

'Human Factors' in Tech Diving

The role of non-technical skills in managing 'risk' in diving



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tekdive europe '19



Lust4Rust & SHOCKAWAY!



Risk, Uncertainty and Dilemmas

*"...To try is to risk
But risks must be taken
hazard in life is
The person who
has nothing, is
He may avoid success
But he cannot
Chained by his
forfeited all freedom
Only a person who
The pessimist
The optimist
And the realist*

- To Risk. William Arthur Ward

Risk

*“...the probability that a particular adverse event occurs during a stated period of time, or results from a particular challenge. As a probability in the sense of statistical theory, **risk obeys all the formal laws of combining probabilities.**”*

1983 -RoyalSociety



Risk - Multiple Meanings

- *Risk as a hazard*
- *Risk as probability*
- *Risk as consequence*
- *Risk as potential adversity or threat*
- *Context Specific*

“Safety is not the absence of accidents or incidents, rather the presence of barriers and defences and the capacity of the system to fail safely.”



Todd Conklin, Los Alamos

Barriers/Defences

System Design

Technical Skills

Non-Technical Skills/Human Factors

Attitude

Knowledge/Experience

Failing Safely

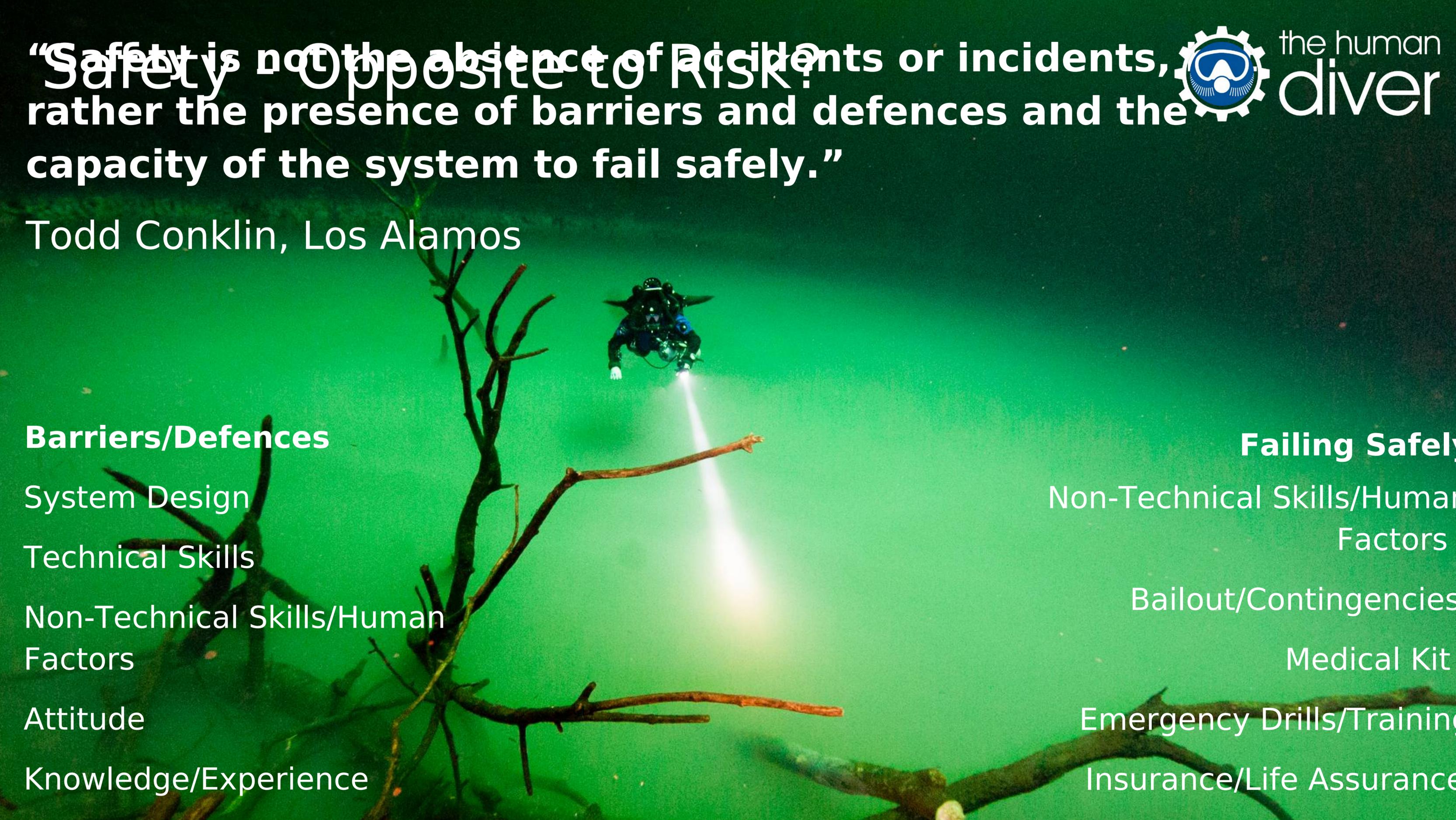
Non-Technical Skills/Human Factors

Bailout/Contingencies

Medical Kit

Emergency Drills/Training

Insurance/Life Assurance



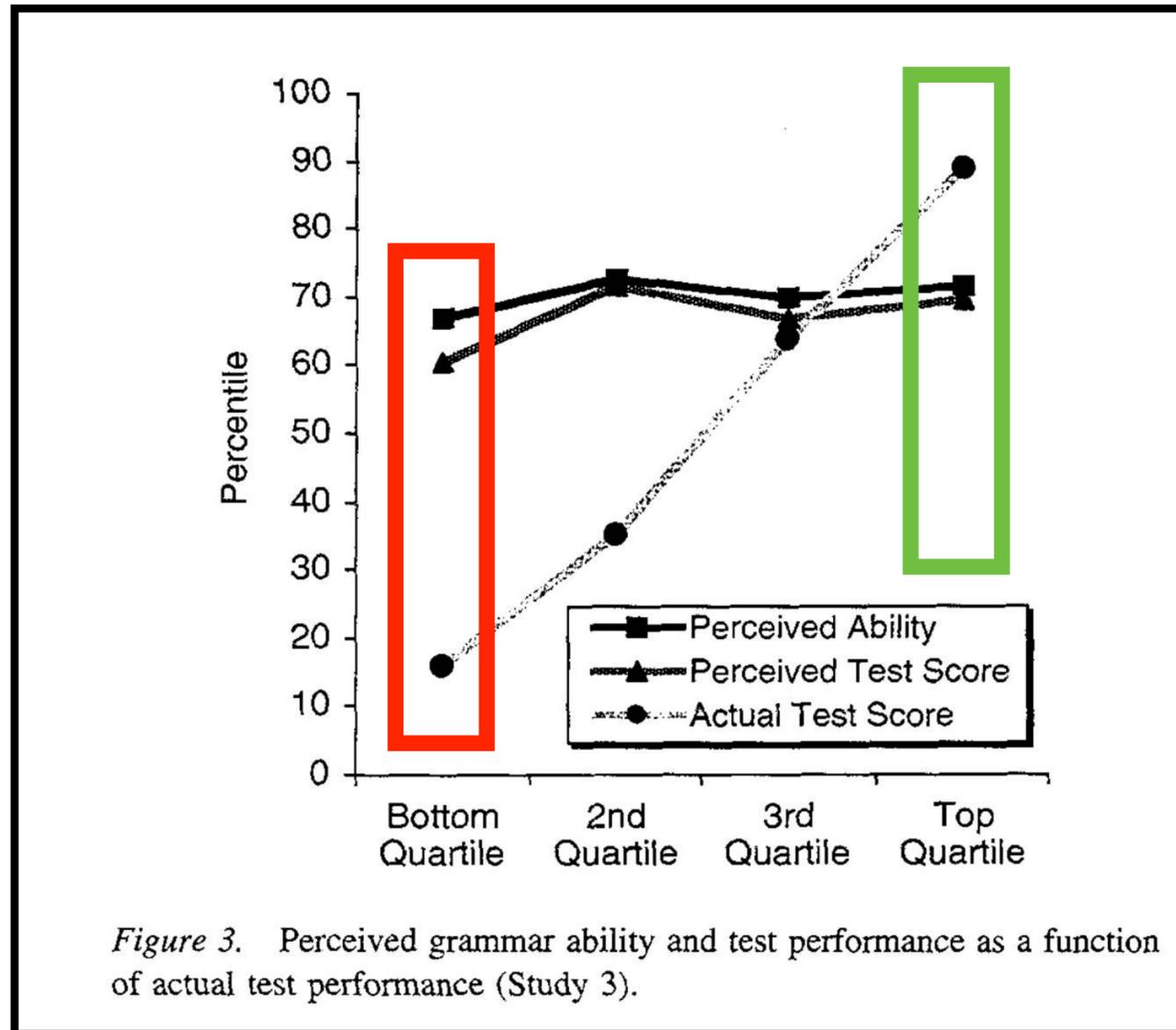
Perceived Risks

Table 3. Ordering of perceived risks for 30 activities and technologies. The ordering is based on the geometric mean risk ratings within each group. Rank 1 represents the most risky activity or technology.

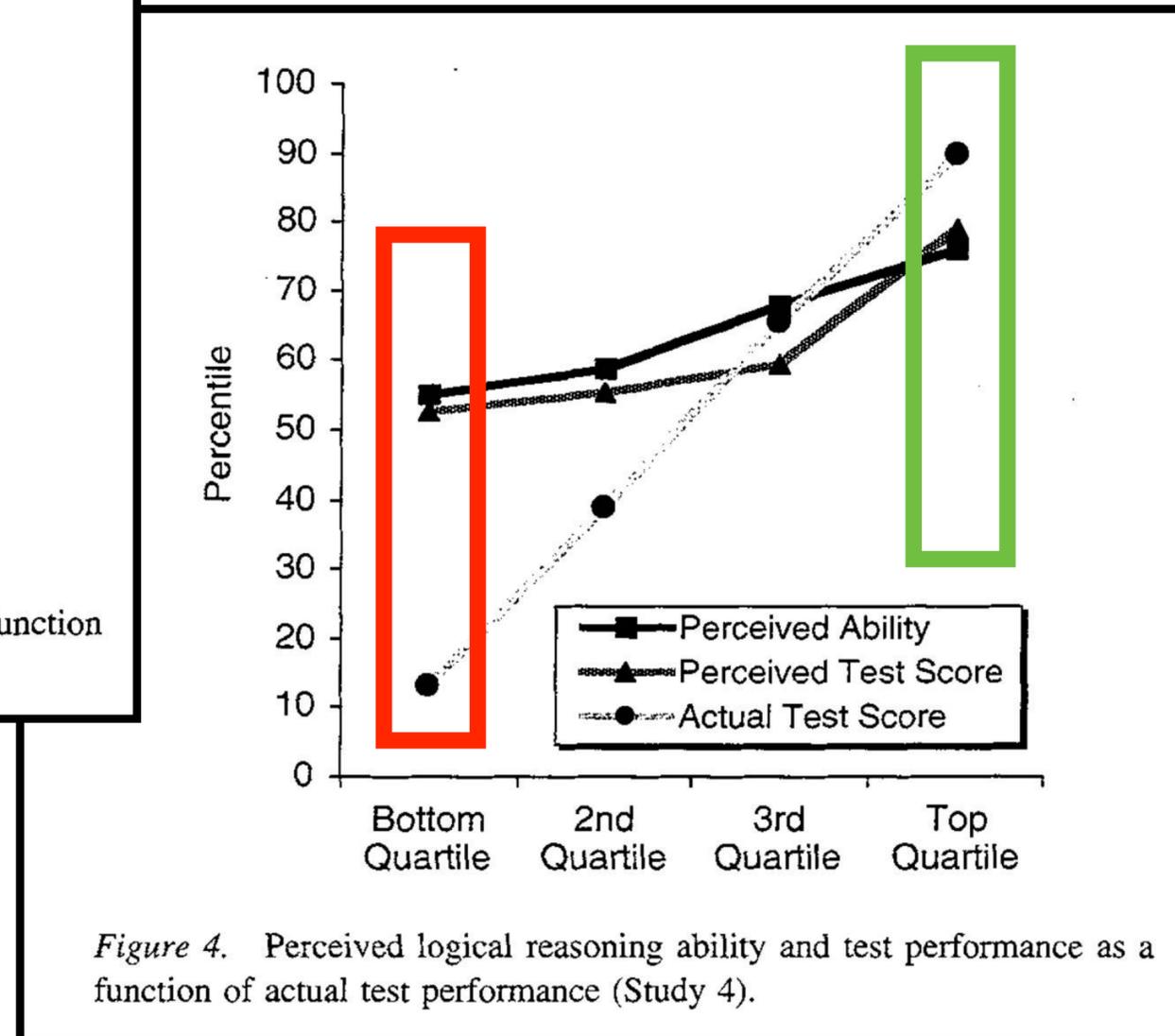
Activity or Technology	League of Women Voters	Active College Students	Club Members	Experts
Nuclear power	1	1	8	20
Motor vehicles	2	5	3	1
Handguns	3	2	1	4
Smoking	4	3	4	2
Motorcycles	5	6	2	6
Alcoholic Beverages	6	7	5	3
General (private) aviation	7	15	11	12

Slovic, P. (1987). Perception of risk posed by extreme events. *Science*, 236(4799), 280–285.

Incompetent and Unaware



Grammar



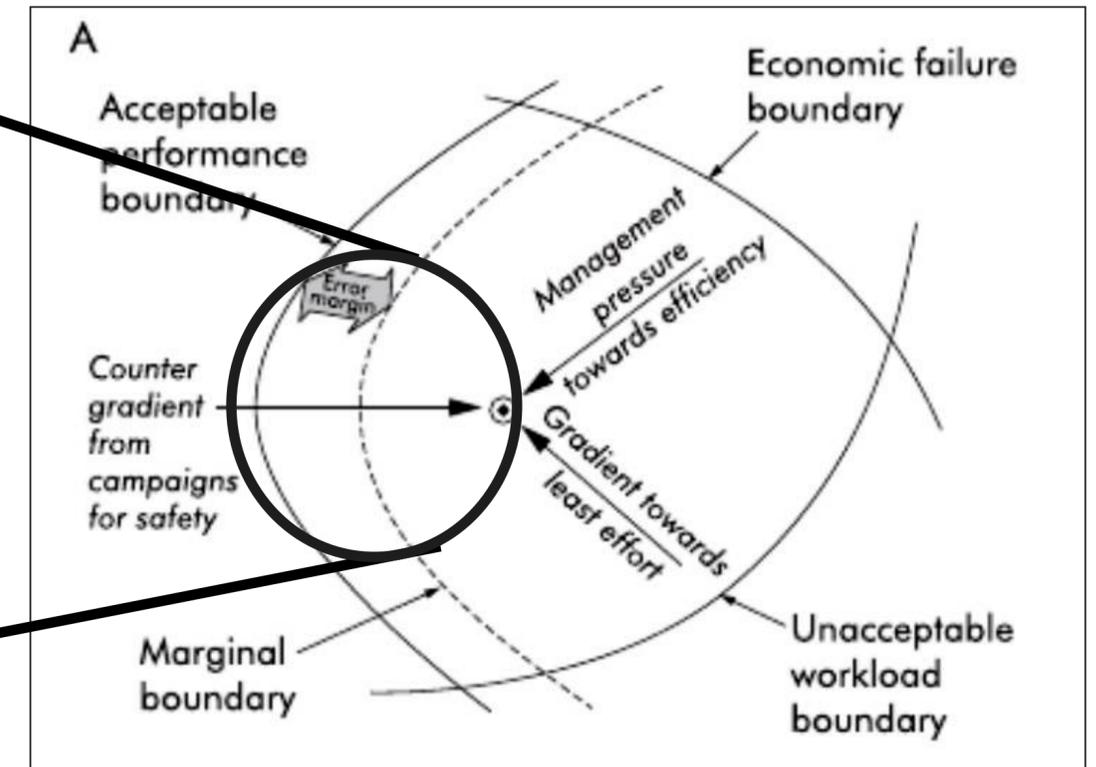
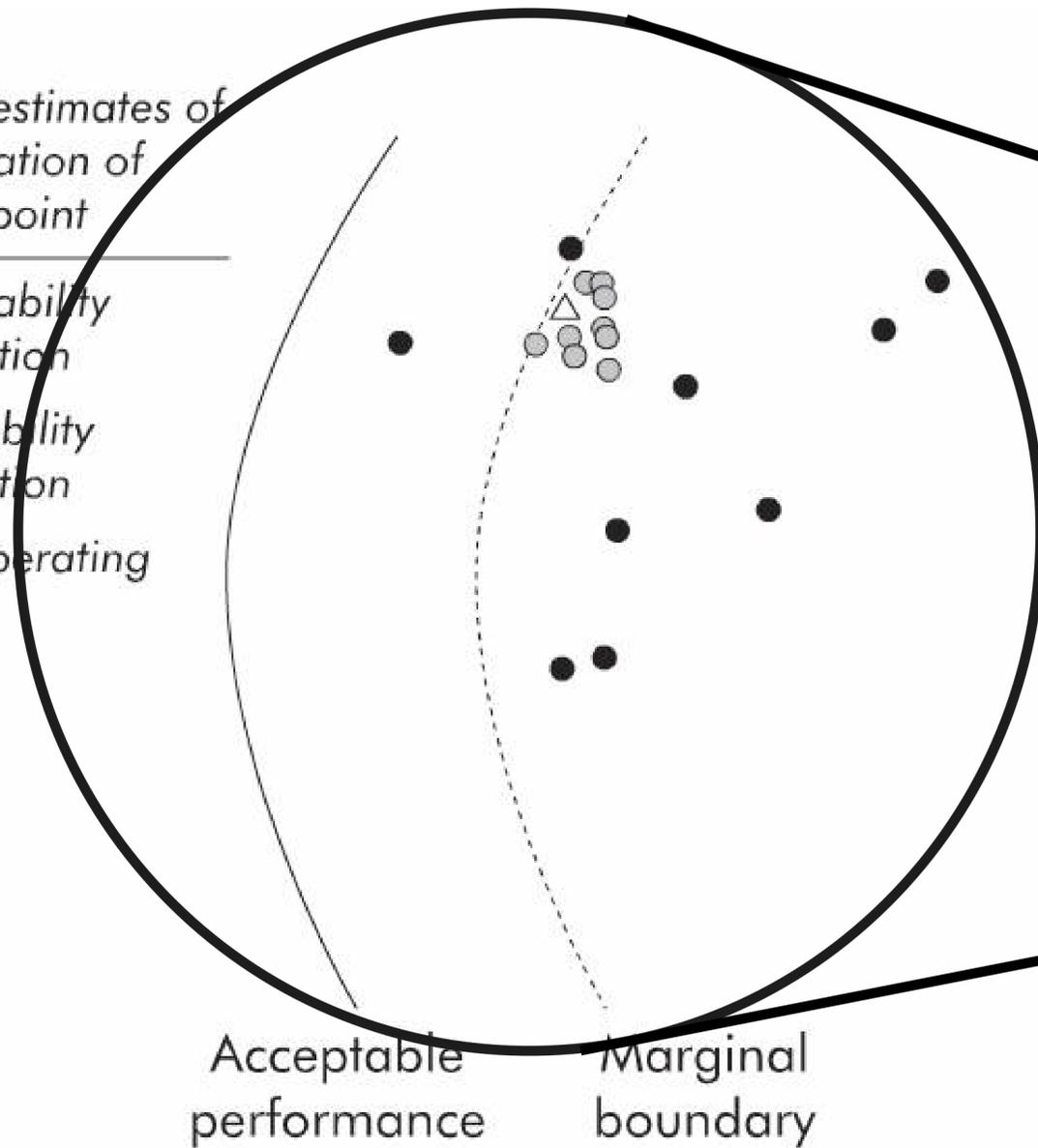
Logical Reasoning

Unskilled and unaware of it: how difficulties in recognizing one's own incompetence lead to inflated self-assessments.
Dunning, Kruger. 1999

Uncertainty: Self and the Situation

Individual estimates of current location of operating point

- High reliability organization
- Low reliability organization
- △ Actual operating point



Modified from Rasmussen

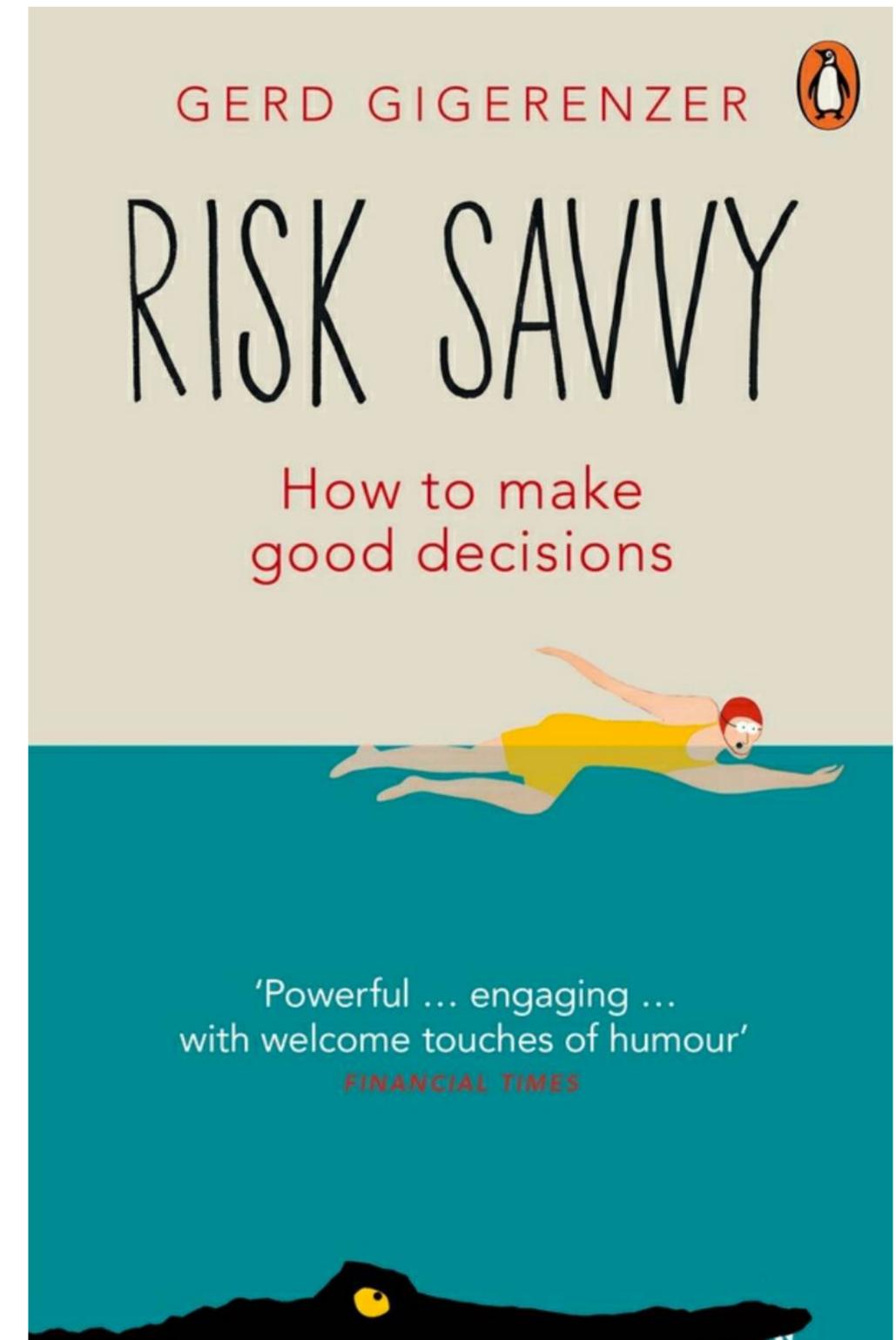
Copyright © 2004 by R.I. Cook

Cook, R, & Rasmussen, J. (2005).

"Going solid": a model of system dynamics and consequences for patient safety.

Uncertainty

- Zero Risk Illusion
 - Large numbers create illusion of certainty
- The 'Turkey Illusion'
 - The longer something happens, the more certain we become that it is certain



Situational Awareness

The ability to **FOCUS** on what is important and / or relevant...

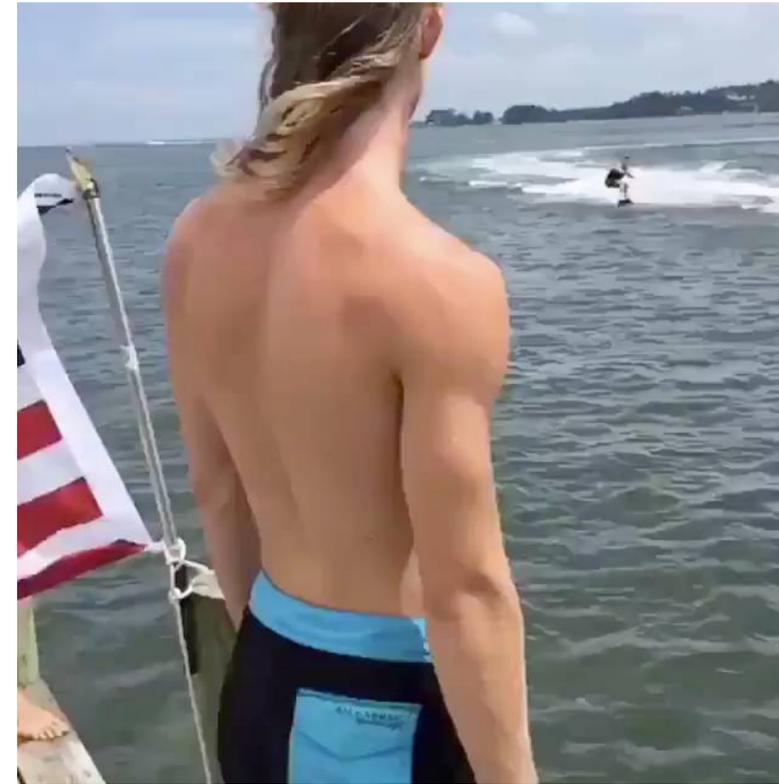
...whilst being conscious of, and taking into account, the limitations of focussed attention



Situational Awareness

The ability to **FOCUS** on what is important and / or relevant...

...whilst being conscious of, and taking into account, the limitations of focussed attention



We only see those things which we are expecting to see...

Frame 1



50%

Frame 2

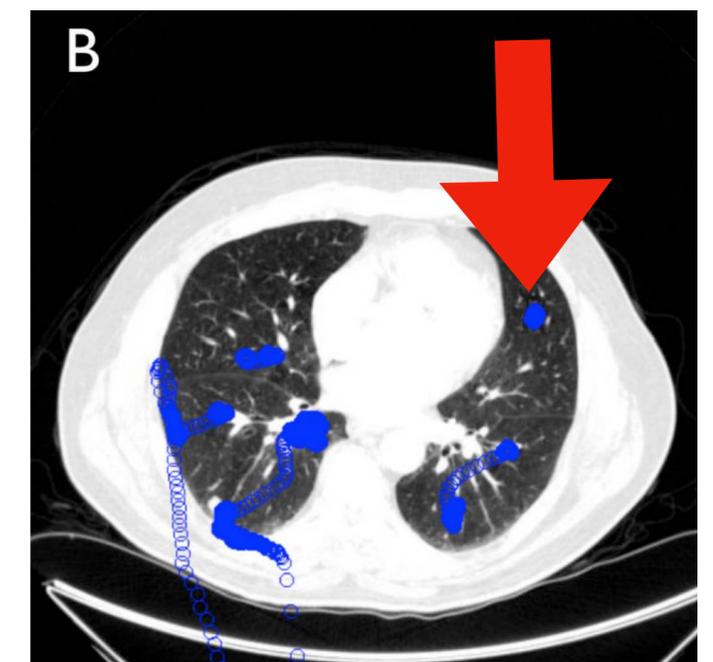


75%

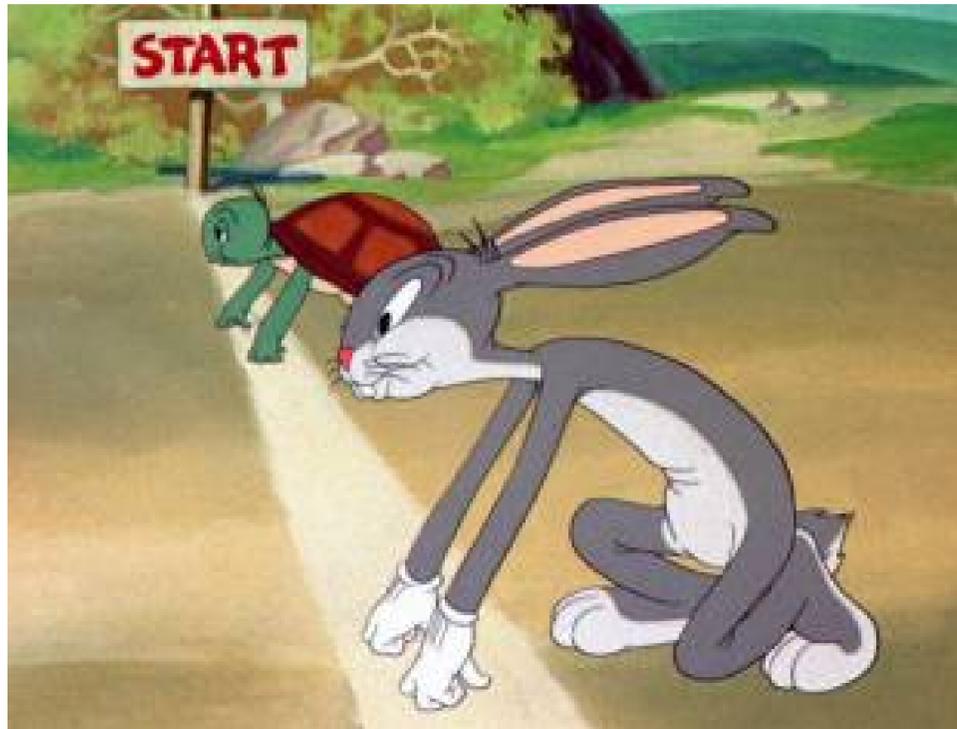
Frame 3



100%



Decision Making



- System 1 / System 2
- Naturalistic Decision Making
- Mental Models/Heuristics



Biases

What Should We Remember?

Recency Bias

Ambiguity effect

Availability heuristic

Belief bias

Conjunction fallacy

Default effect

Dunning-Kruger effect

Framing effect

Gambler's fallacy

Too Much Information

Not Enough Meaning



Blog article: <https://www.thehumandiver.com/blog/17-cognitive-biases>

Intuition can be correct but only if...

- There is regularity in the world
- You undertake lots of practice
- You get immediate feedback...



"Intuition is thinking that you know without knowing why you know. In general, confidence is a very poor cue to accuracy. Because intuitions come to your mind with considerable confidence and there is no guarantee they're right."

Thinking. Fast and Slow. Kahneman.

Intuition can be correct but only if...

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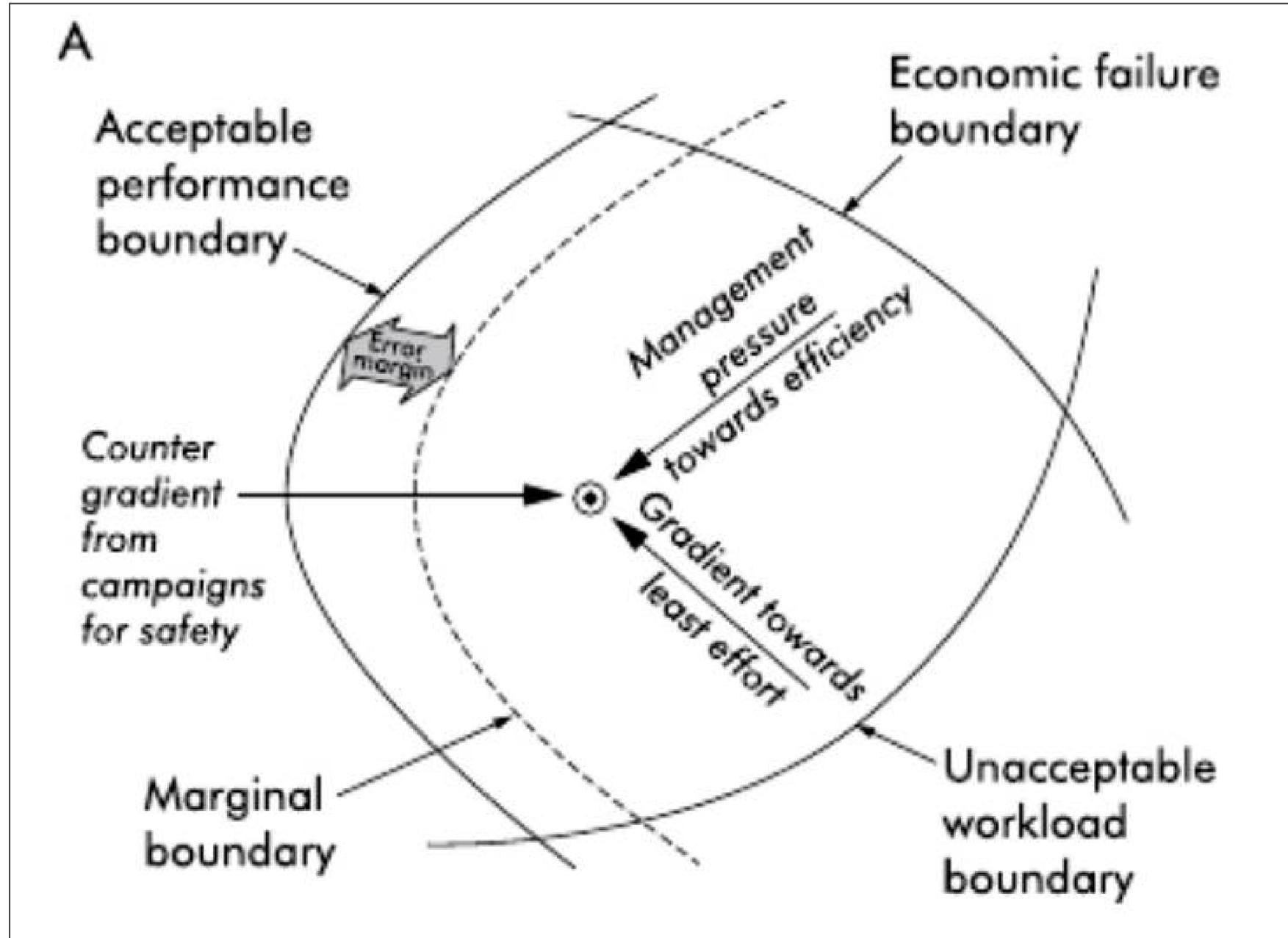
Otherwise we fill the gaps with
made-up stuff!



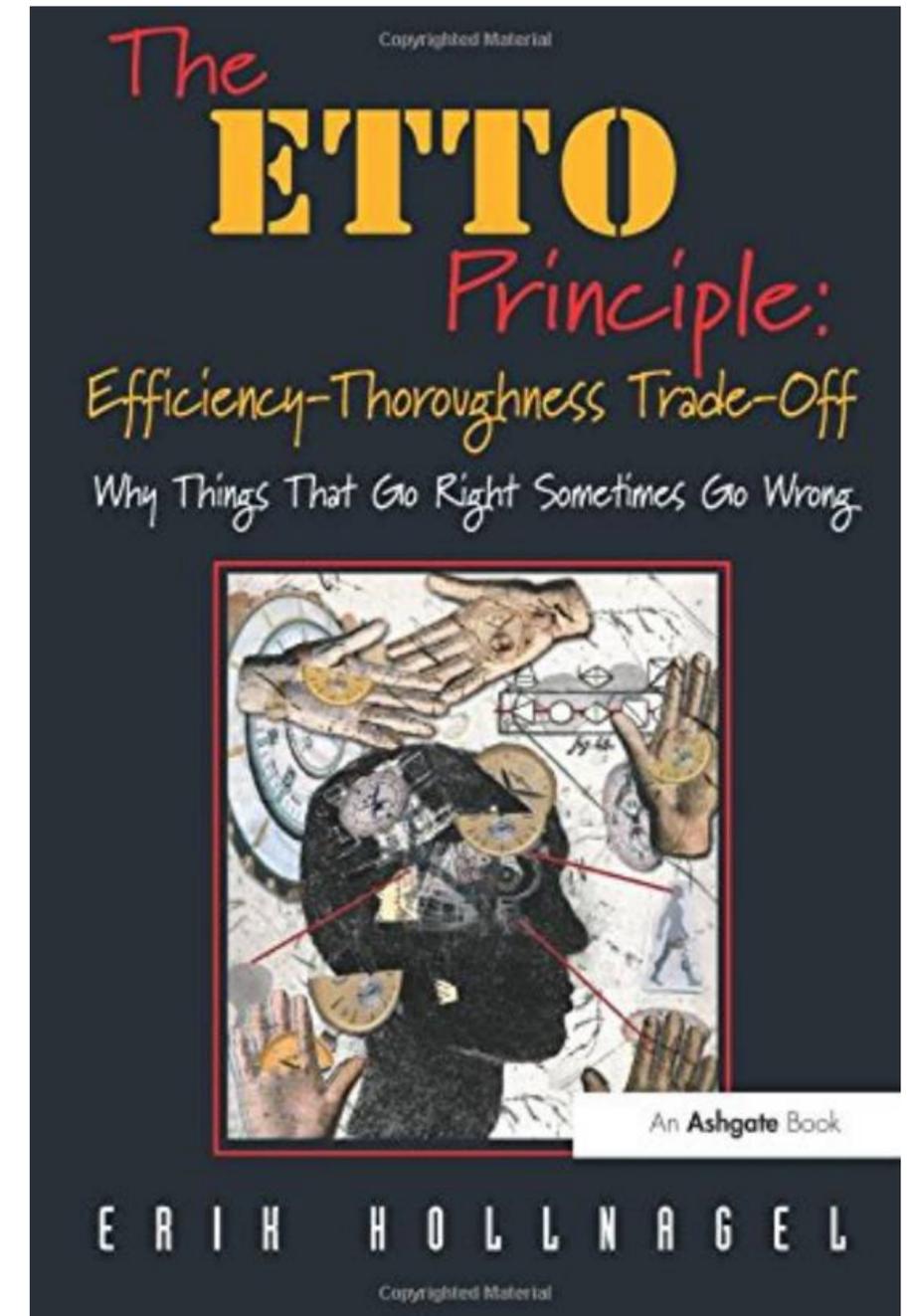
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Diving risks don't exist in isolation



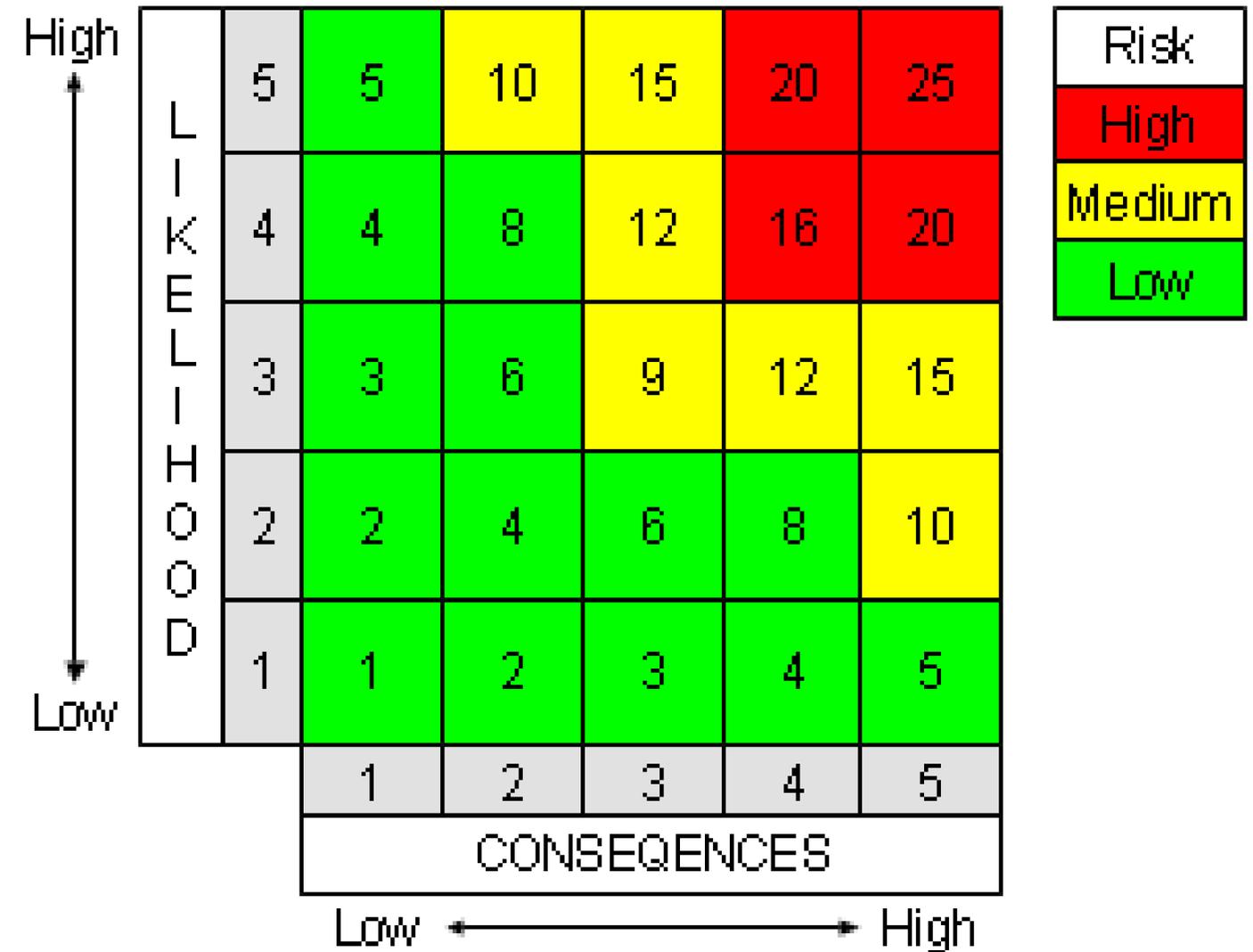
Cook, R, & Rasmussen, J. (2005). *Modified from Rasmussen*



Risk Management - Logical Approach

Where do you get the likelihood information from?

How many 'Greens' make a 'Red'?



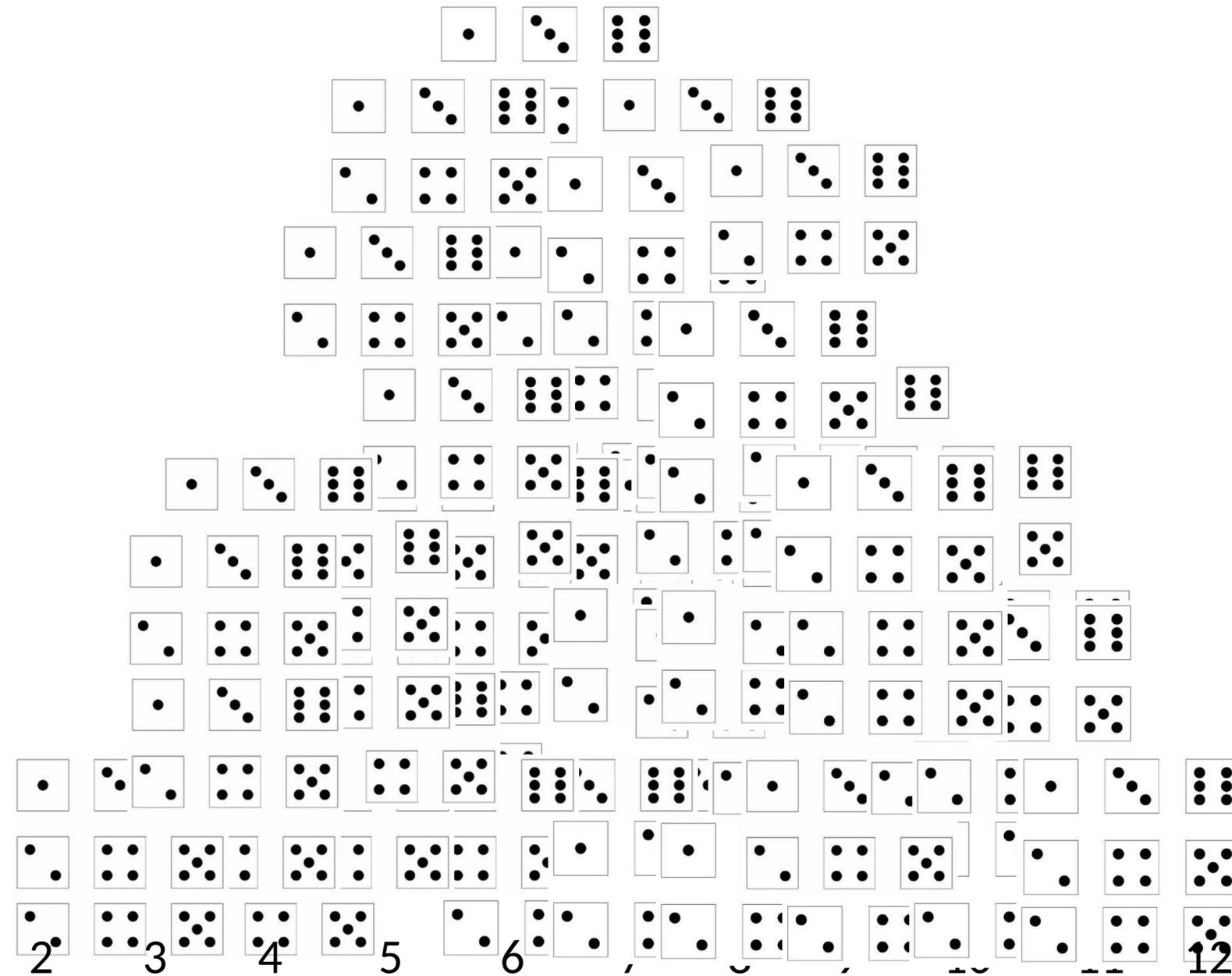
“The job of any human is to be able to predict with 100% accuracy what is going to happen next. Sadly though, this is an utterly impossible task so instead the human has to make a probability/possibility trade-off where they gamble on the million and one things that can possibly happen next against the one or two things that will probably happen next.”

Gambling...

Free Photoshop PSD file download - resolution: 1280x1024 px - www.psdgraphics.com

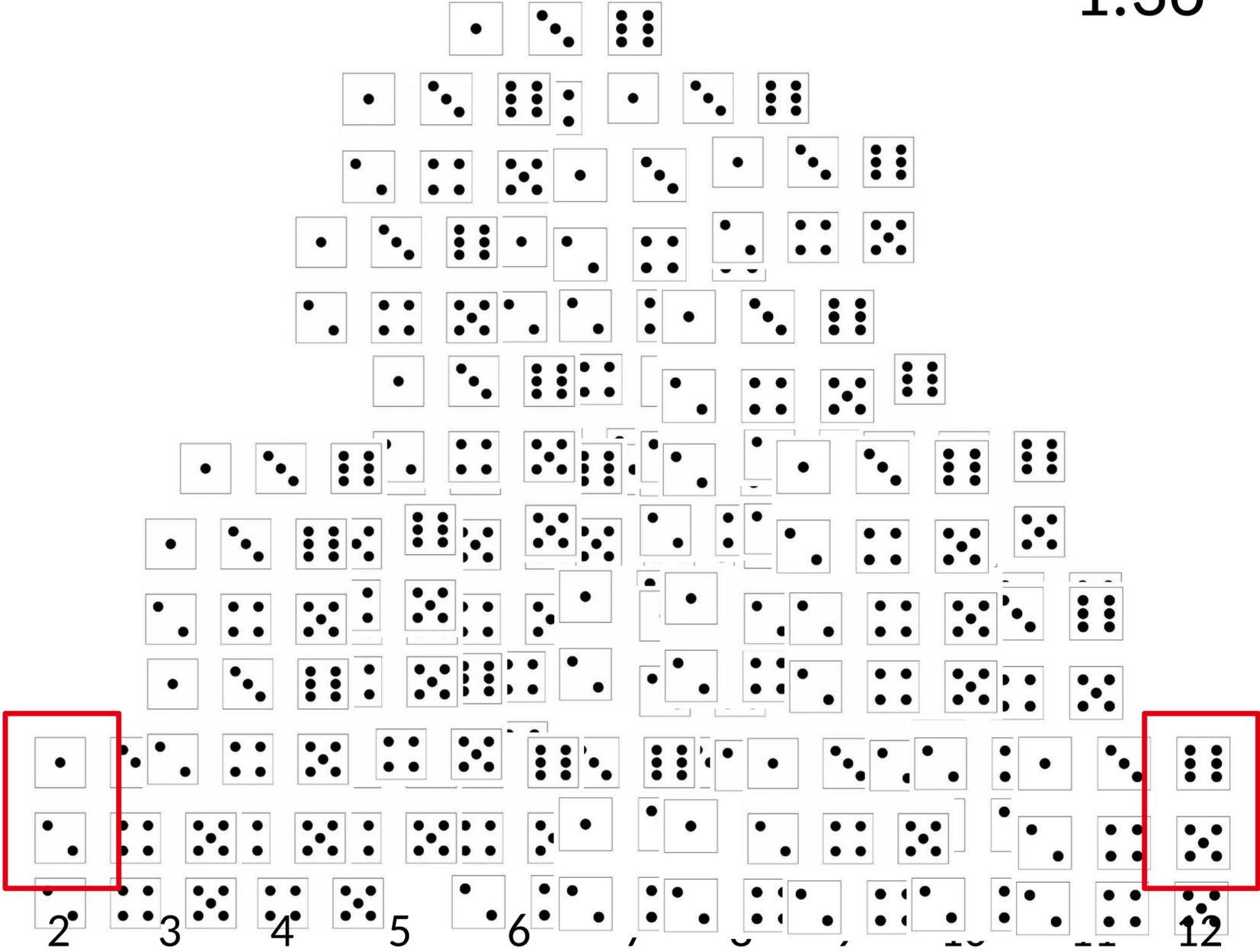


Gambling with two dice

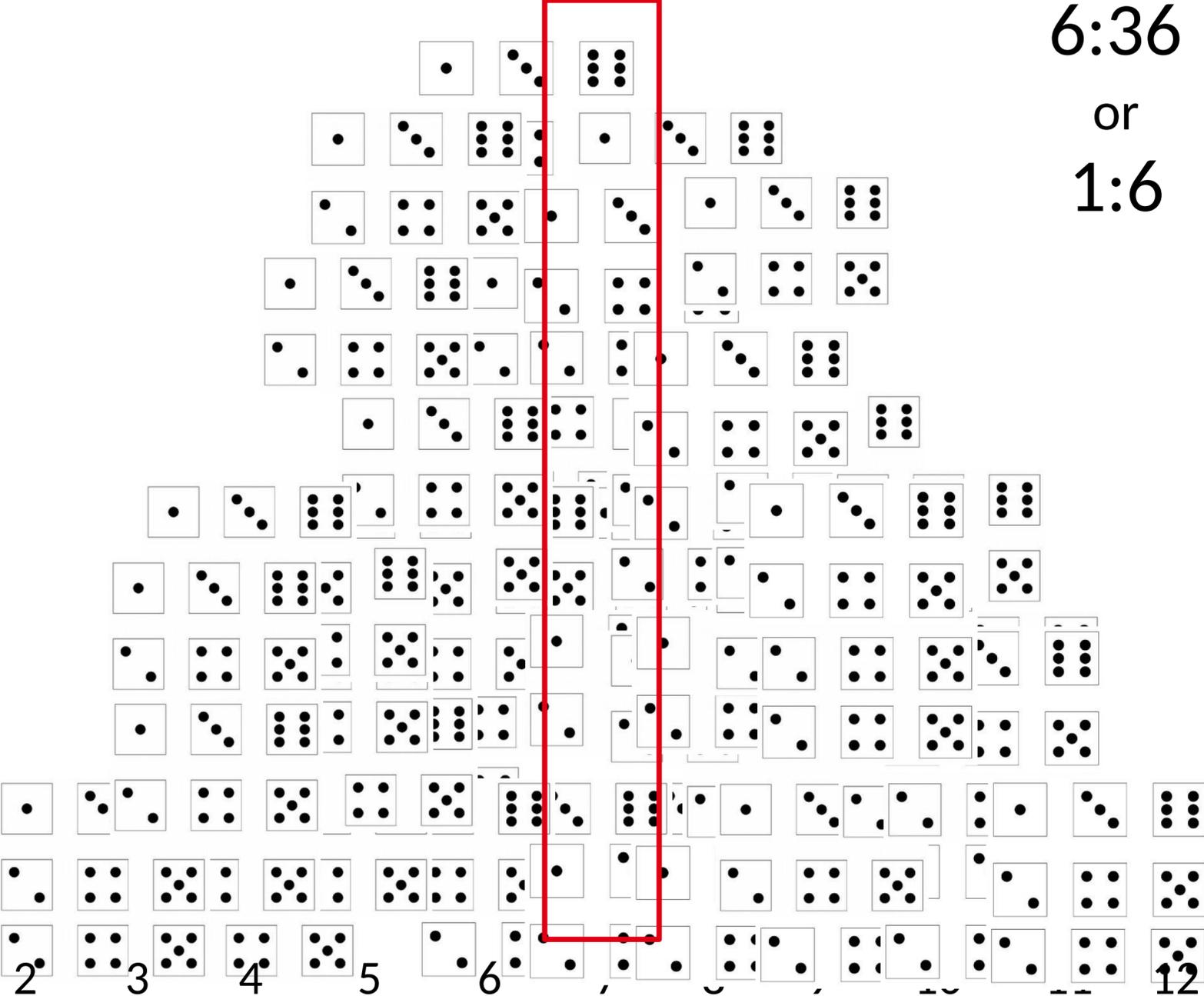


Gambling with two dice

1:36



Gambling with two dice

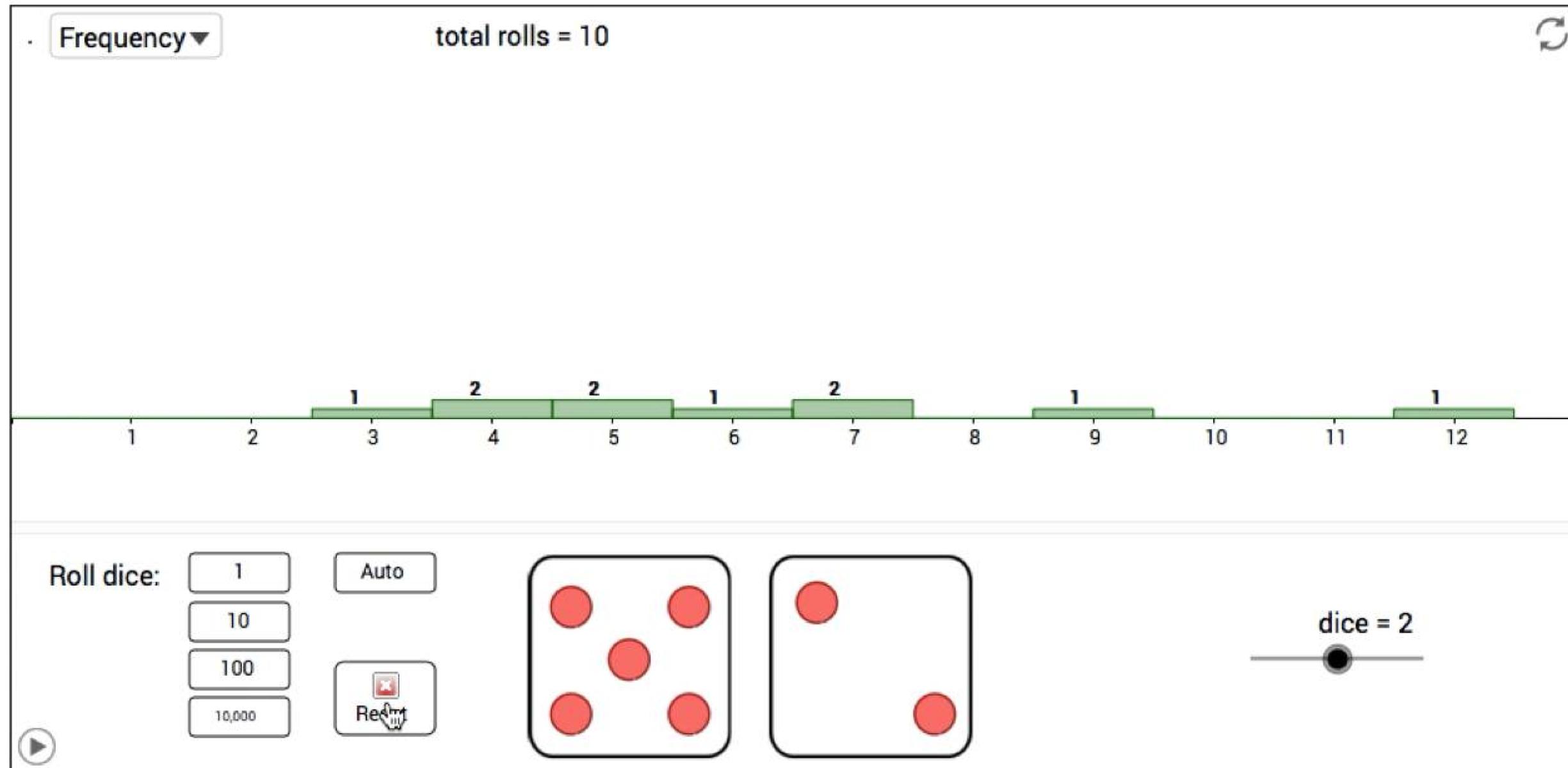


6:36
or
1:6

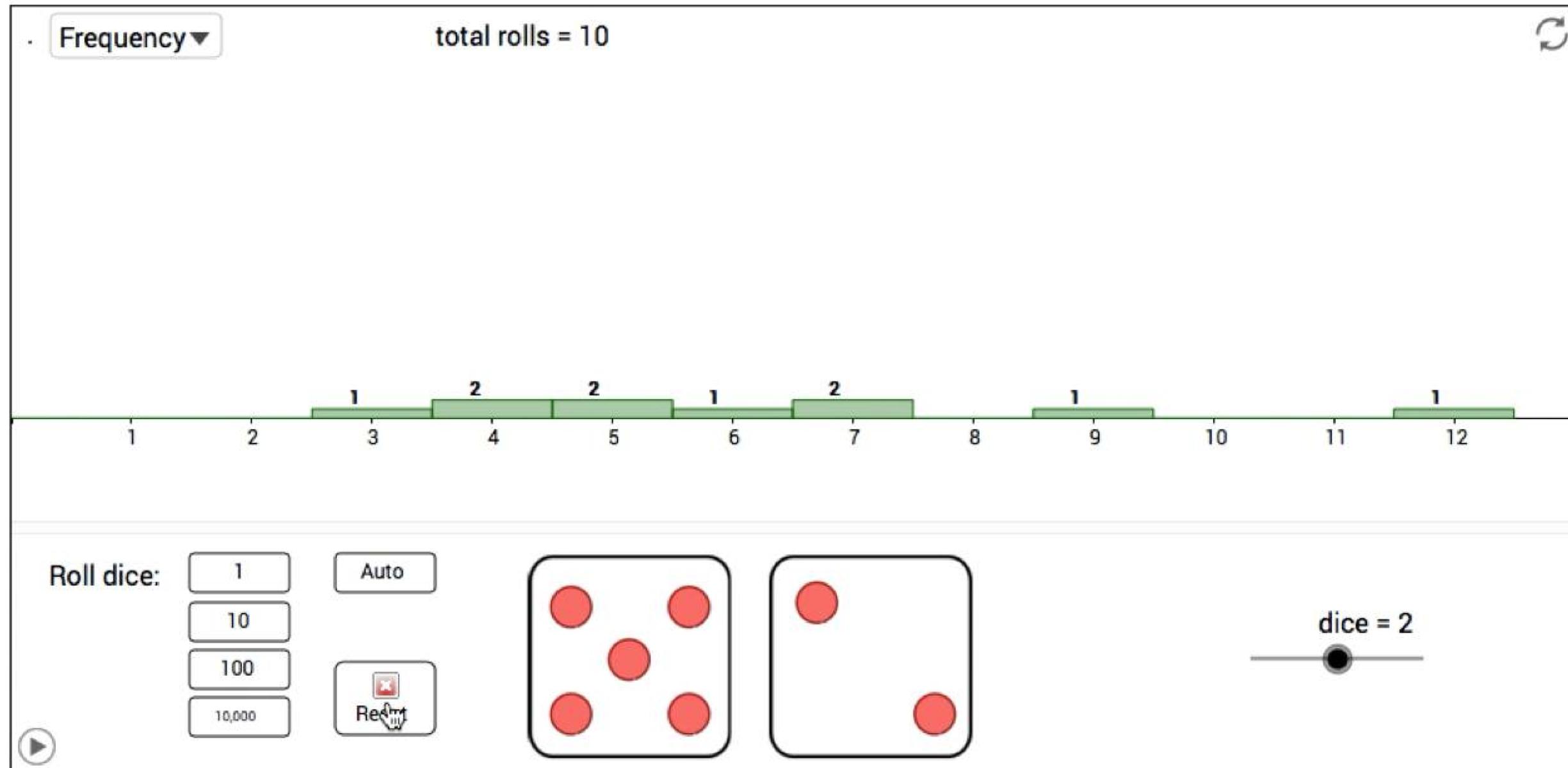
Large Numbers



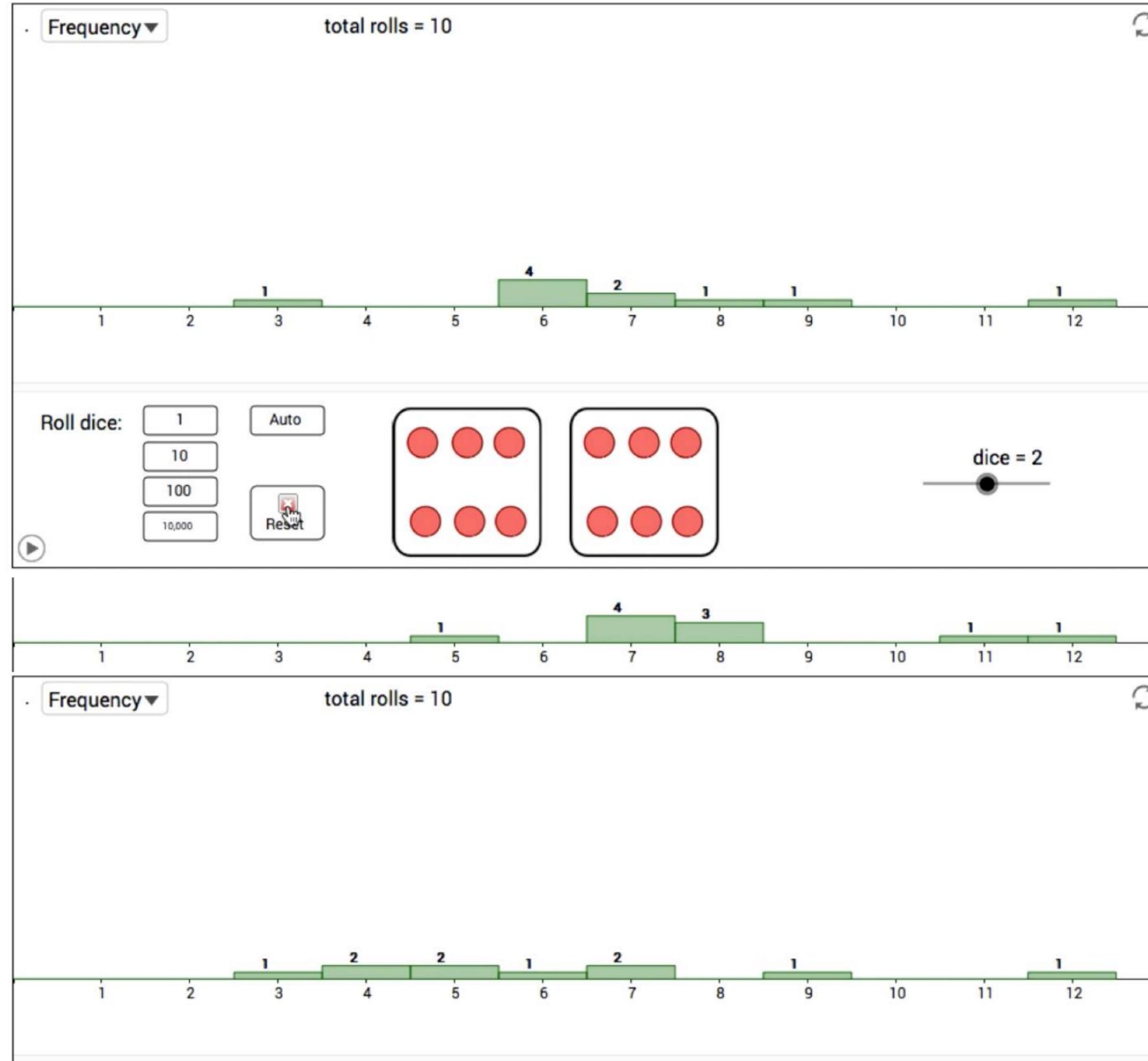
1 person, 2 dice



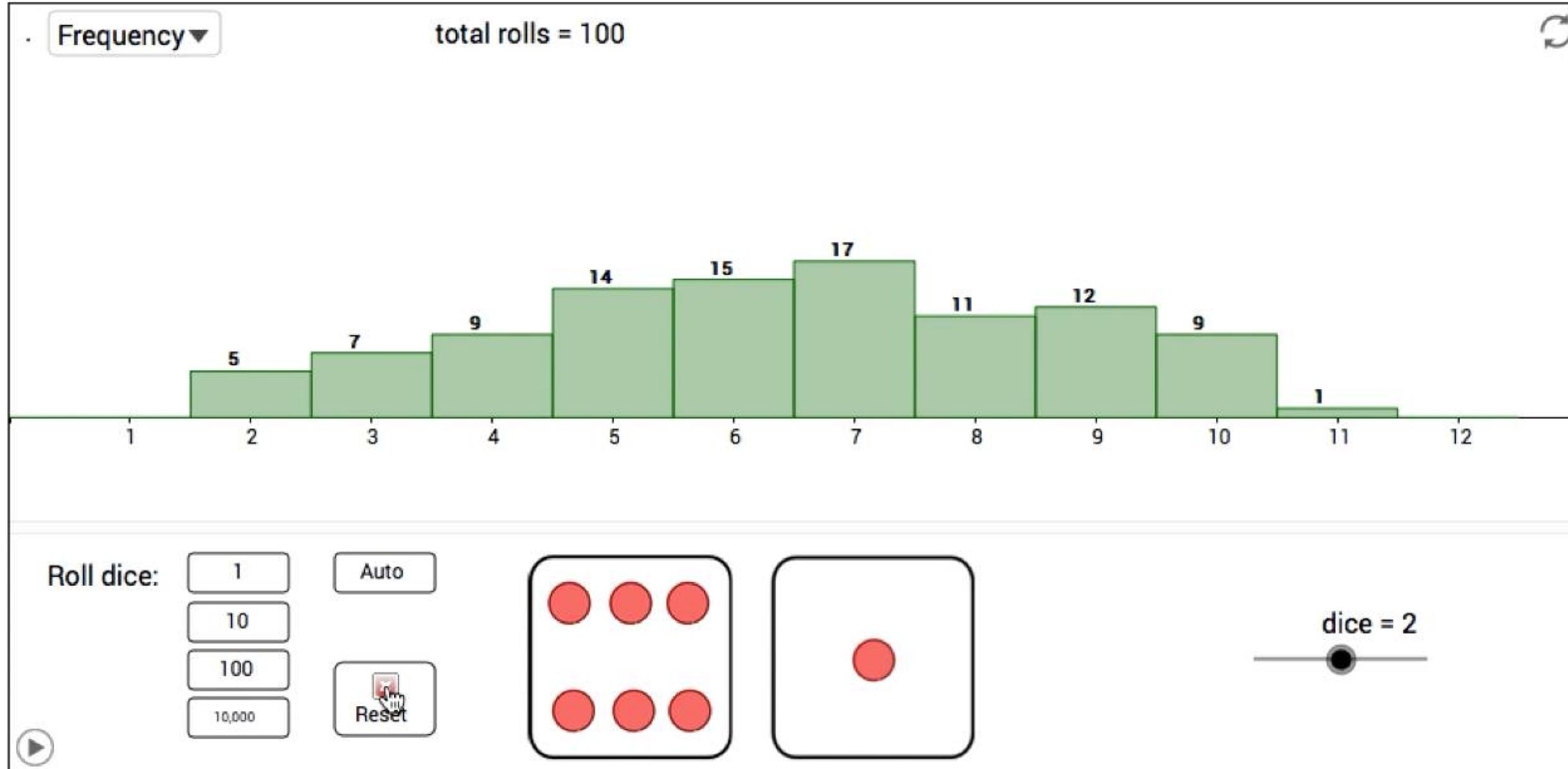
1 person, 2 dice



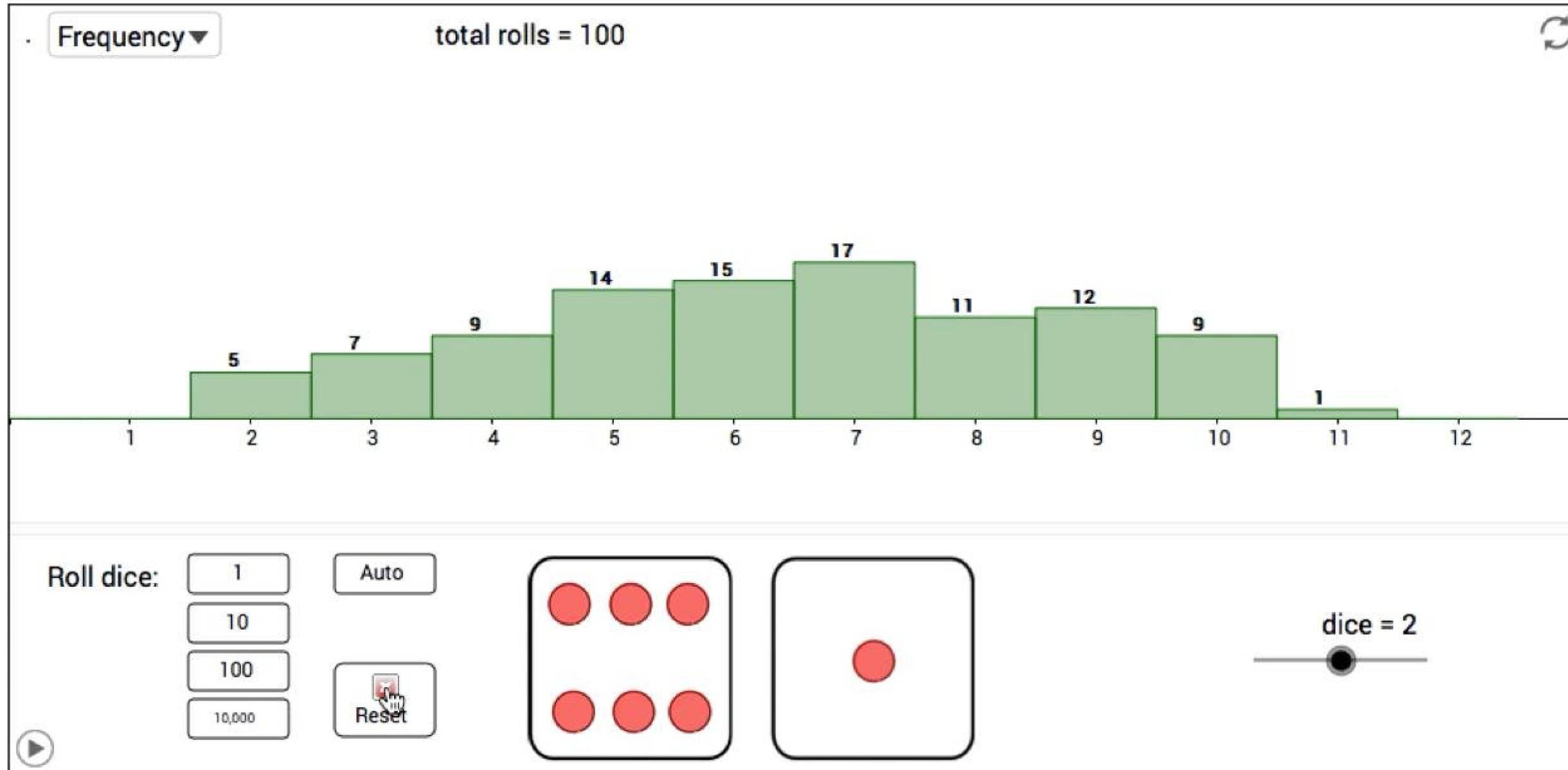
3 people, 3 experiences



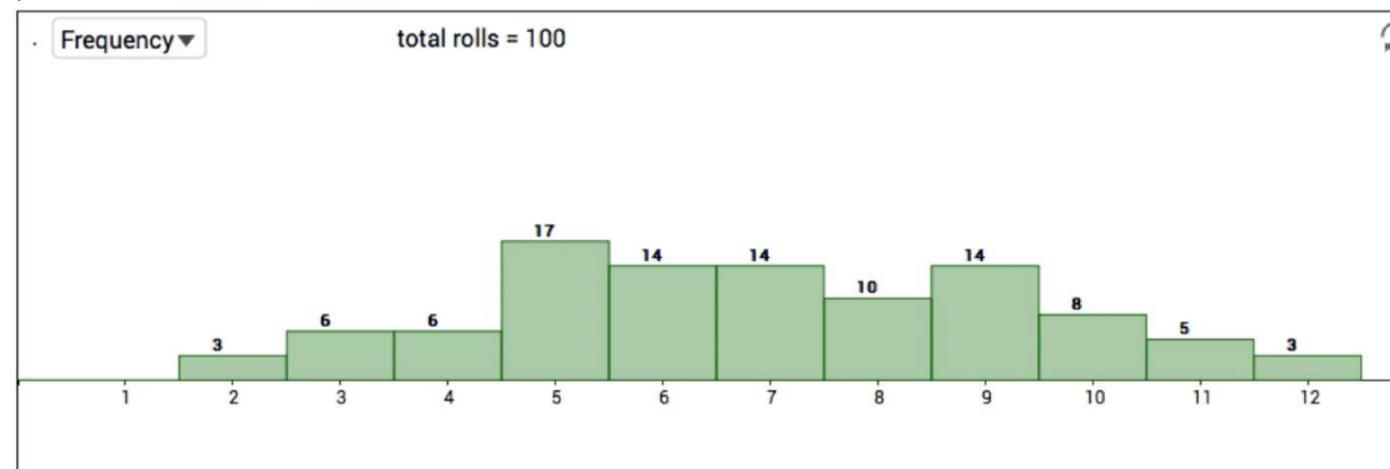
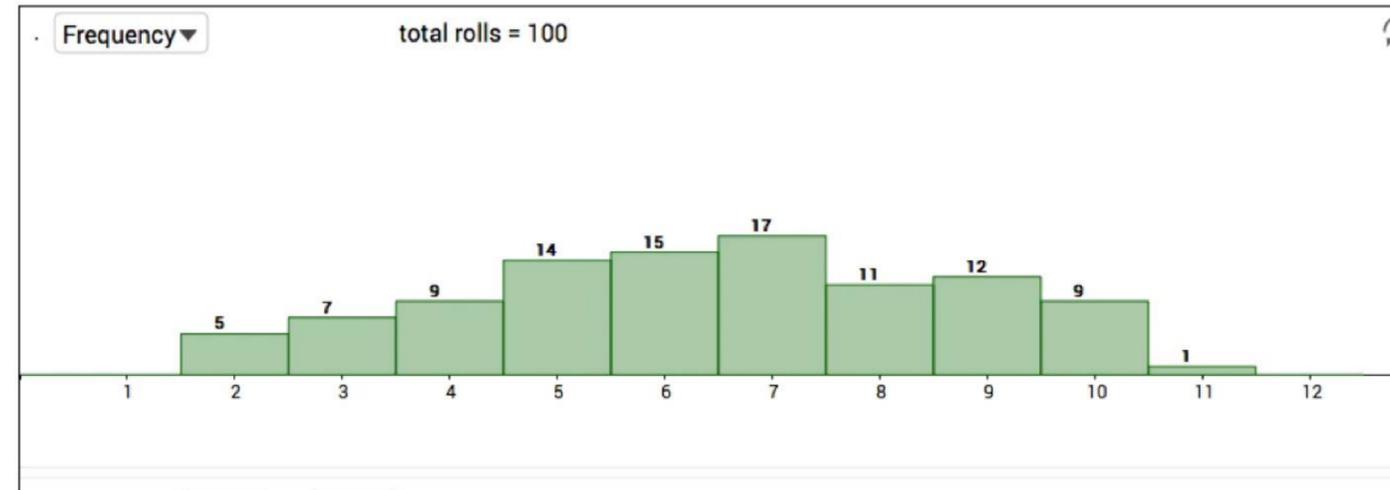
100 rolls...



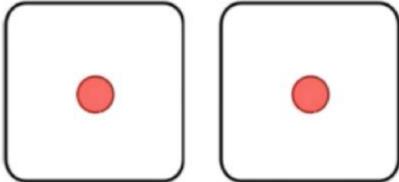
100 rolls...



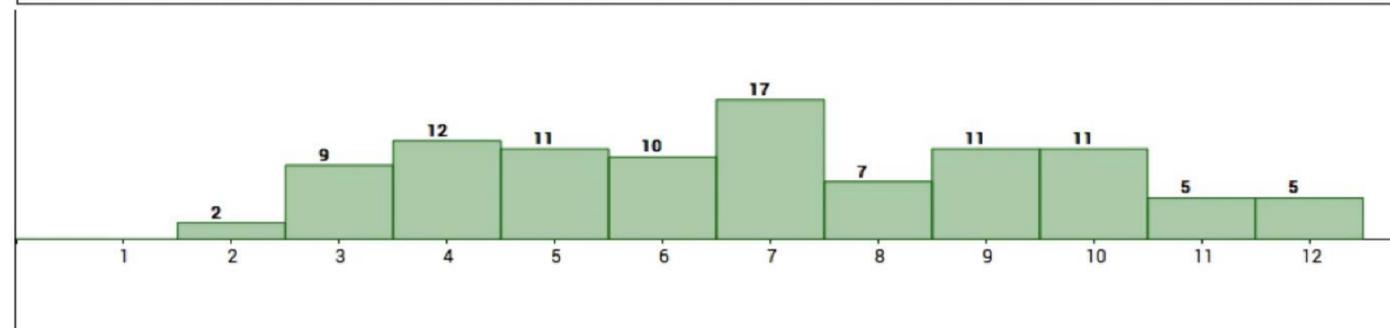
3 people, 3 closer experiences



Roll dice:



dice = 2

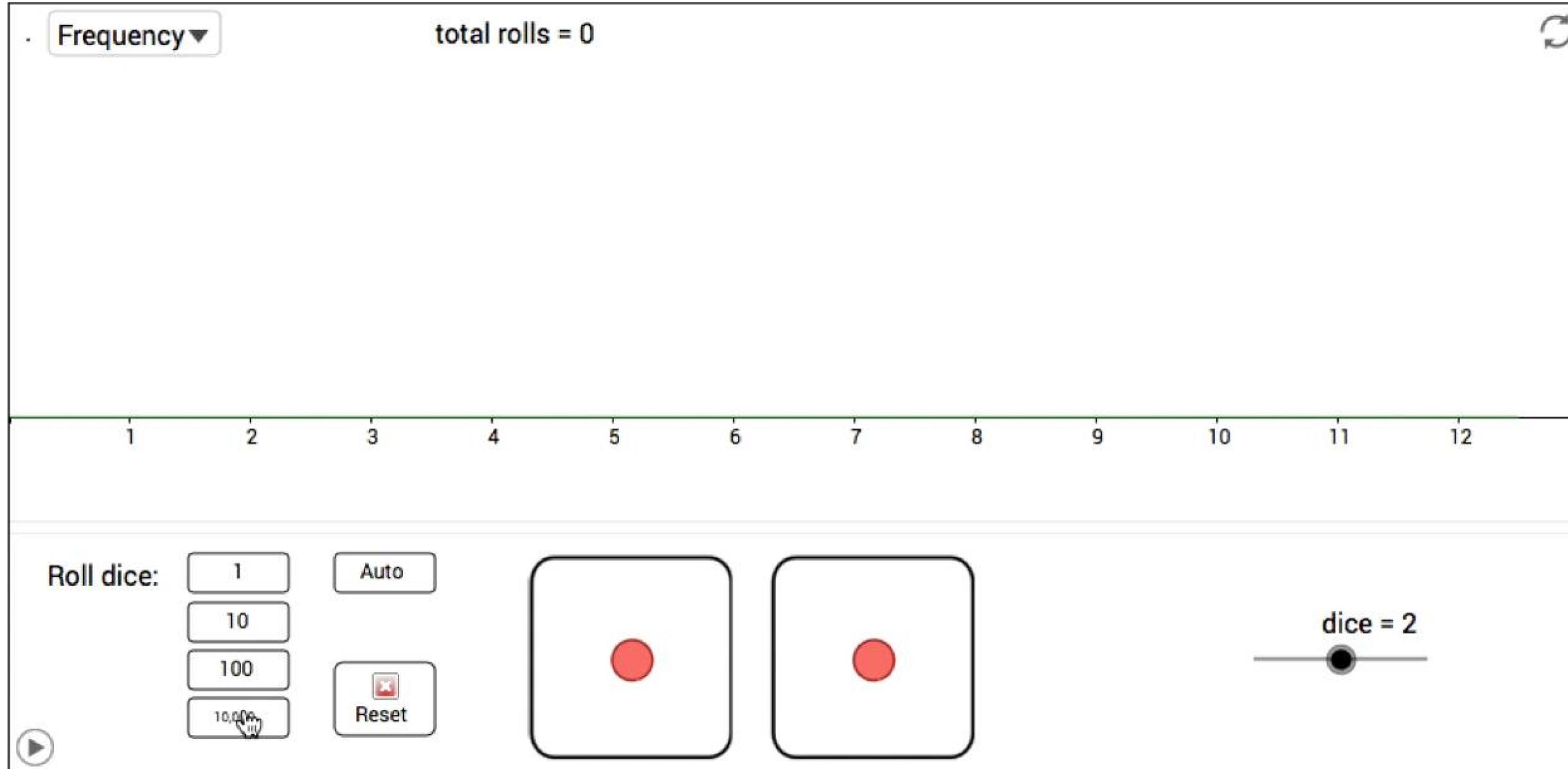


Roll dice:

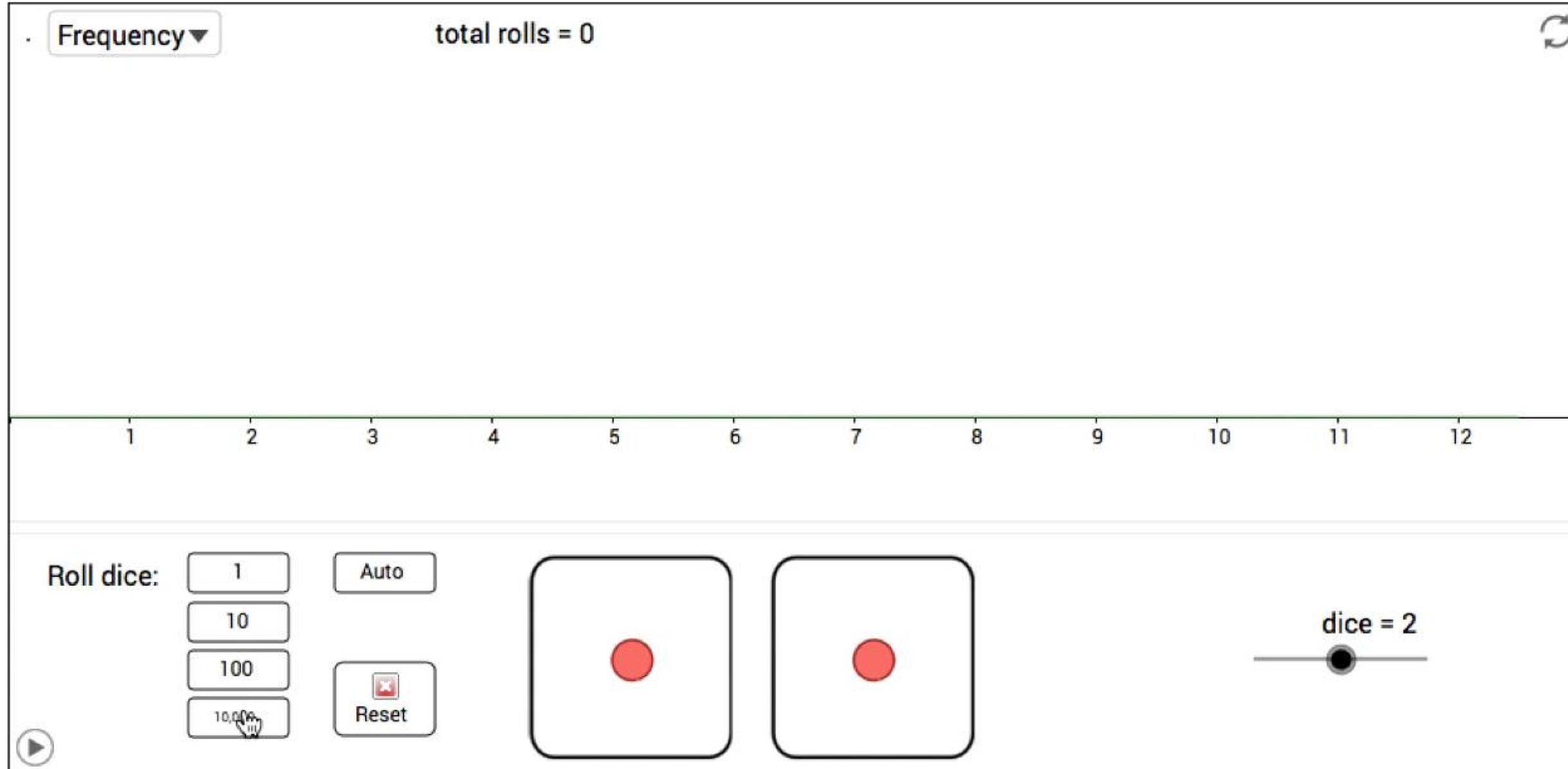


dice = 2

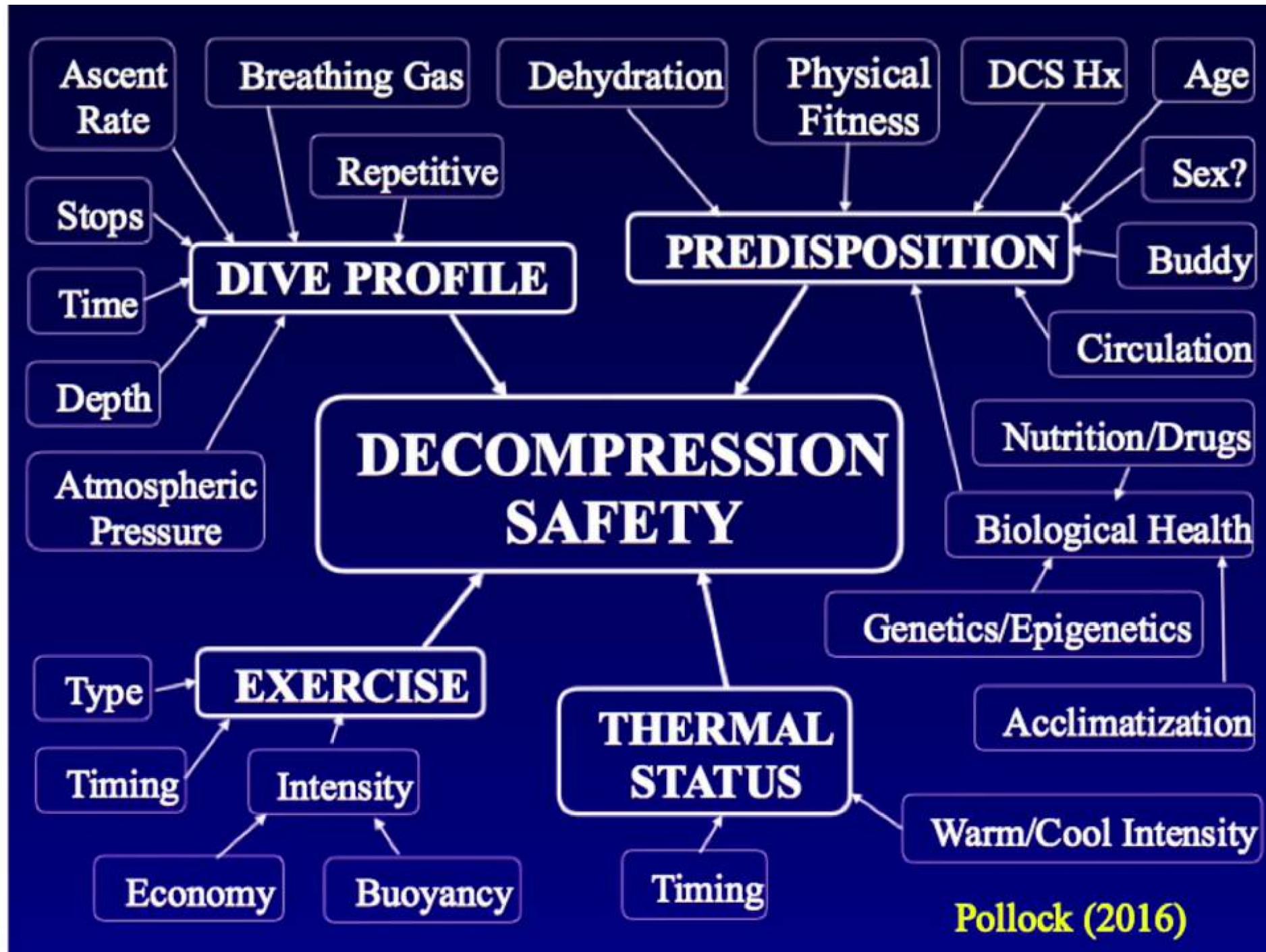
10 000 rolls...



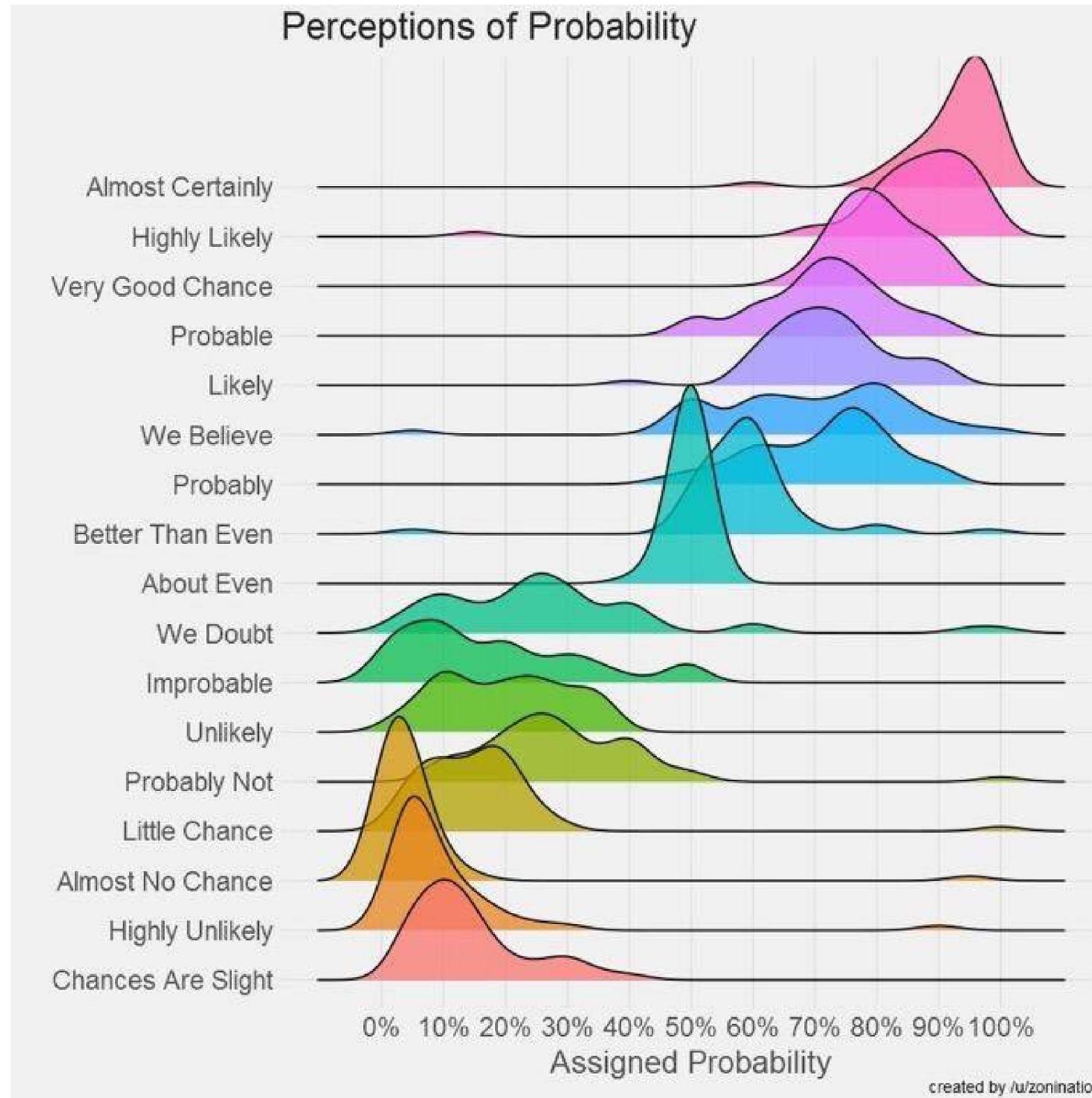
10 000 rolls...



How many variables (dice) in diving?



How we Communicate Risk is Important



Possibility?

DCS

Fatality

Totally running out of gas

Total electronics failure

Partial electronics failure

Bailing out and ascending
to surface

Hyperoxia

Hypoxia

Hypercapnia

Possibility?

DCS

Fatality

Totally running out of gas

Total electronics failure

Partial electronics failure

Bailing out and ascending
to surface

Hyperoxia

Hypoxia

Hypercapnia

Probability?

DCS

Fatality

Totally running out of gas

Total electronics failure

Partial electronics failure

Bailing out and ascending
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Hyperoxia

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Possibility?

DCS
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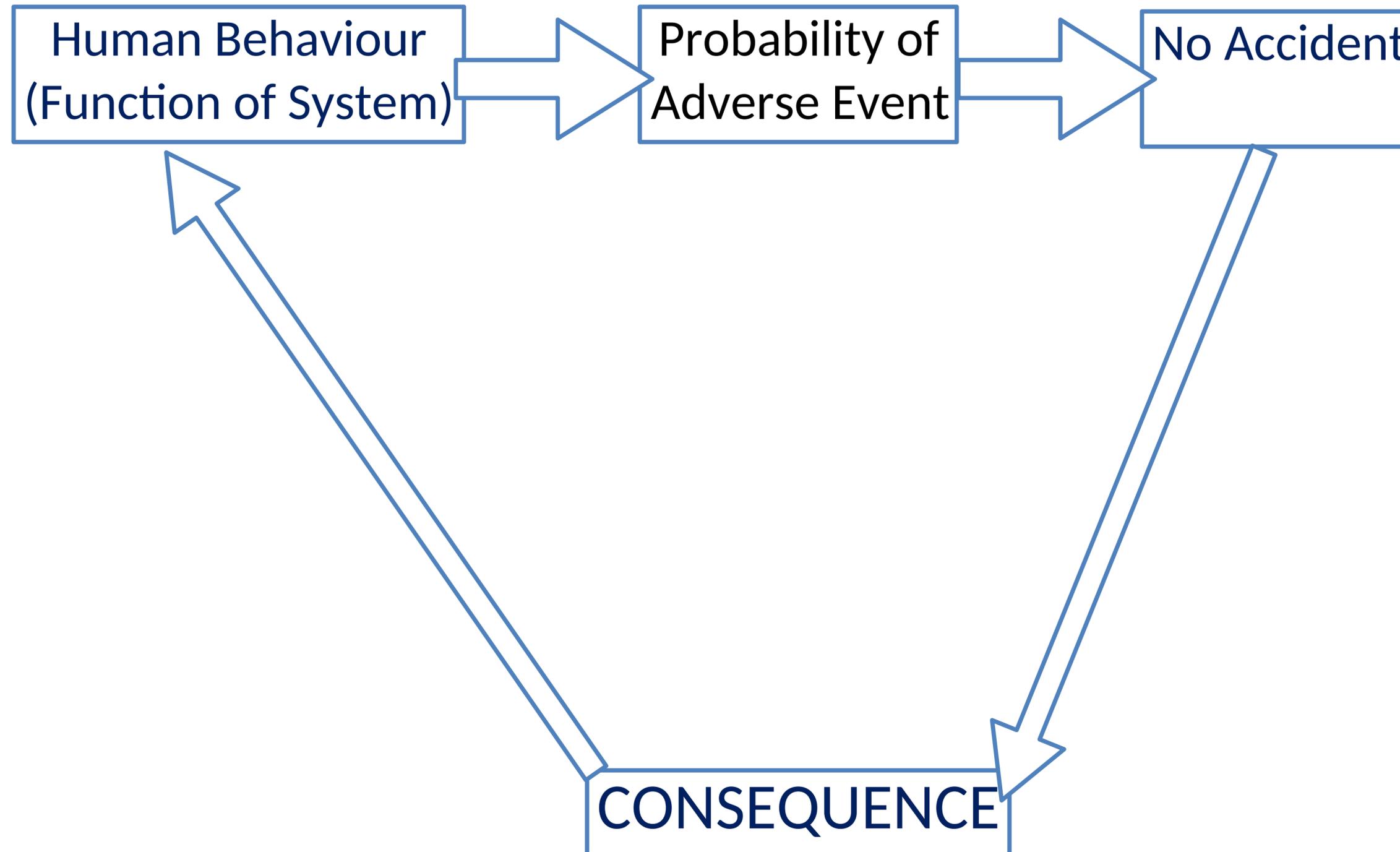
Probability?

DCS
Fatality
Totally running out of gas
Total electronics failure
Partial electronics failure
Bailing out and ascending
to surface
Hyperoxia
Hypoxia
Hypercapnia

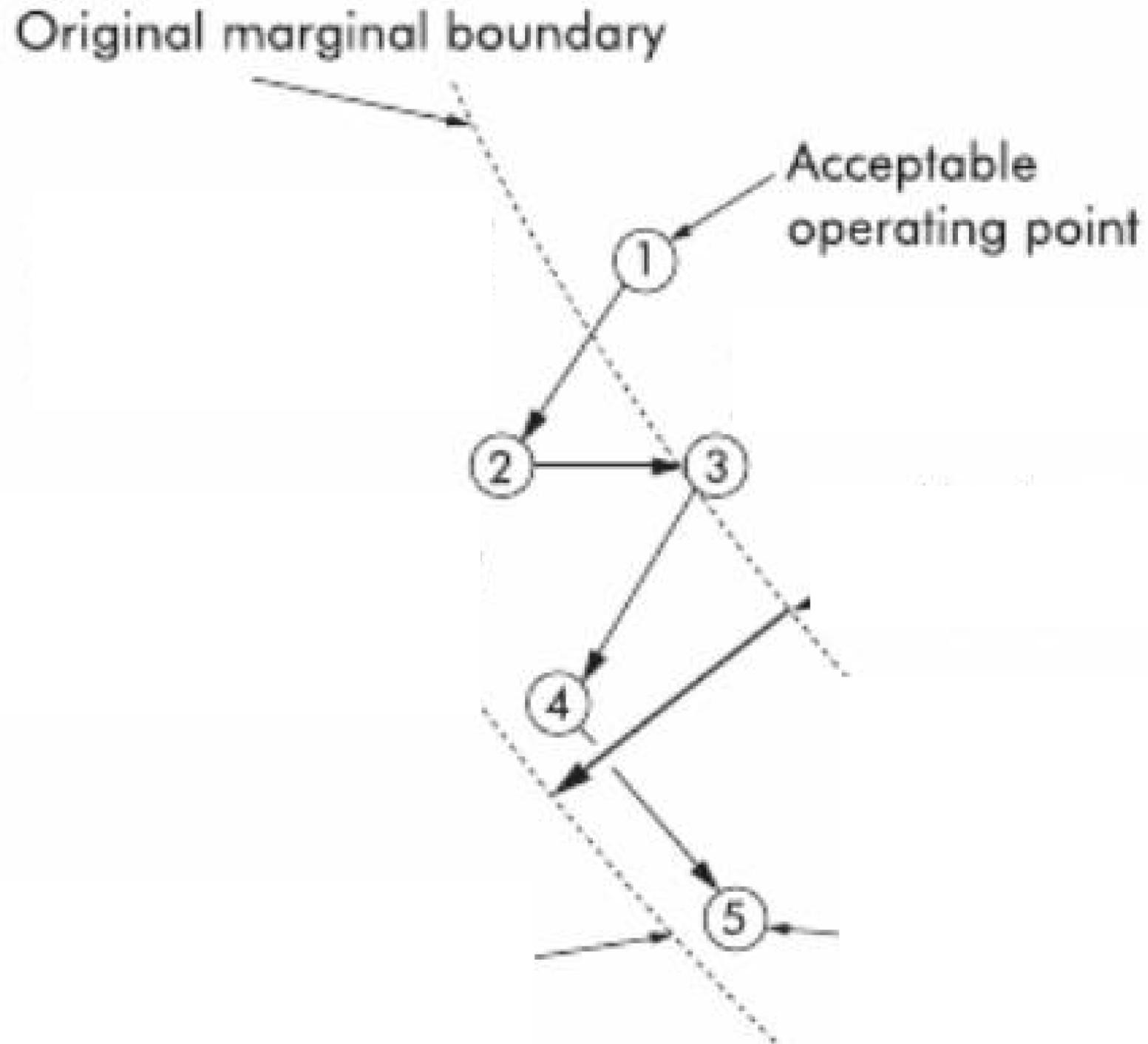
Acceptable?

DCS
Fatality
Totally running out of gas
Total electronics failure
Partial electronics failure
Bailing out and ascending
to surface
Hyperoxia
Hypoxia
Hypercapnia

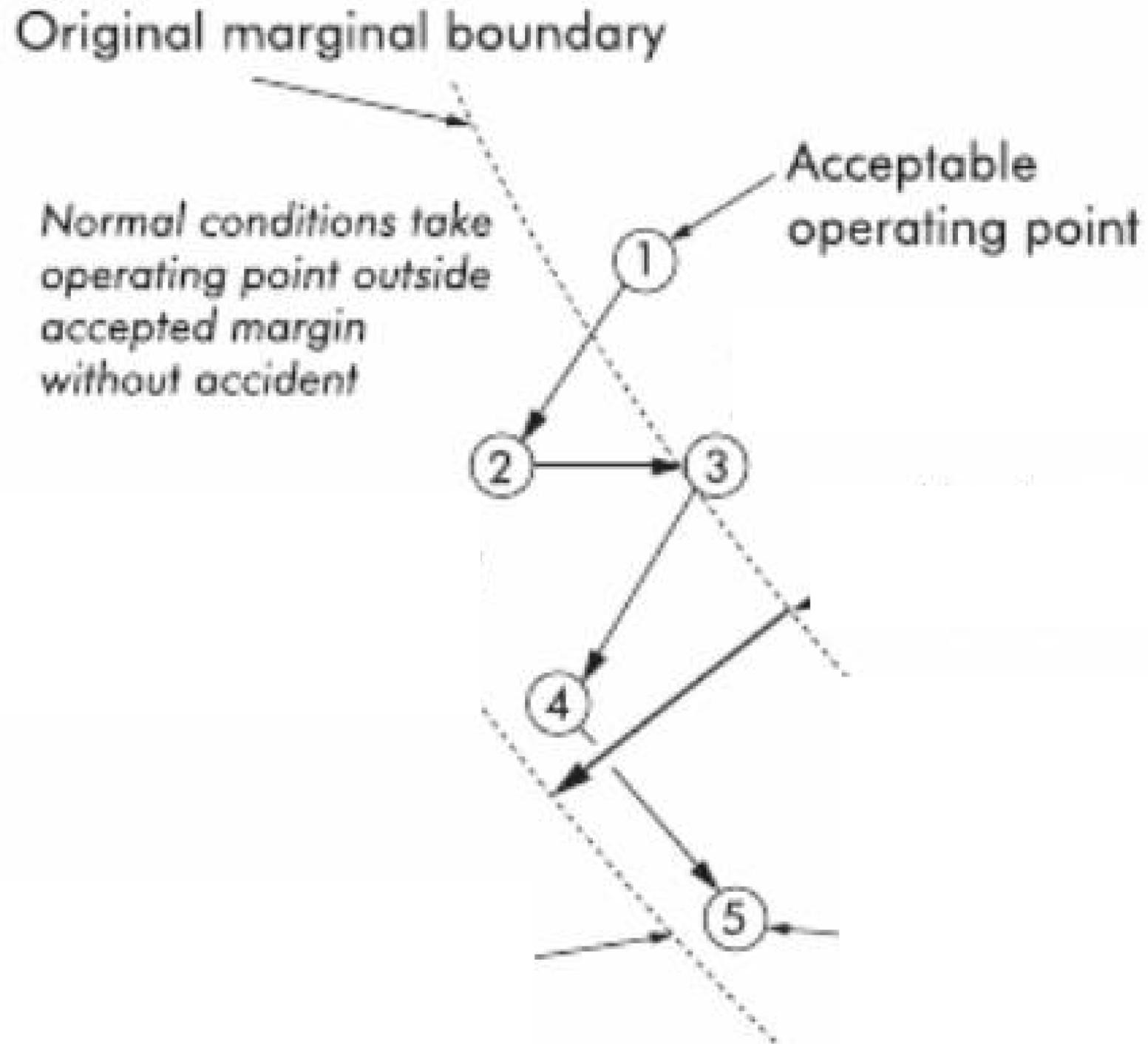
Feedback reinforces behaviour



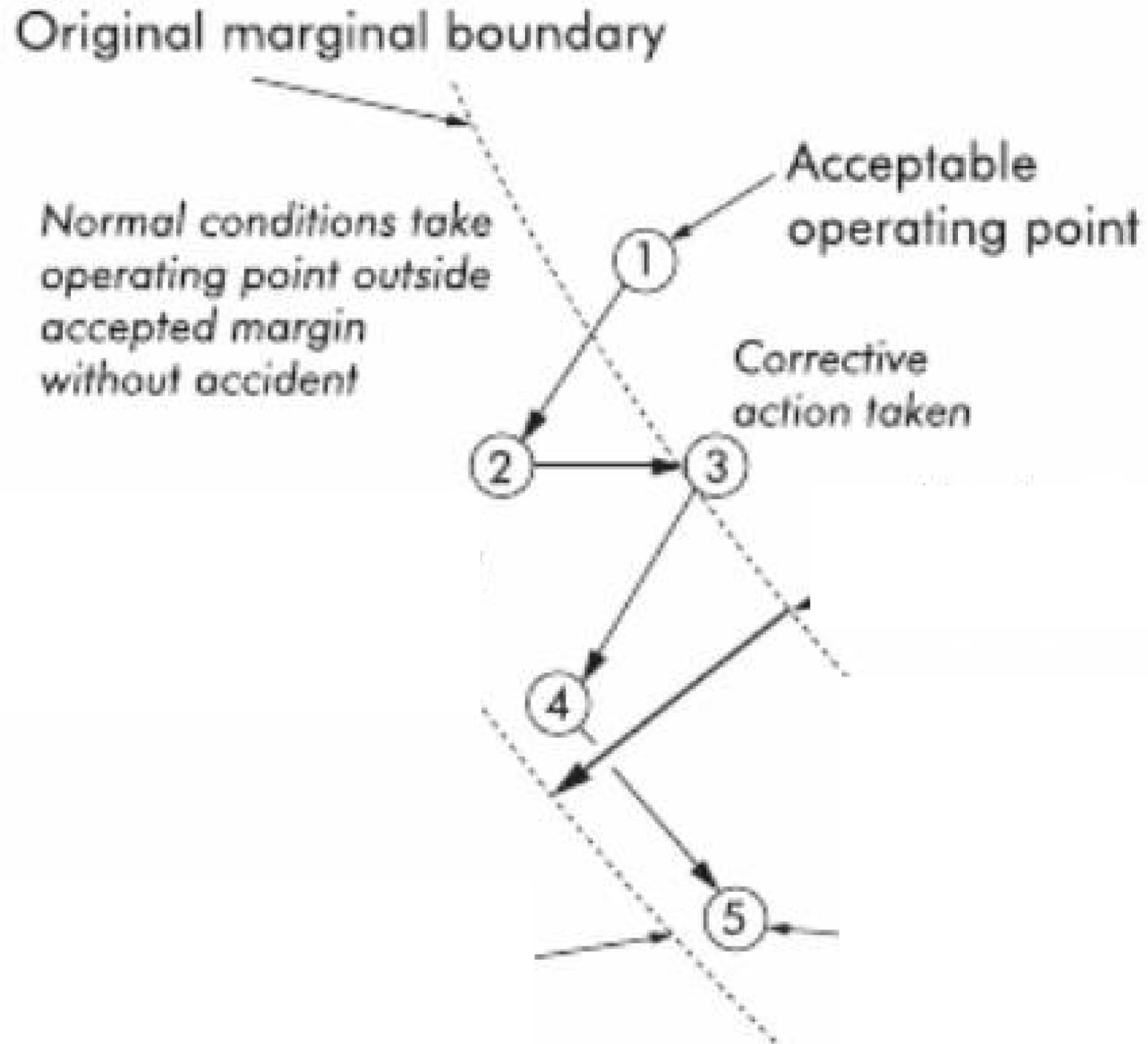
Normalisation of Deviance/Risk Homeostasis



