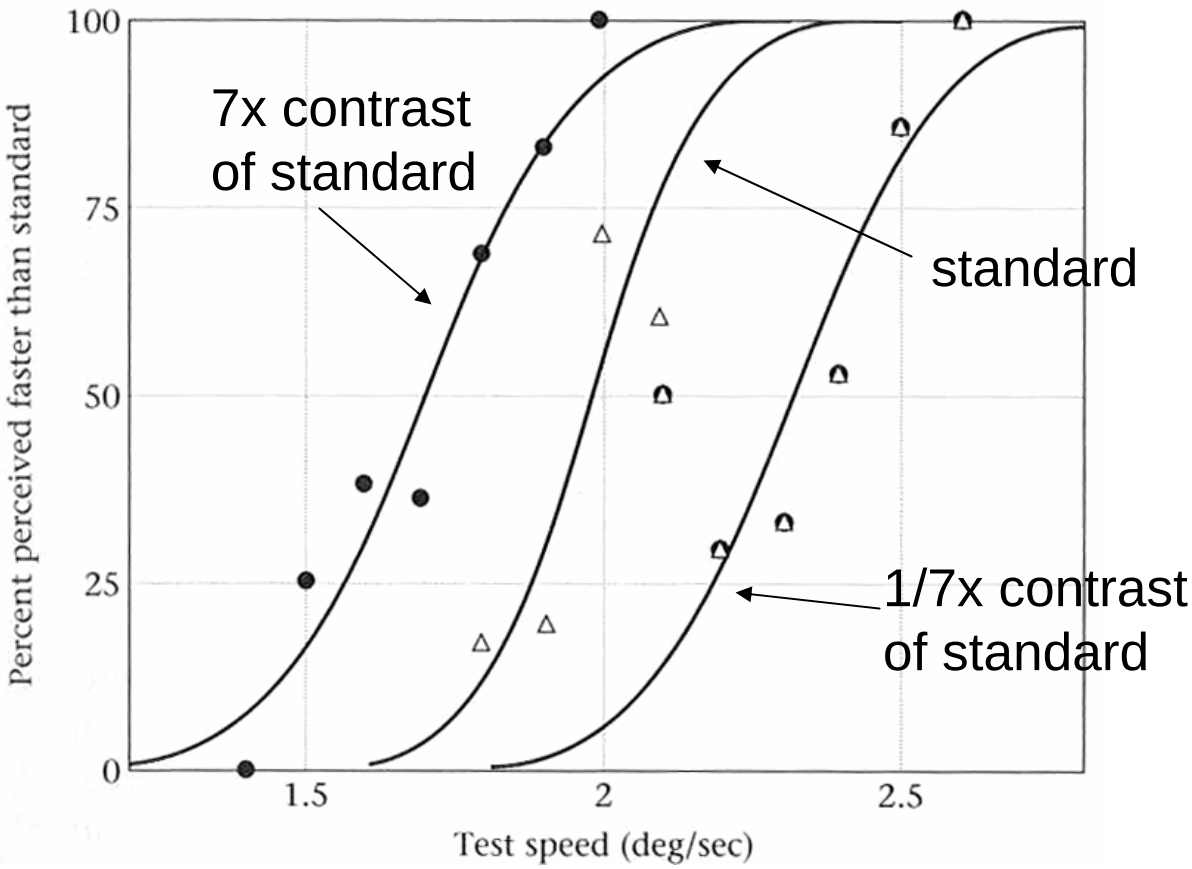
Durchschnitt
über die Zeit

Subtraktion

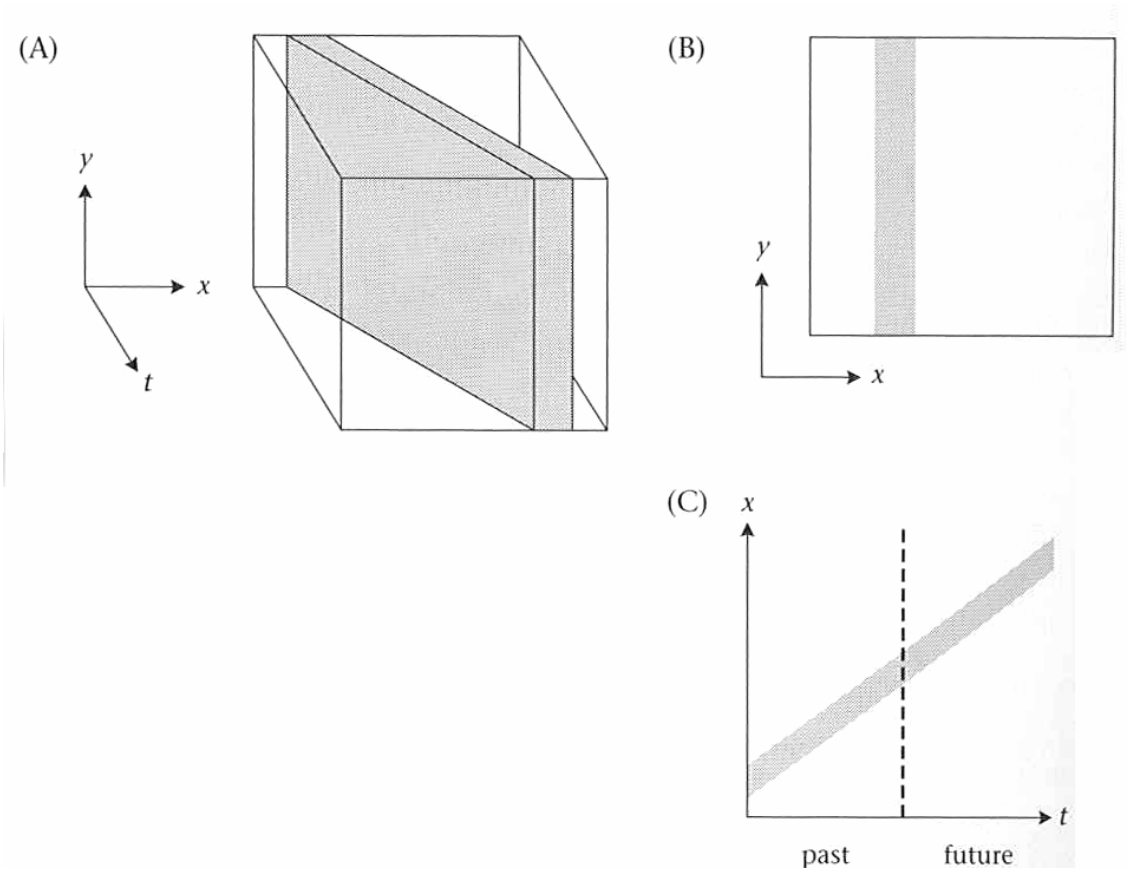
Reichardt -Detector

- Der Reichhardt-Detektor wurde zuerst im visuellen System der Fliege nachgewiesen
- Der Detektor spricht an, wenn die Verzögerung seines zeitlichen Filters identisch ist mit der Dauer der Reizbewegung
- Daraus folgt, dass man für jede Geschwindigkeit einen eigenen Detektor benötigt
- Um einfachen Flicker von Bewegung zu unterscheiden, werden zwei Detektoren für gegensätzliche Richtungen kombiniert

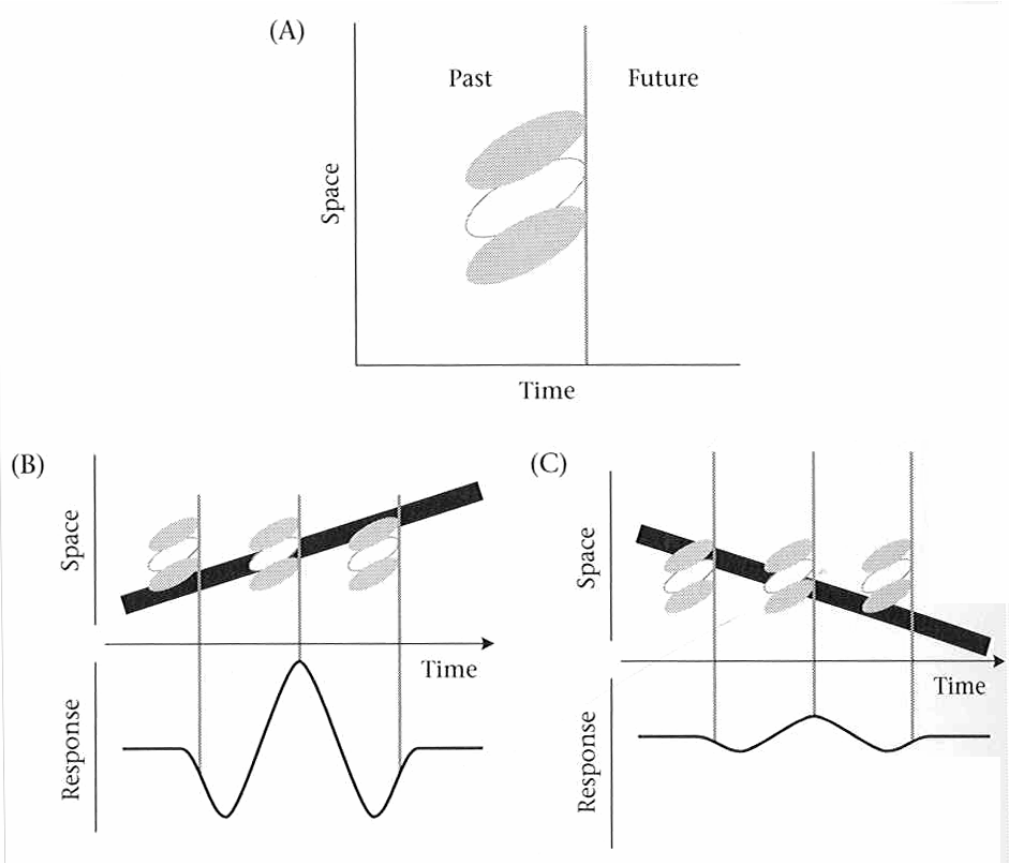
Perceived Speed Depends on Stimulus Contrast



