



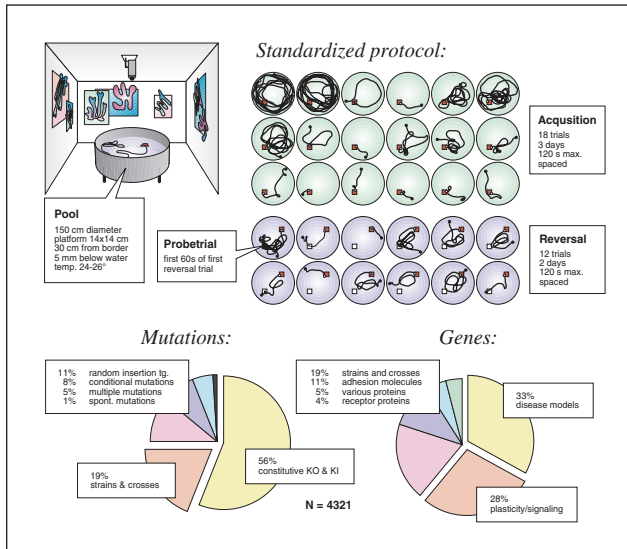
# Escape strategies of mice in the watermaze: a meta-analytical dissection

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## Summary

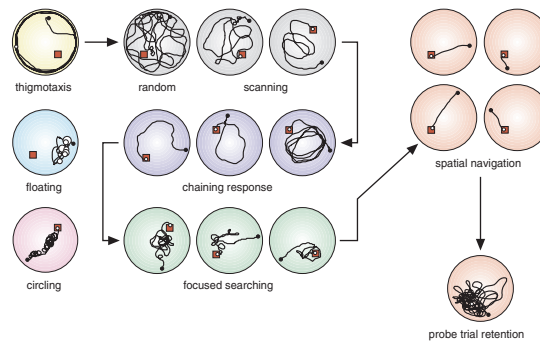
Variants of the Morris swim navigation task are widely used to assess spatial learning in genetically modified mice. However, mutations affecting procedural components of learning, behavioral flexibility or motivation may interrupt learning at early stages, long before spatial navigation becomes critical. We have used a standardized watermaze procedure for most of our strain comparisons and studies of genetically modified mice conducted during the past 15 years. Using principal component analysis and 120'240 tracked swim paths from 4008 mice, we evaluate a range of experimental parameters across different strains and mutations, and group them according to their ability to quantify particular escape strategies. We find that watermaze experiments provide a wealth of information about the behavioral abilities of mice. However, careful analysis and suitable control experiments are necessary to avoid misinterpretations and fully exploit this information.

## 1 4008 mice and 60 mutations were tested in a standardized watermaze procedure

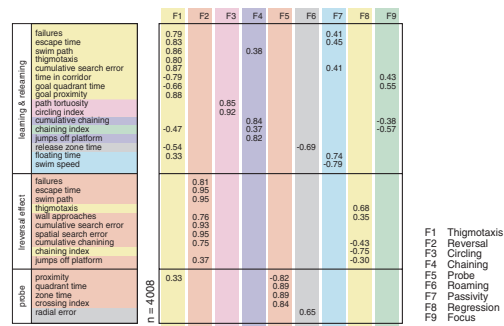


## 2 Appropriate variable combinations can capture learning stages and strategies

Various escape strategies and swim patterns are observed during watermaze learning:



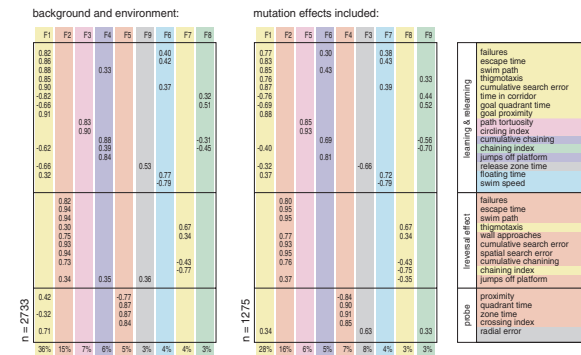
Principal component analysis relates variables to strategies and swim patterns:



Principal component analysis on variables assessing training, probe trial, and reversal effect (performance drop due to relocation of the goal) extracts 9 factors, accounting for >80% of total variability. Escape performance is mainly determined by thigmotaxis (wall hugging) and passivity. It remains largely unaffected by the transition from scanning to serial and spatial strategies. Measures of escape performance have little predictive value for the precision and intensity of searching during a later probe trial. Quantification of searching behavior during a probe trial may alone underestimate the degree of spatial learning. Mice with a strong reversal effect do not necessarily exhibit clear searching during the probe trial (and vice versa).

## 3 Biased environment or genetic background could easily mimic a large mutation effect

Subsets with and without mutation effects share same factor structure ...



... and parametric space:

