**Exploiting video-tracking data to dissect
water maze learning and strategy choice in mutant mice**
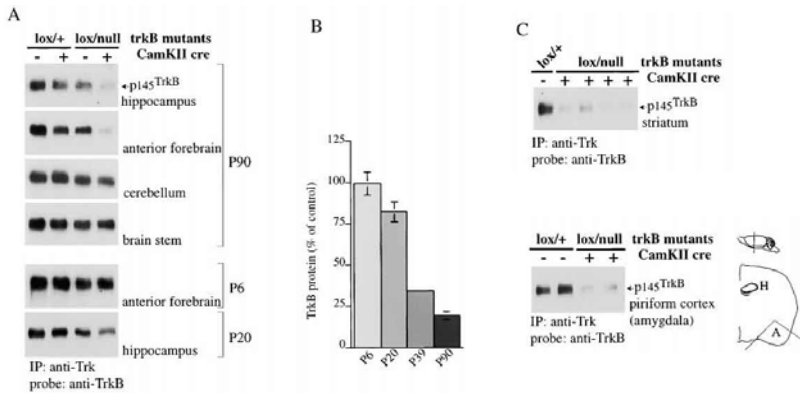
David P. Wolfer
Neuroanatomy and Behavior, Institute of Anatomy
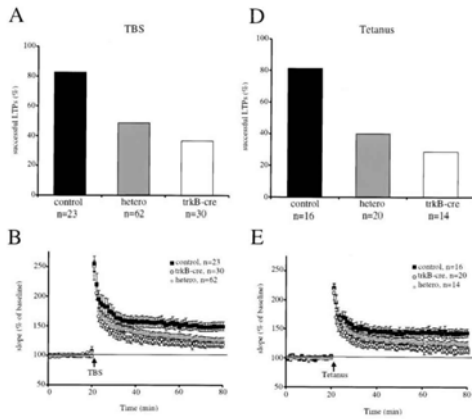University of Zurich

david@dpwolfer.ch, http://www.dpwolfer.ch

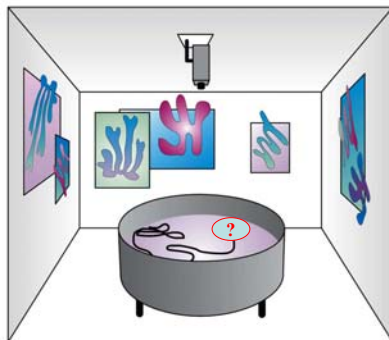**Conditional ablation of trkB using CRE-lox system**

Neuron 24:401, 1999

Hippocampal synaptic plasticity in trkB-CRE mice

Neuron 24:401, 1999

In vitro LTP reduced in CA1 of homozygous mutant mice, heterozygous animals show intermediate phenotype.

Place navigation in the watermaze

Morris RGM,
Learn Motiv, 12:239-260, 1981
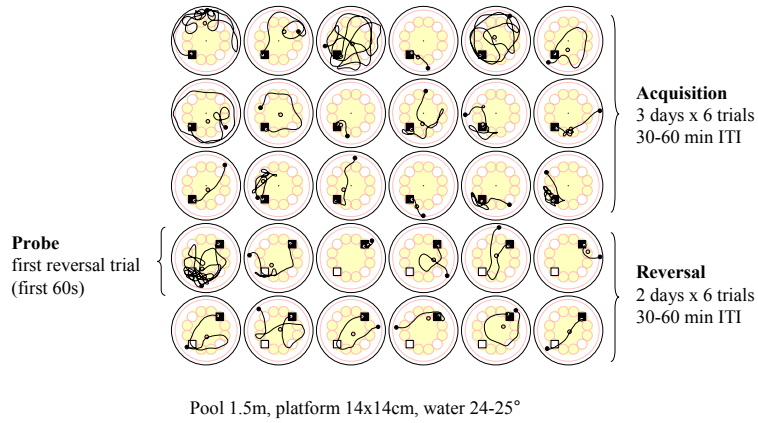
Morris RGM et al.,
Nature, 297:681-683, 1982