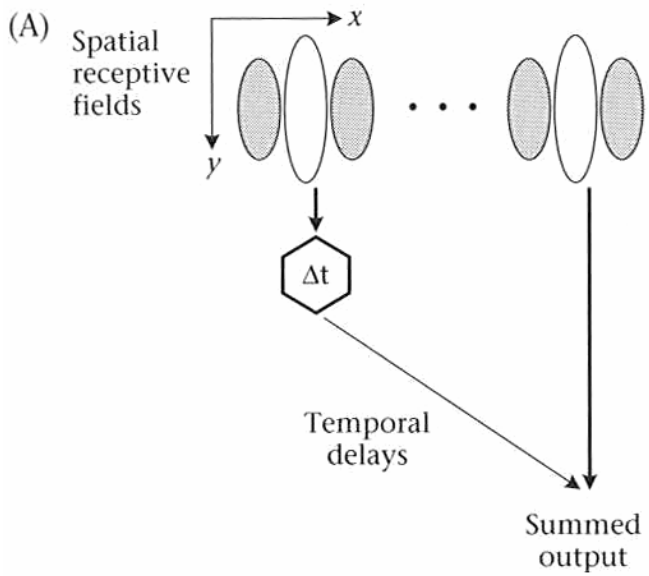
A Motion Sequence



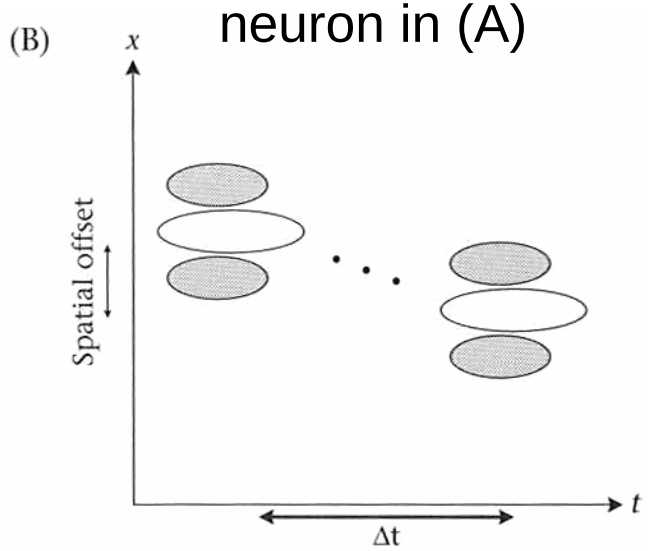
Space-Time-Oriented Receptive Field



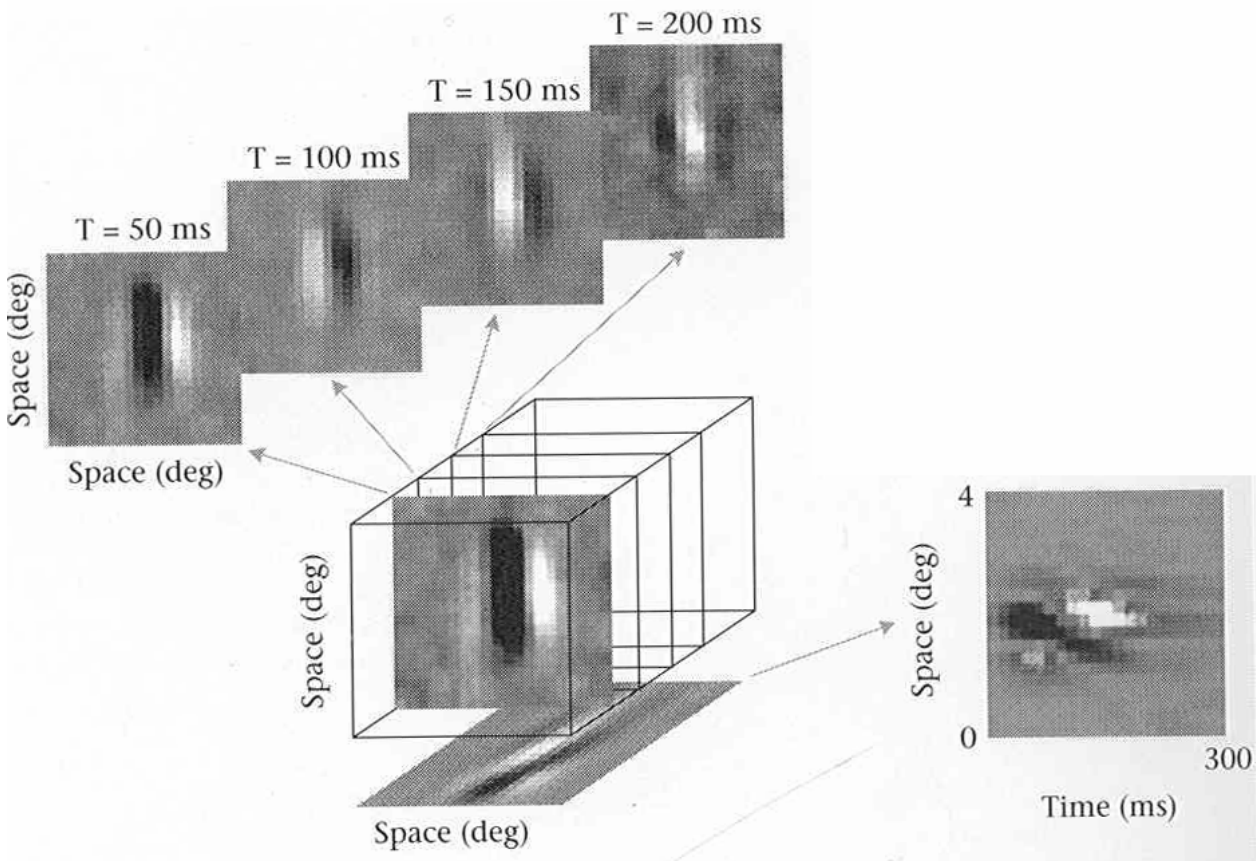
A Method for Creating A Space-Time-Oriented Receptive Field



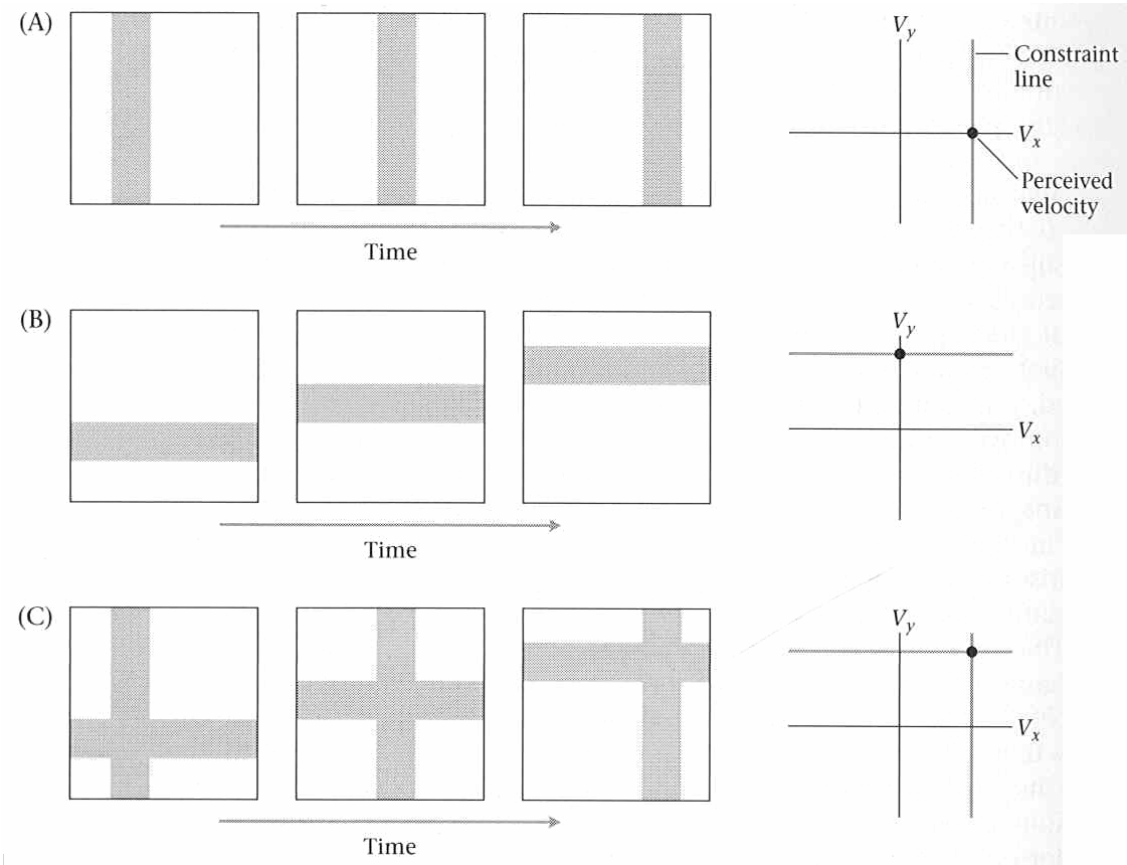
(t,x) receptive field of neuron in (A)



