Depth Learning: How zebrafish brains come to explore and balance in the water column.
Why zebrafish move when they do.

How zebrafish come to climb.

How zebrafish explore depth.
Why do zebrafish move when they do.

How do zebrafish explore depth.

How do zebrafish come to climb.
Why do zebrafish move when they do?

or

Bout timing

Ehrlich & Schoppik 2017a
Buoyant Force

Gravity

Buoyant Force

\( \theta \)
Active equilibrium
Point $\Theta_0^{\Theta_0}$
Buoyant Force

Gravity

Buoyant Force

\[ \theta \]
1. Bouts correct destabilization.

2. As they develop, larvae come to bout preferentially when unstable.
Why zebrafish move when they do.

How zebrafish explore depth.

How zebrafish come to climb.
Why do zebrafish move when they come to climb.

How do zebrafish explore depth.

How zebrafish come to climb.
Bout trajectory (deg)

Pre-bout orientation (deg)
1. Navigate

2. Balance

Explore
Righting

point

Set
Fish make bouts when unstable. Each bout partially returns the fish to its preferred posture. Recap:
What happens at night?
Posture (deg) vs. Bout rate (Hz)

Day: []  Night: []
How can fish maintain posture given that they make fewer bouts at night?
1. Fish make bouts when unstable.
2. Each bout partially returns the fish to its preferred posture.
3. Sensitivity to posture isn't different at night.
4. Amazingly, fish are better able to return to their preferred posture at night.

Summary:
Why zebrafish move when they do.

How zebrafish come to climb.

How zebrafish explore depth.

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Why zebrafish move when they do.

How zebrafish explore depth.

How zebrafish come to climb.
An animal can achieve a goal with redundant movements.
Hypothesis: locomotion develops because preferences are learned

Movement D
Movement C
Movement B
Movement A

Goal

Berger & Adolph, 2007
Sporns & Edelman, 1993
Fish can climb using their bodies or fins.

Swimming matures via acquired preference for fins.

Development
% bouts with attack angle >15°
Acquire a preference for fin use?
Why zebrafish move when they do.

How zebrafish come to climb.

How zebrafish explore depth.

do.

Why zebrafish move when they do.
Why zebrafish move when they do.

How zebrafish come to climb.

How zebrafish explore depth.