Morris RGM,
J Neurosci Meth, 11:47-60, 1984

Morris RGM et al.,
Nature, 319:774-778, 1986

Parameters
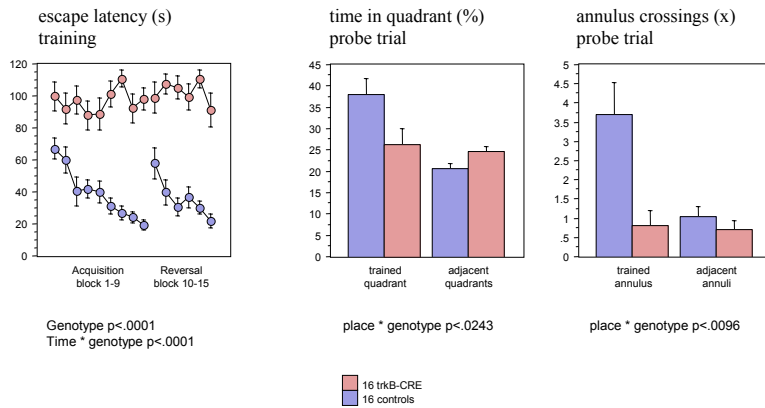- escape latency (training)
- time in quadrant (probe trial)
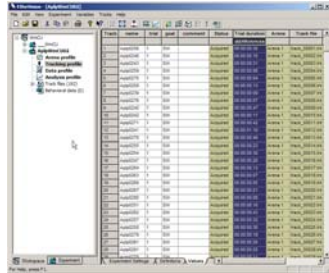- annulus crossings (probe trial)

Place navigation protocol in Zurich

Probe
first reversal trial
(first 60s)

Acquisition
3 days x 6 trials
30-60 min ITI

Reversal
2 days x 6 trials
30-60 min ITI

Pool 1.5m, platform 14x14cm, water 24-25°

Swimming navigation in trkB-CRE mice

escape latency (s)
training

time in quadrant (%)
probe trial

annulus crossings (x)
probe trial

Genotype p<.0001
Time * genotype p<.0001

place * genotype p<.0243

place * genotype p<.0096

16 trkB-CRE
16 controls

Off-line data analysis
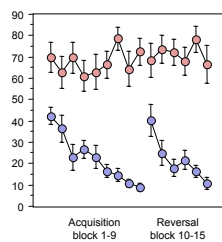
Noldus EthoVision 1.96/2.30
trial acquisition
www.noldus.com
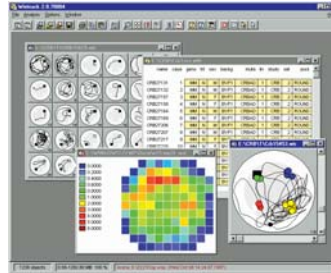
Wintrack 2.3
off-line data analysis
www.dpwolfer.ch/wintrack

Swimming navigation in trkB-CRE mice

search error (m*s)
training

path efficiency (%)
training

"proximity" (m)
probe trial

Acquisition block 1-9   Reversal block 10-15

Acquisition block 1-9   Reversal block 10-15

to trained goal

Genotype p<.0001
Time * genotype p<.0001
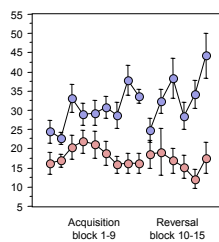
Genotype p<.0001
Time * genotype p<.0024
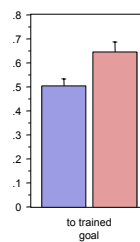
Genotype p<.0088

16 trkB-CRE
16 controls

Watermaze transfer test in trkB-CRE mice

control
search for
trained goal

trkB-CRE
disoriented
swim pattern

control
search for
trained goal

trkB-CRE
thigmotactic
swim pattern

Strategies and swim patterns of mice in the watermaze

thigmotaxis   random   scanning   chaining   focal   spatial

floating   circling   probe trial

Automatic classification of watermaze trials

circling
cumulative circling > 1000 ° and index > 500 °/m

Y

N

floating
total floating time > 30 s

spatial
spatial search error < 1 m

focal
average distance to gravity center < 0.35 m

chaining
chaining > 45% visits and > 1.40/m

scanning
space usage < 60% and wall pref. < 1.0

random
wall zone preference < 1.0

thigmotaxis

Automatic classification of watermaze trials according to predominant strategy or swim pattern.

Prevalence of strategies and swim patterns reflects time course of watermaze learning

thigmotaxis

random

scanning

chaining

focal

spatial

% trials classified, blocks of 2 trials: 1-9 acquisition, 10-15 reversal.

All mutations and genotypes, N=4363
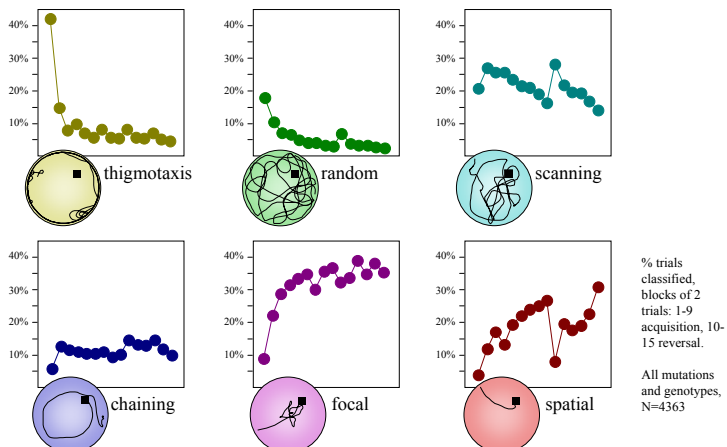
**Effect of genetic background and hybrid vigor
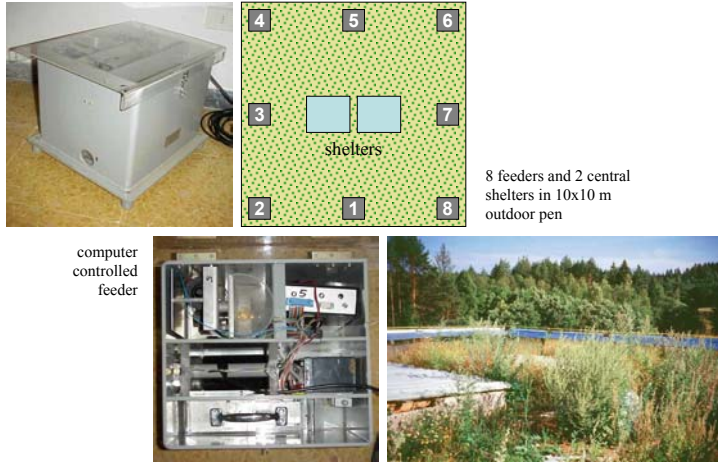on *strategy choice* during water-maze training**
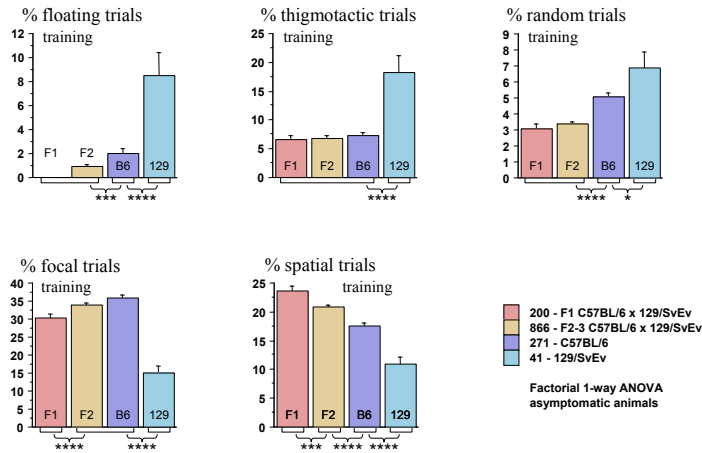
***Early adaptation* in the watermaze blocked
in mice lacking forebrain TrkB receptors**
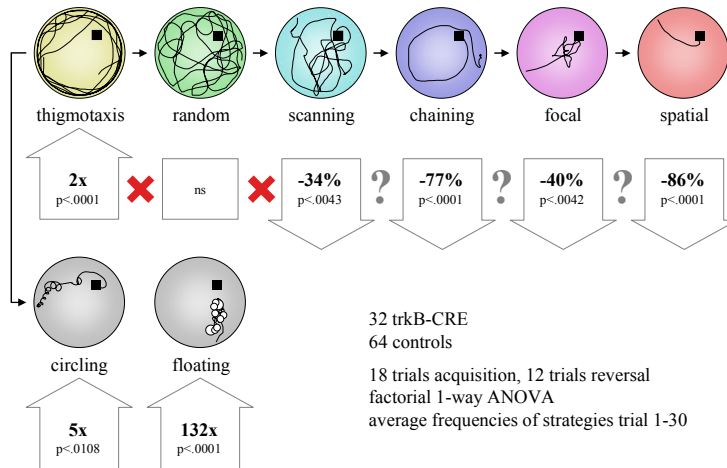
Spatial learning under naturalistic conditions

shelters

8 feeders and 2 central shelters in 10x10 m outdoor pen

computer controlled feeder

Conditional trkB KO mice show reduced behavioral flexibility but *normal spatial memory* in a naturalistic setting

F(2,27)=1.2 ns

F(2,27)=9.6 p<.008

F(2,27)=8.9 p<.001

F(2,27)=2.9 p<.070

feeder visits

Number of errors

- mutant
- heterozygous
- wild-type

feeding in outdoor feeders only

feeding also inside