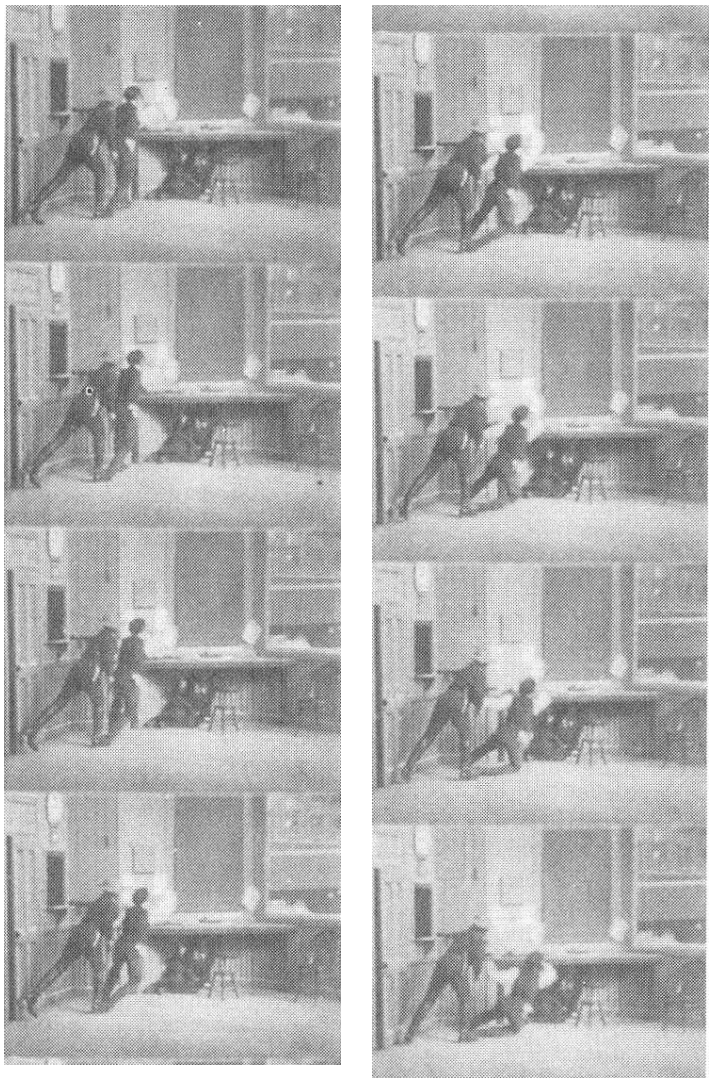
Space-Time-Oriented Receptive Field in Cat Cortex



The Intersection of Constraints



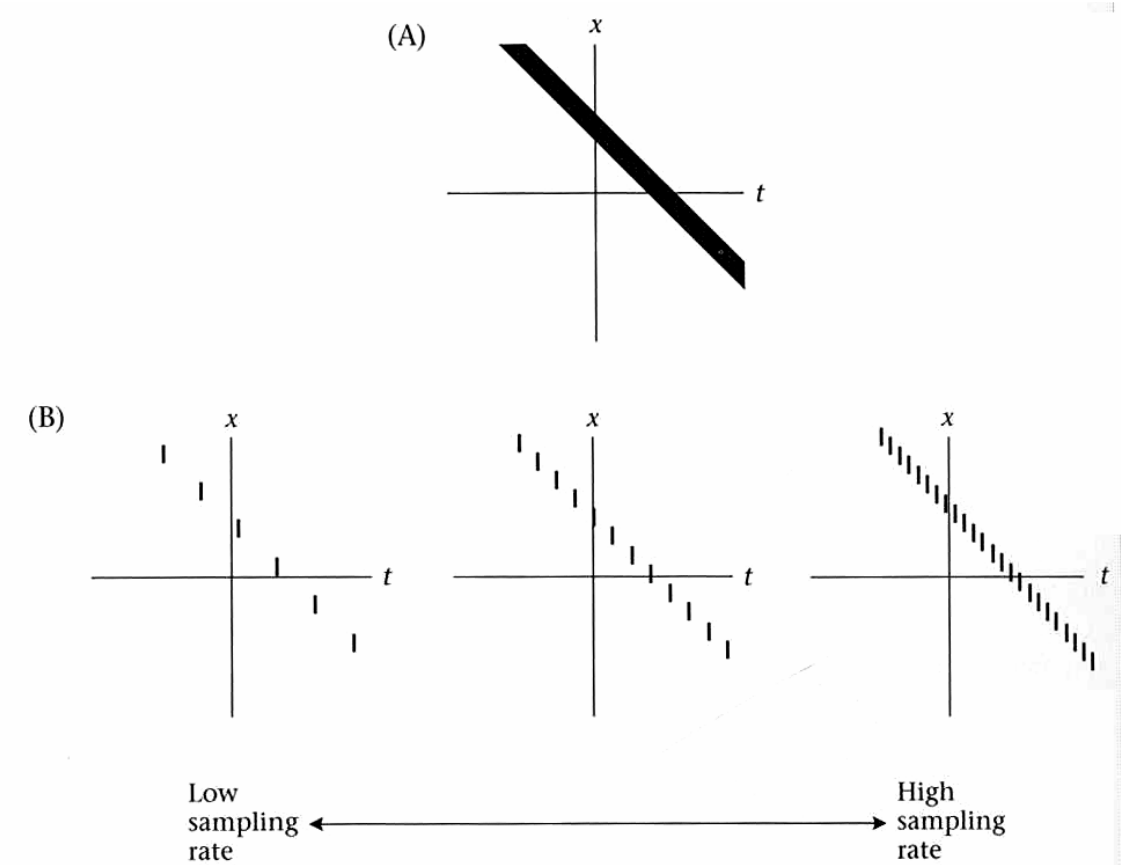
Scheinwelt Kino



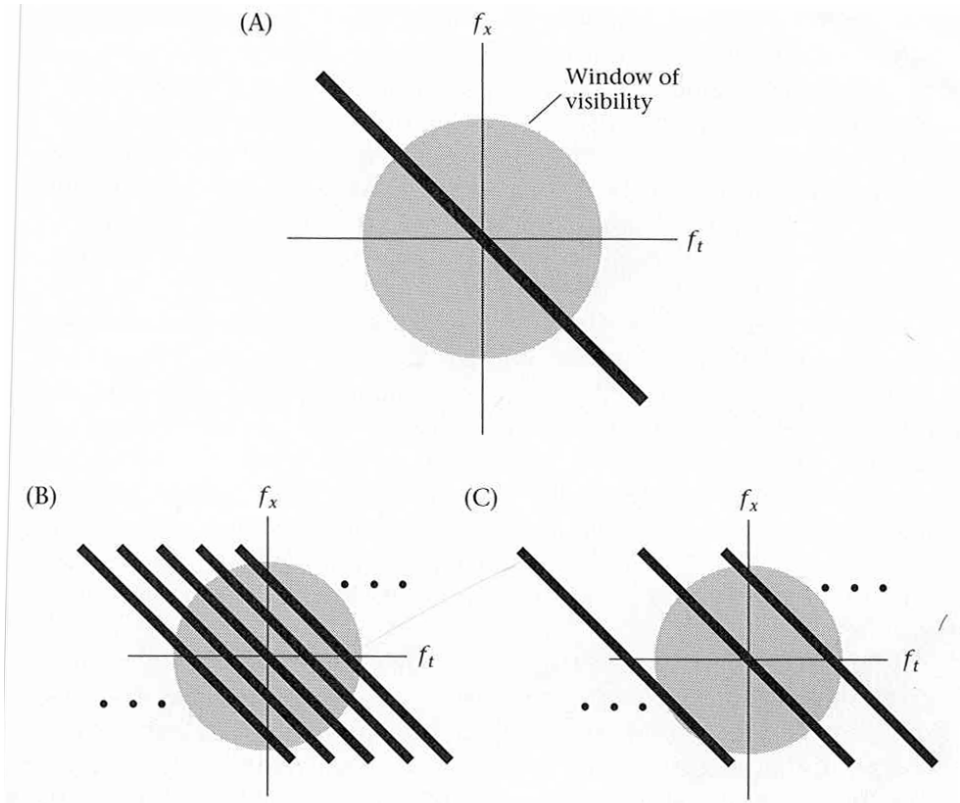
Im Kino und Fernsehen werden Reihen von stationären Bildern gezeigt (25 pro Sekunde), die dann als glatte Bewegungen wahrgenommen werden

Als Faustregel gilt: Ist der zeitliche Abstand der Bilder kleiner als 15 msec (60 Hz), dann kann die Bildsequenz nicht von einer glatten Bewegungsfolge unterschieden werden

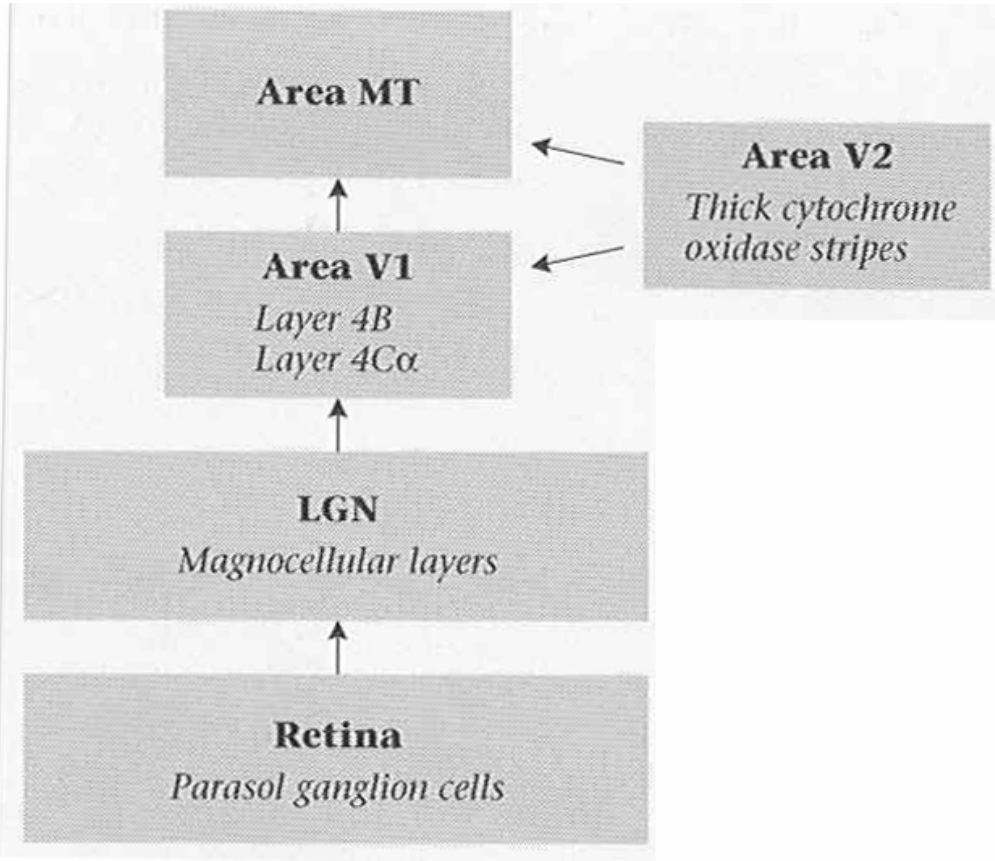
The Representation of Continuous and Temporally Sampled Motion



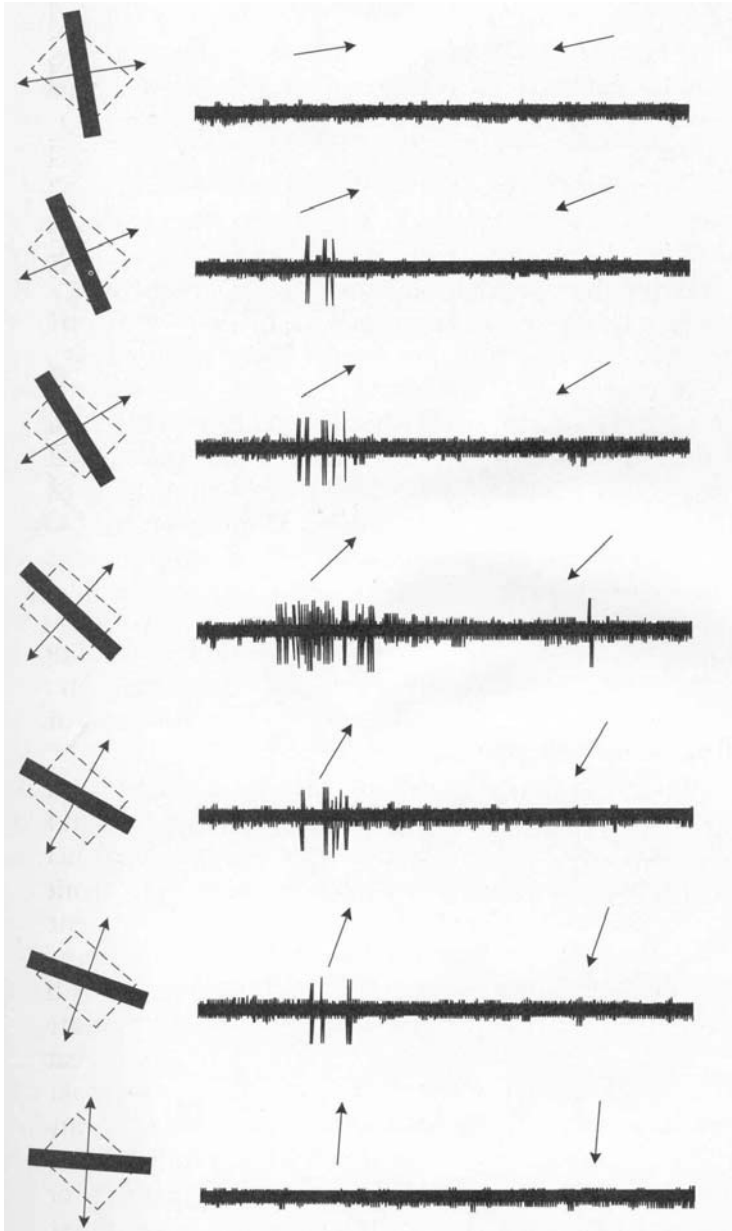
A Graphical Method to Decide when Sampled Motion can be Discriminated from Continuous Motion



Anatomy of the Motion Pathway



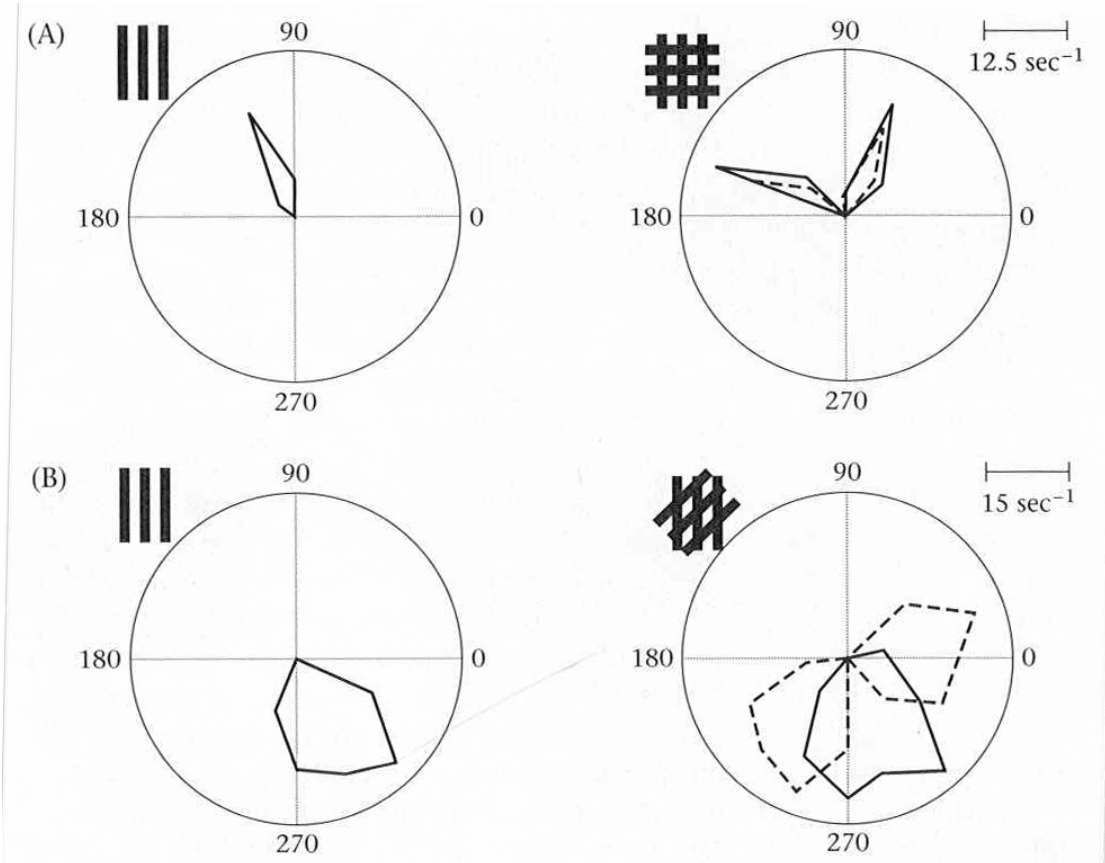
Preferred Direction



Ein kleiner Prozentsatz der Zellen in V1 (weniger als 10%) hat eine bevorzugte Bewegungsrichtung. Reize in Gegenrichtung lösen keine Antwort aus. Diese Zellen befinden sich vor allem in der Schicht 4B, deren Eingangssignale aus den magnozellulären Schichten des CGL stammen.

Die Neurone aus der Schicht 4B projizieren in andere kortikale Areale, die für die Bewegungswahrnehmung wichtig sind.

Direction Selectivity in Area MT



Referat 1:

Watson, A. B., Thompson, P. G. , Murphy, B. J. and Nachmias, J. (1980). Summation and discrimination of gratings moving in opposite directions. *Vision Research*, **20,** 341-347.

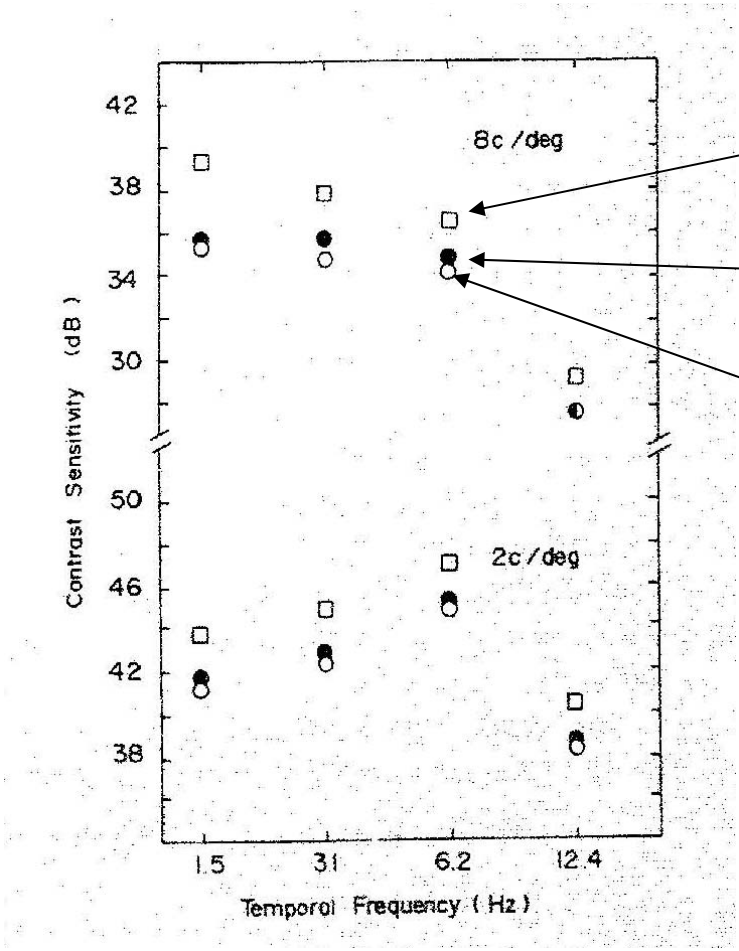
Purpose of study

- Test of Levision & Sekuler's claim that the sum of two gratings is not more visible than either grating (Levinson & Sekuler, 1975, J. Physiol., 250, 347-366).
- Different here: 2AFC instead of MOA

Task

- Contrast sensitivity of detection and identification of moving and counterphase sinusoidal grating
- Two subjects
- **Exp. 1:** Detection of left-moving, right-moving and counterphase grating (4 contrasts, 1300 trials, fixed spatial and temporal frequency, 7.7% catch trials)
- **Exp. 2:** 2AFC task, subject had to simultaneously detect grating & identify direction of moving grating

Results, Exp. 1:



counter phase grating

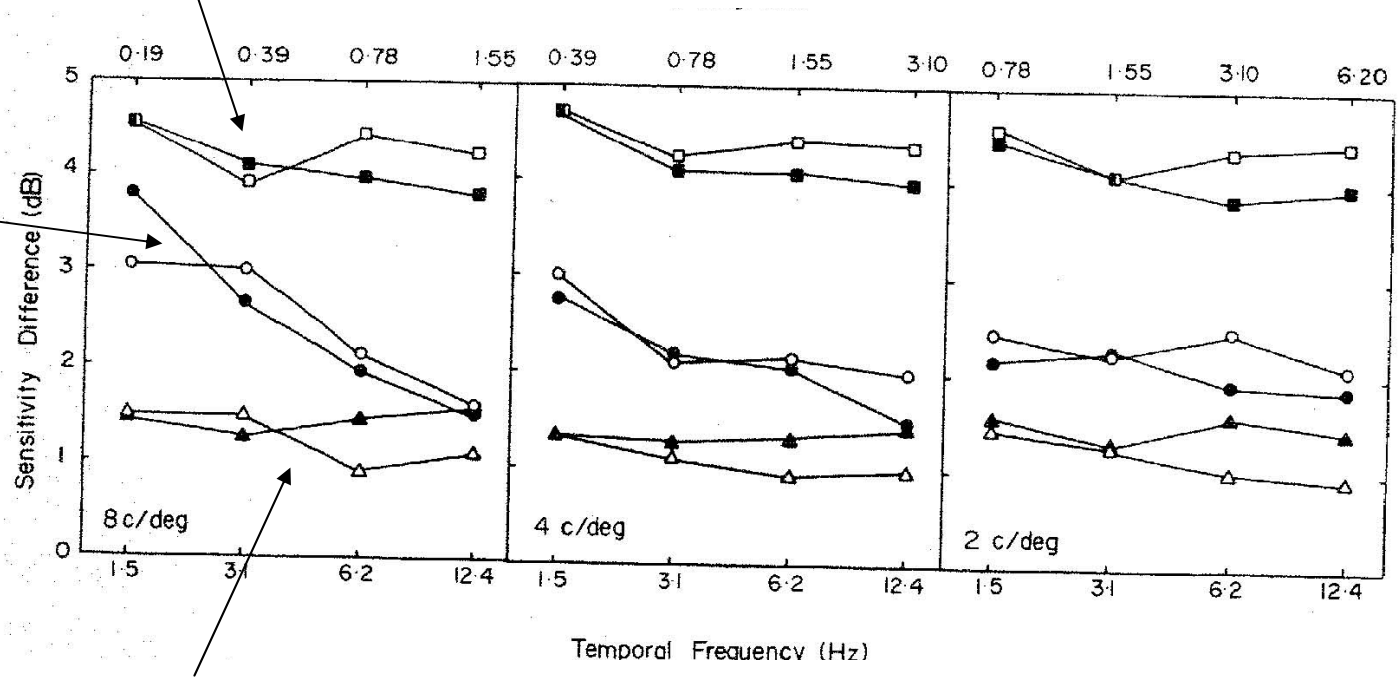
rightward moving grating

leftward moving grating

Results, Exp. 1:

prediction directional non-selective mechanism

data

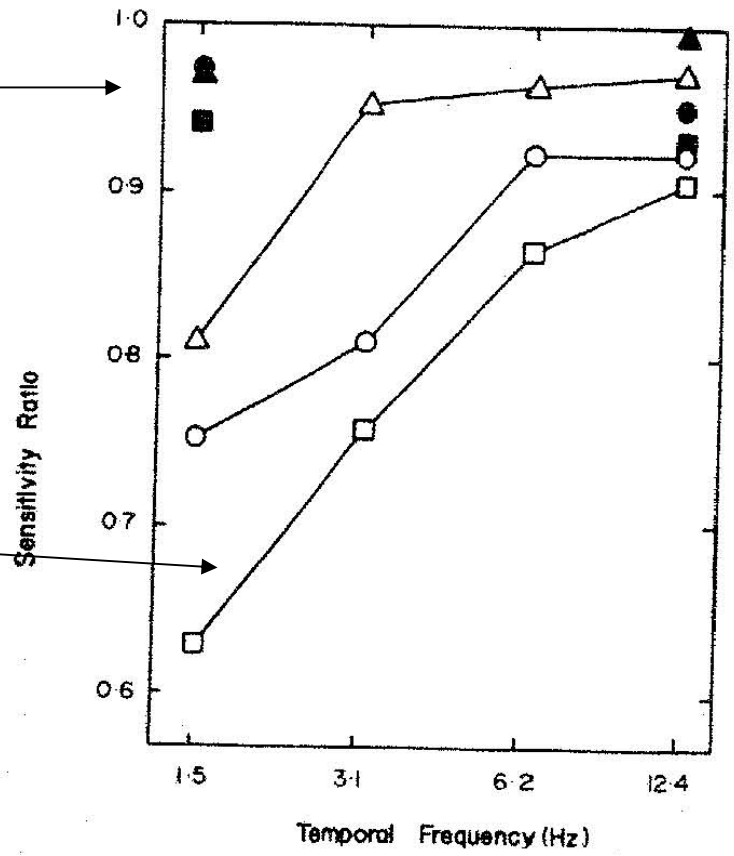


directional selective mechanism

Results, Exp. 2:

Spatial frequency of 2c/deg

Spatial frequency of 8c/deg

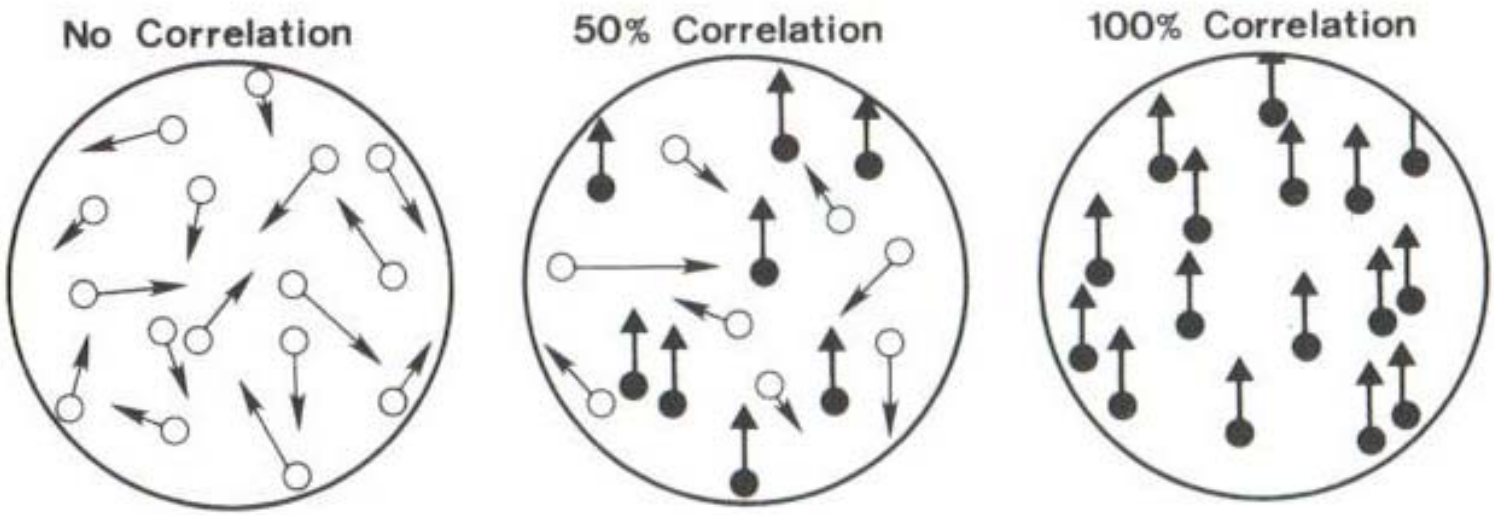


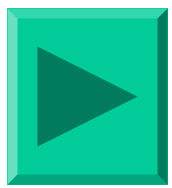
Referat 2:

Newsome, W.T., Britten, K.H. & Movshon, J.A. (1989). Neuronal correlates of a perceptual decision. *Nature*, **341,** 52-54.

Single Cell Activity in MT

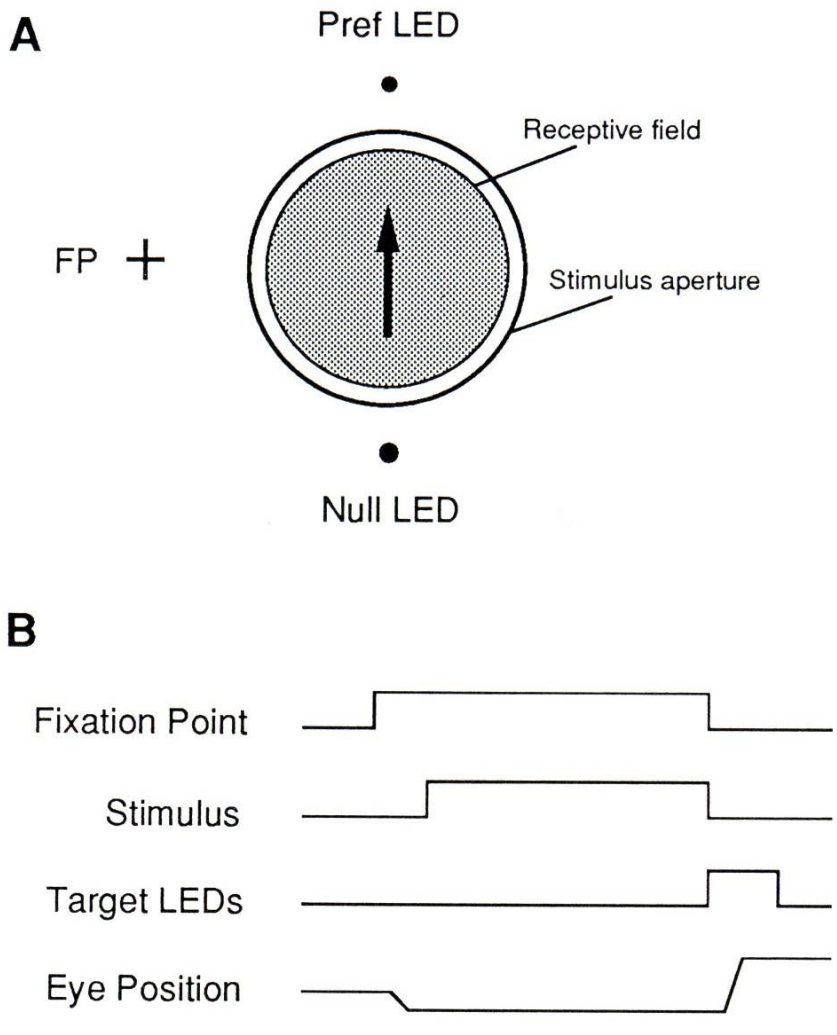
Stimuli:





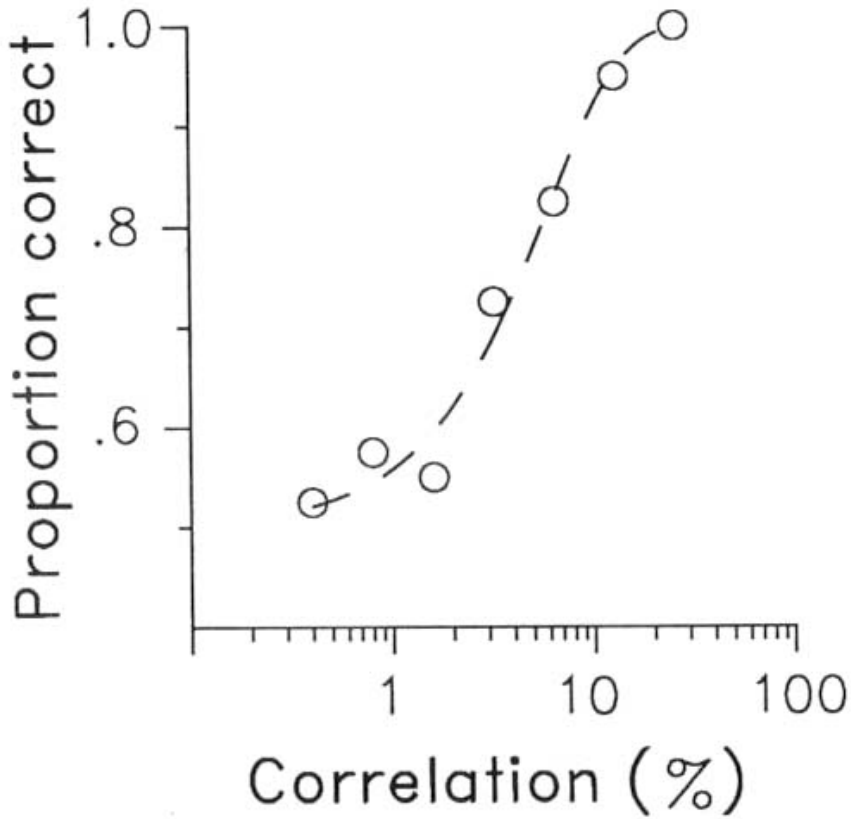
-> Video

Task

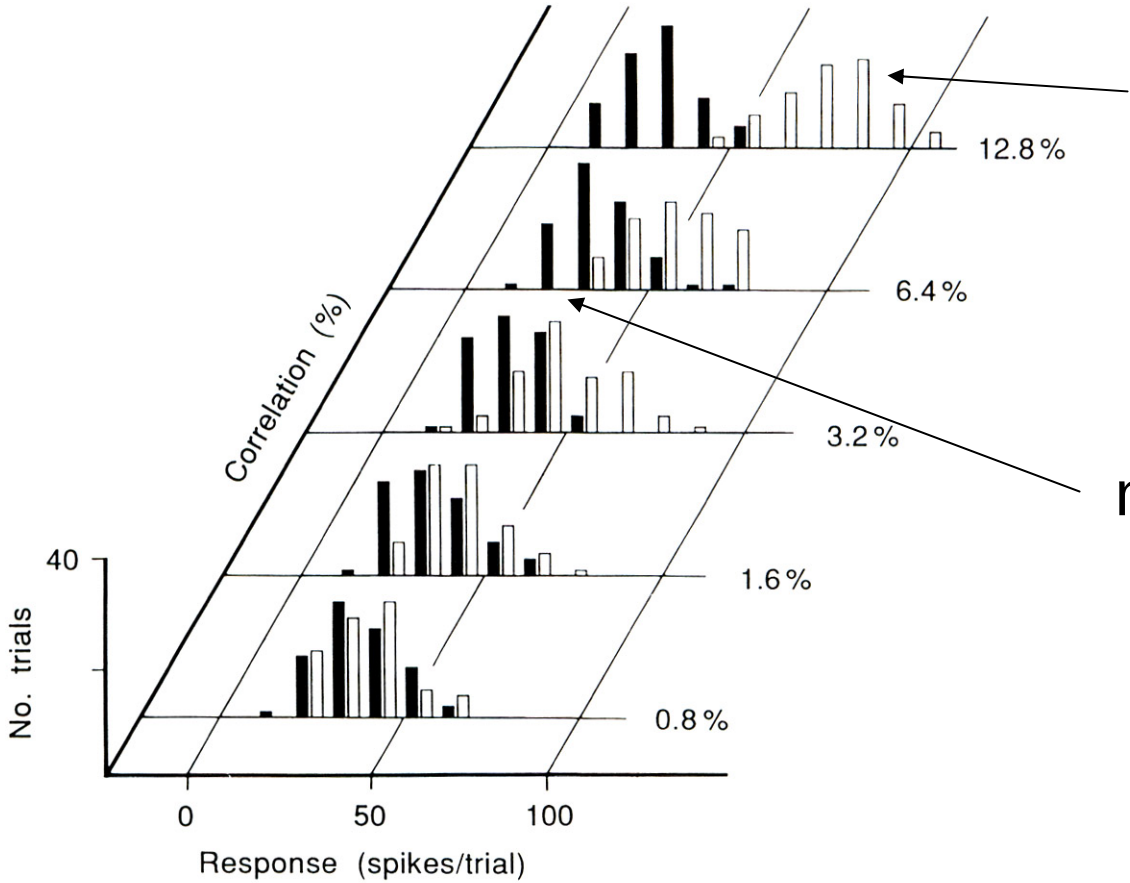


- Monkey performs psychophysical task
- Single cell recordings from MT
- Motion simulus centered on receptive field

Psychophysics



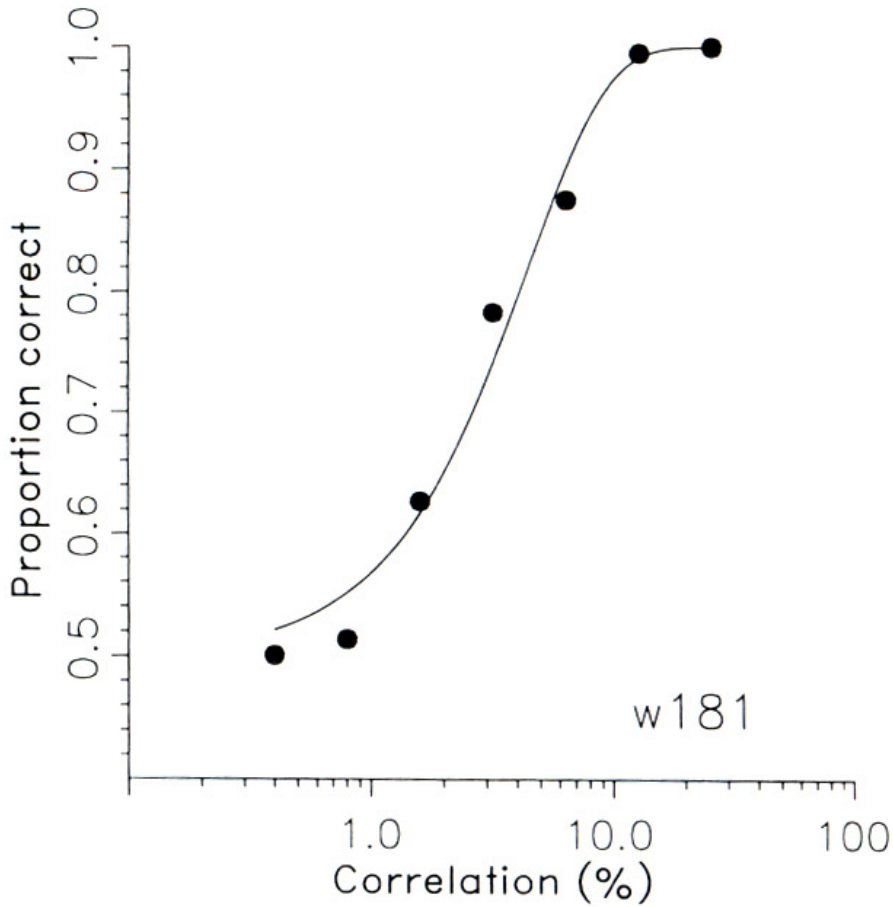
MT responses



preferred direction

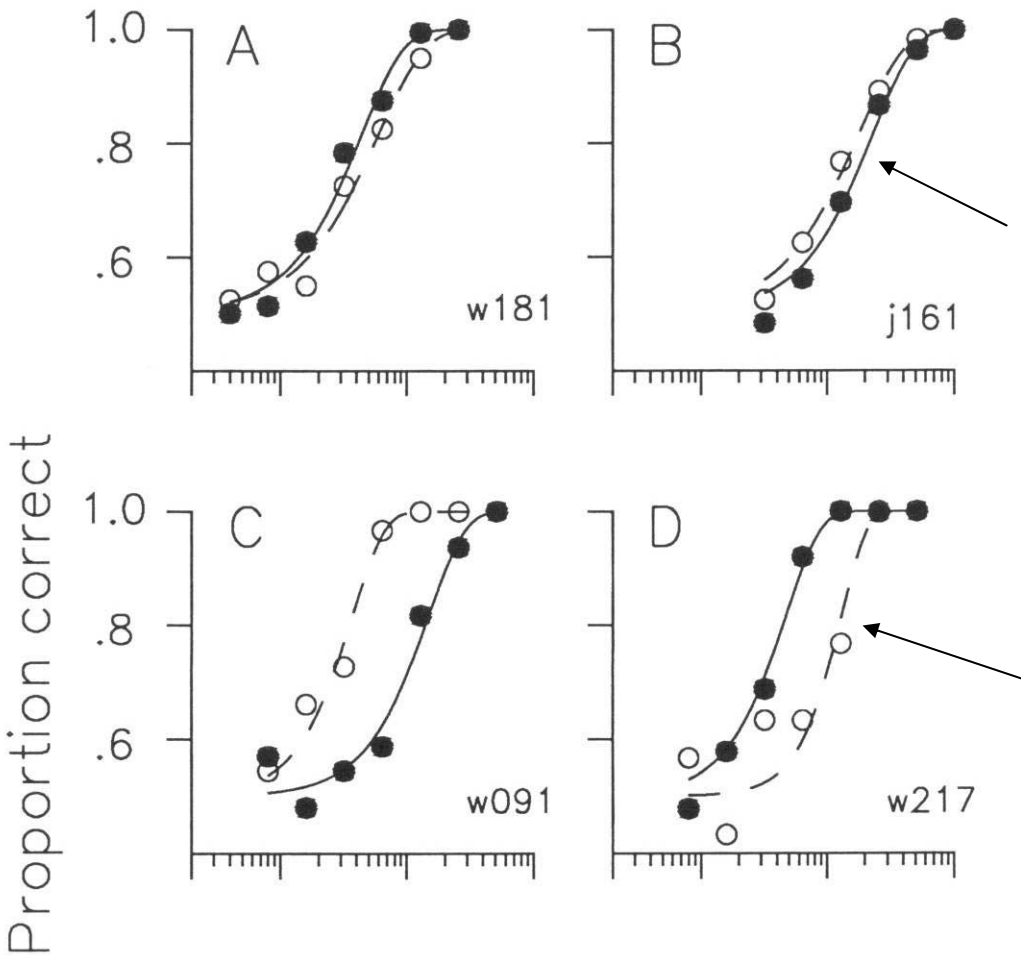
null direction

Neurometric Function



A neurometric function quantifies how well stimulus direction can be predicted based on single cell activity.

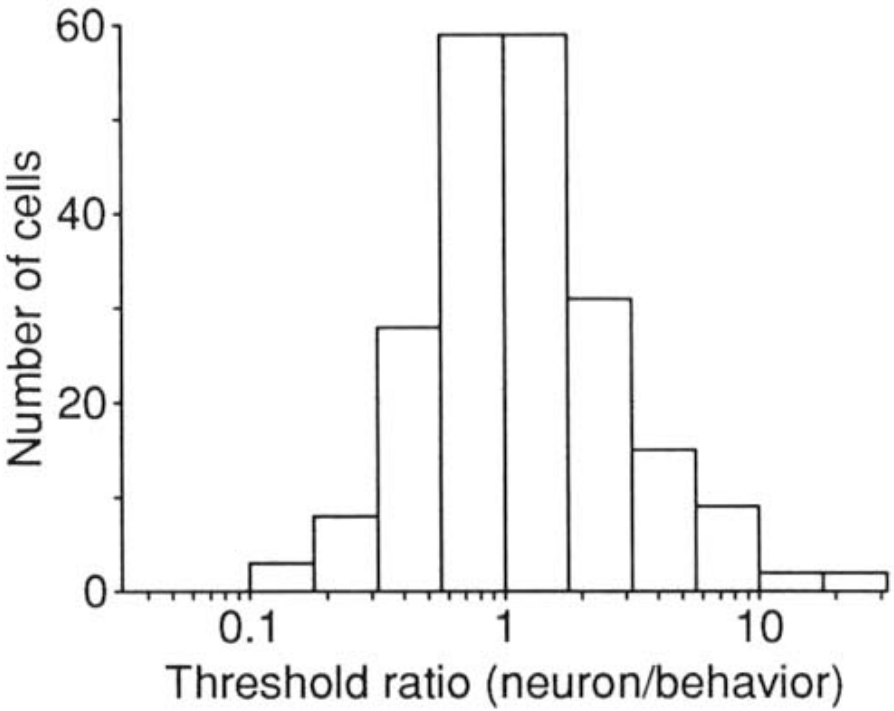
Comparison



Neurometric function

Psycho-physics

Comparison of psychophysical and physiological thresholds



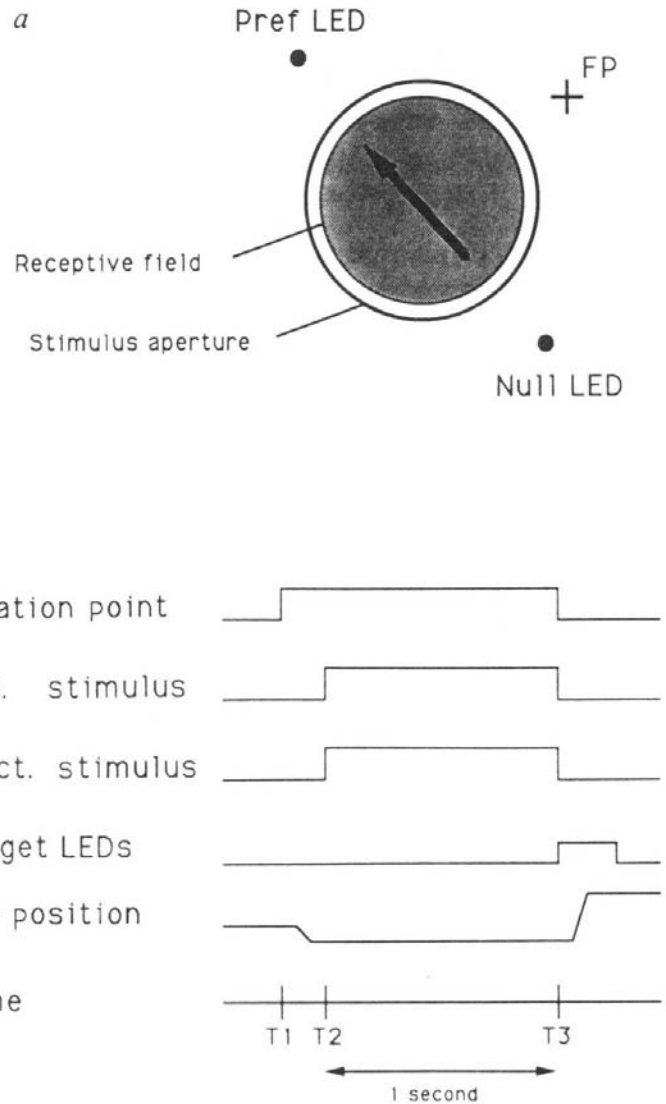
Einzelne Zellen sind im Schnitt genauso gut bei dieser Aufgabe wie der ganze Affe

Viele Zellen sind sogar besser!

Referat 3:

Salzman, C.D. Britten, K.H. & Newsome, W.T. (1990). Cortical microstimulation influences perceptual judgements of motion direction. *Nature*, **346,** 174-177.

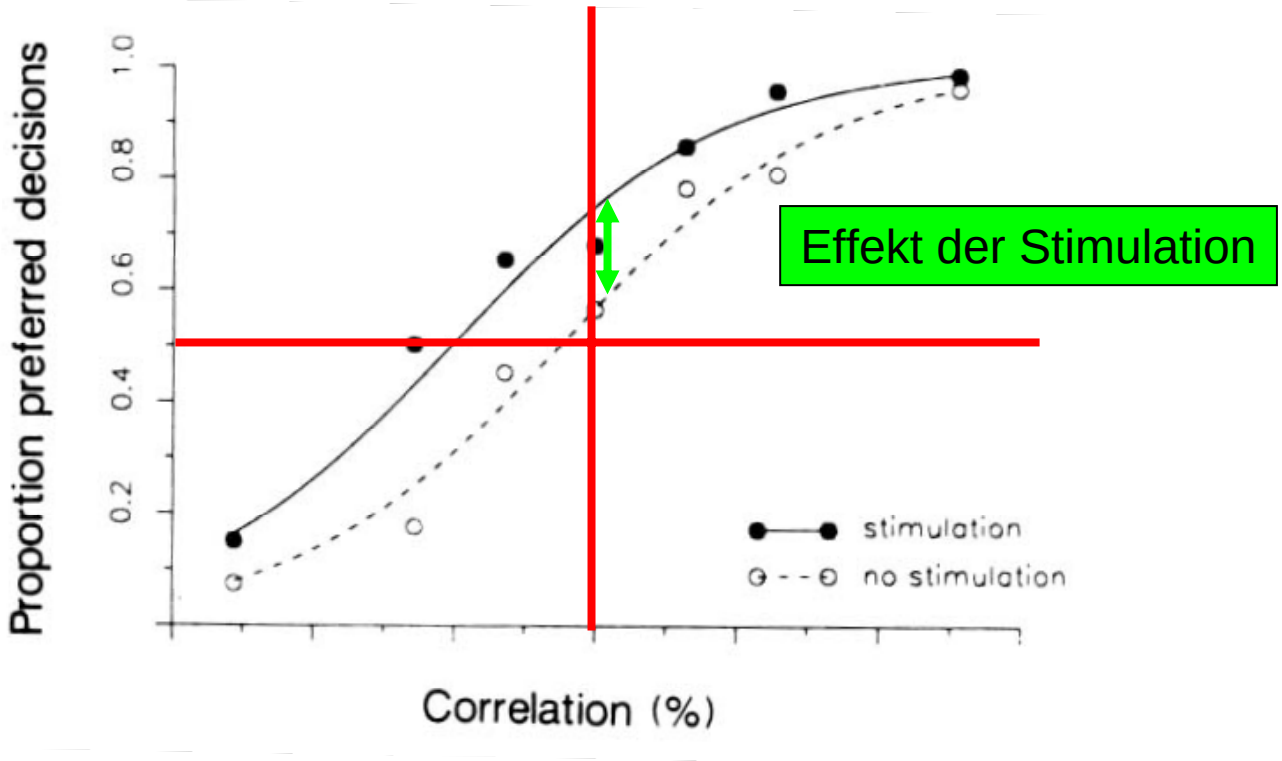
Mikrostimulation



- Zellen in MT sind nach ihrer bevorzugten Bewegungsrichtung angeordnet

- Während der Darbietung eines Bewegungsreizes wird nun eine solche Kolumne elektrisch stimuliert

Mikrostimulation von Neuronen



Stimulation verändert die Angaben der Bewegungsrichtung und daher vermutlich auch die wahrgenommene Richtung. Neurone in MT sind an diesen Entscheidungen kausal beteiligt!