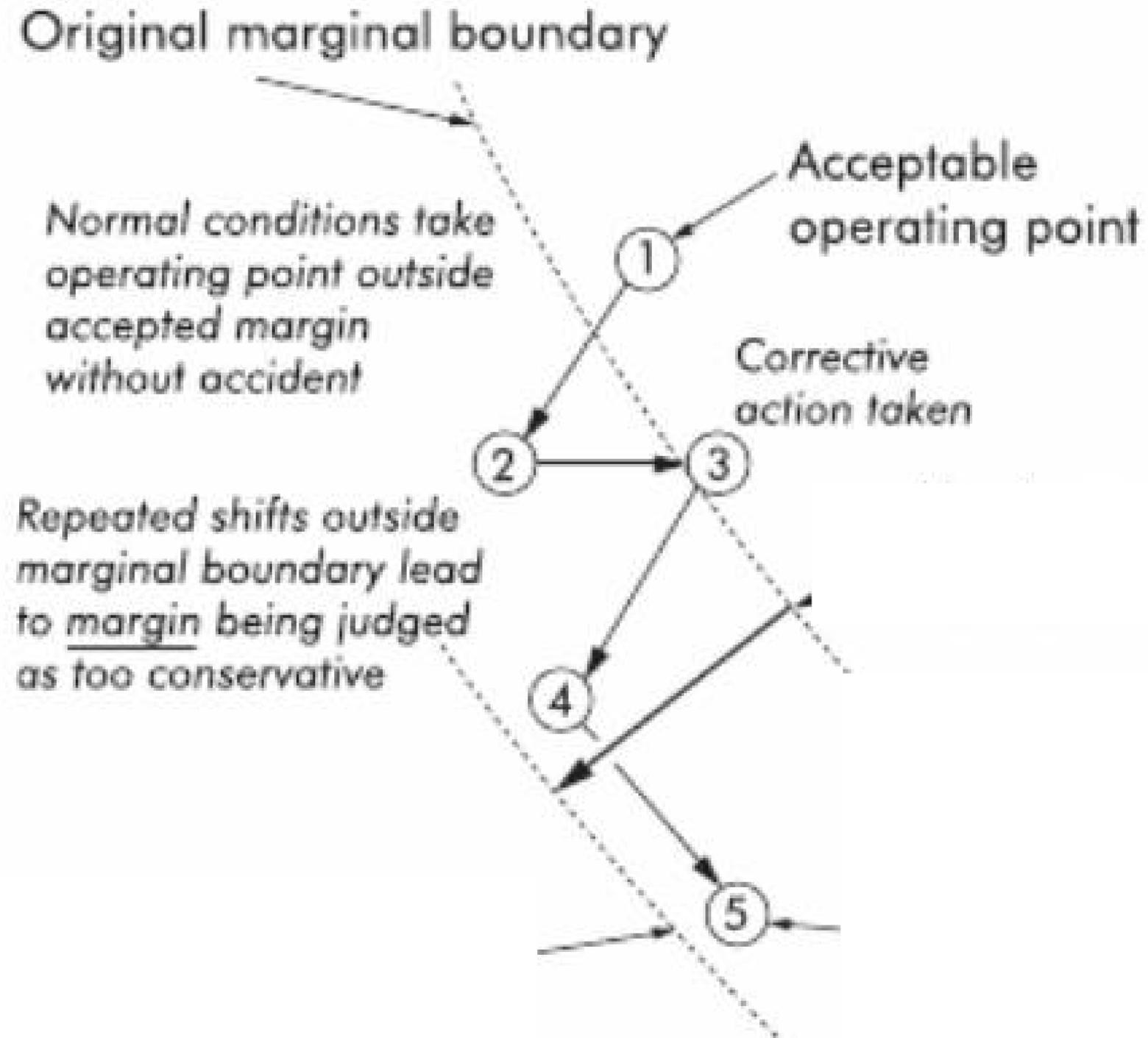
Normalisation of Deviance/Risk Homeostasis



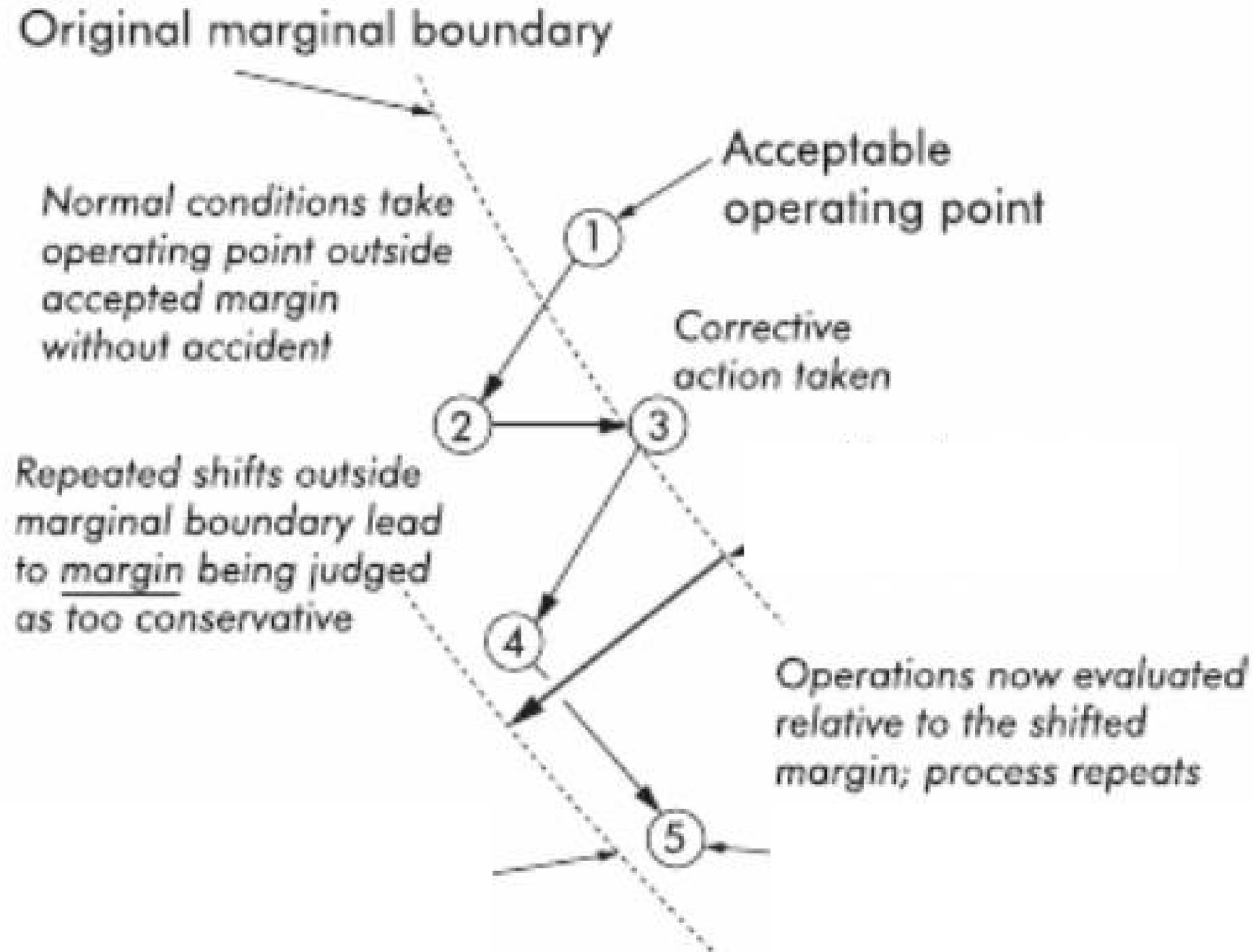
Normalisation of Deviance/Risk Homeostasis



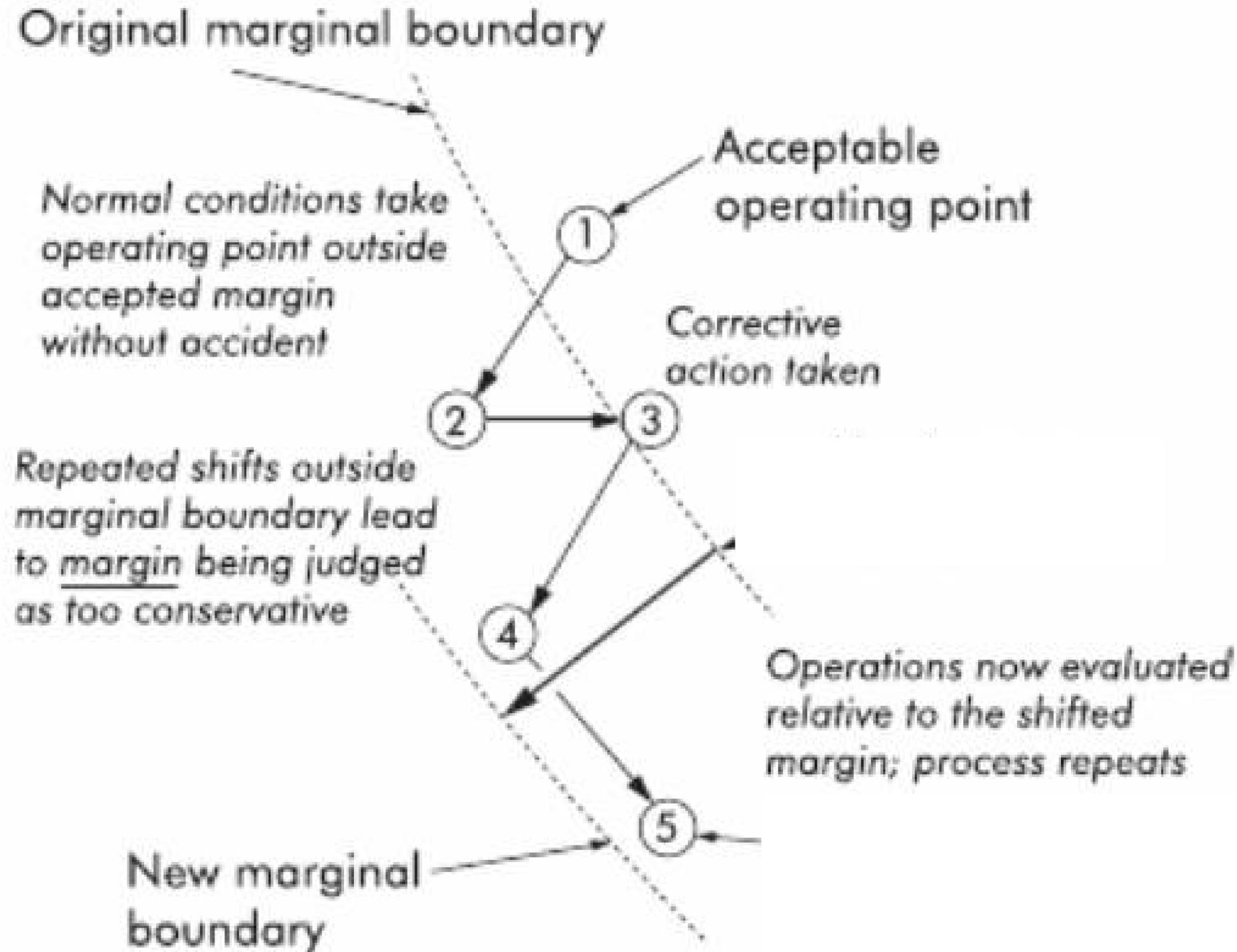
Normalisation of Deviance/Risk Homeostasis



Normalisation of Deviance/Risk Homeostasis



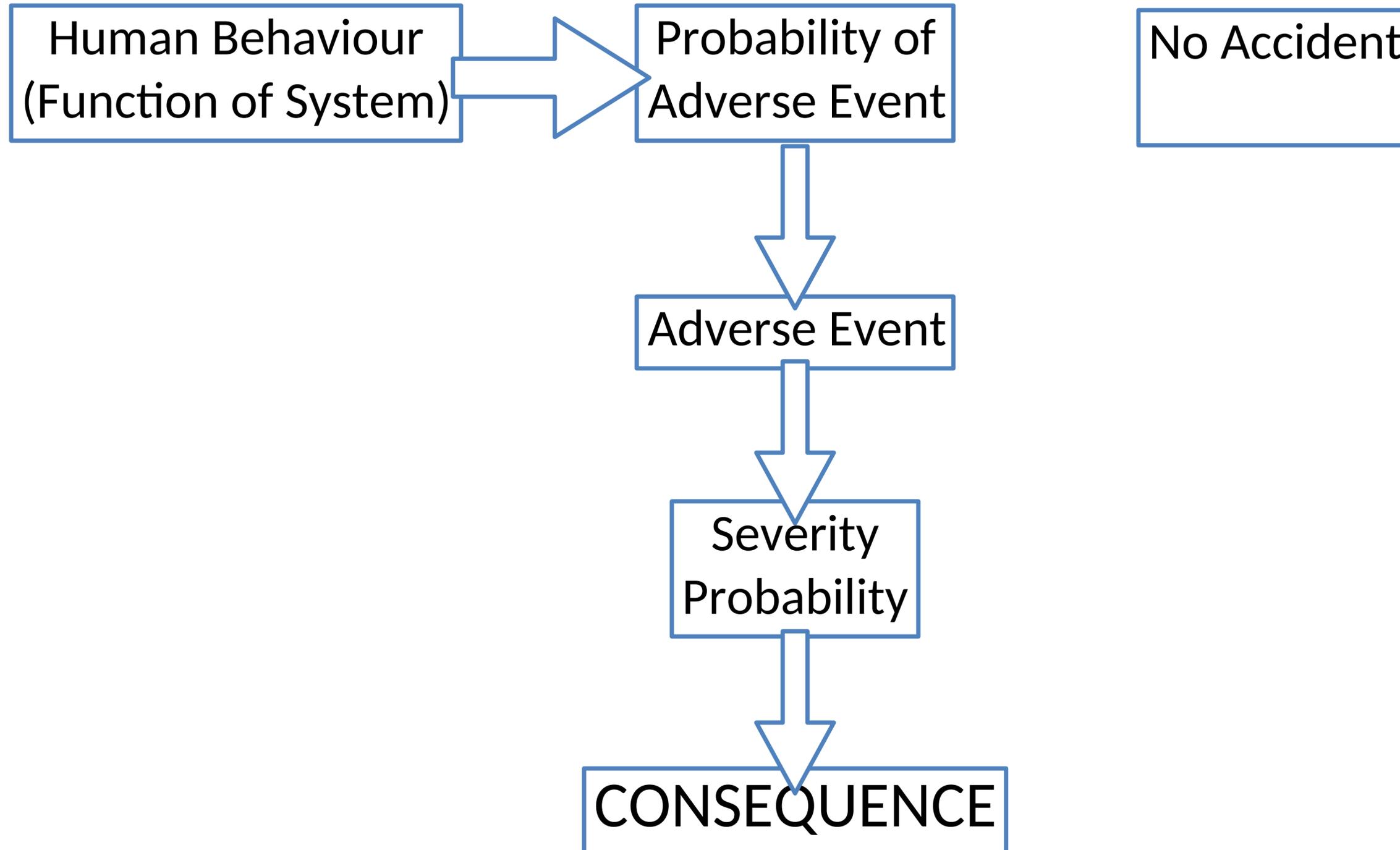
Normalisation of Deviance/Risk Homeostasis



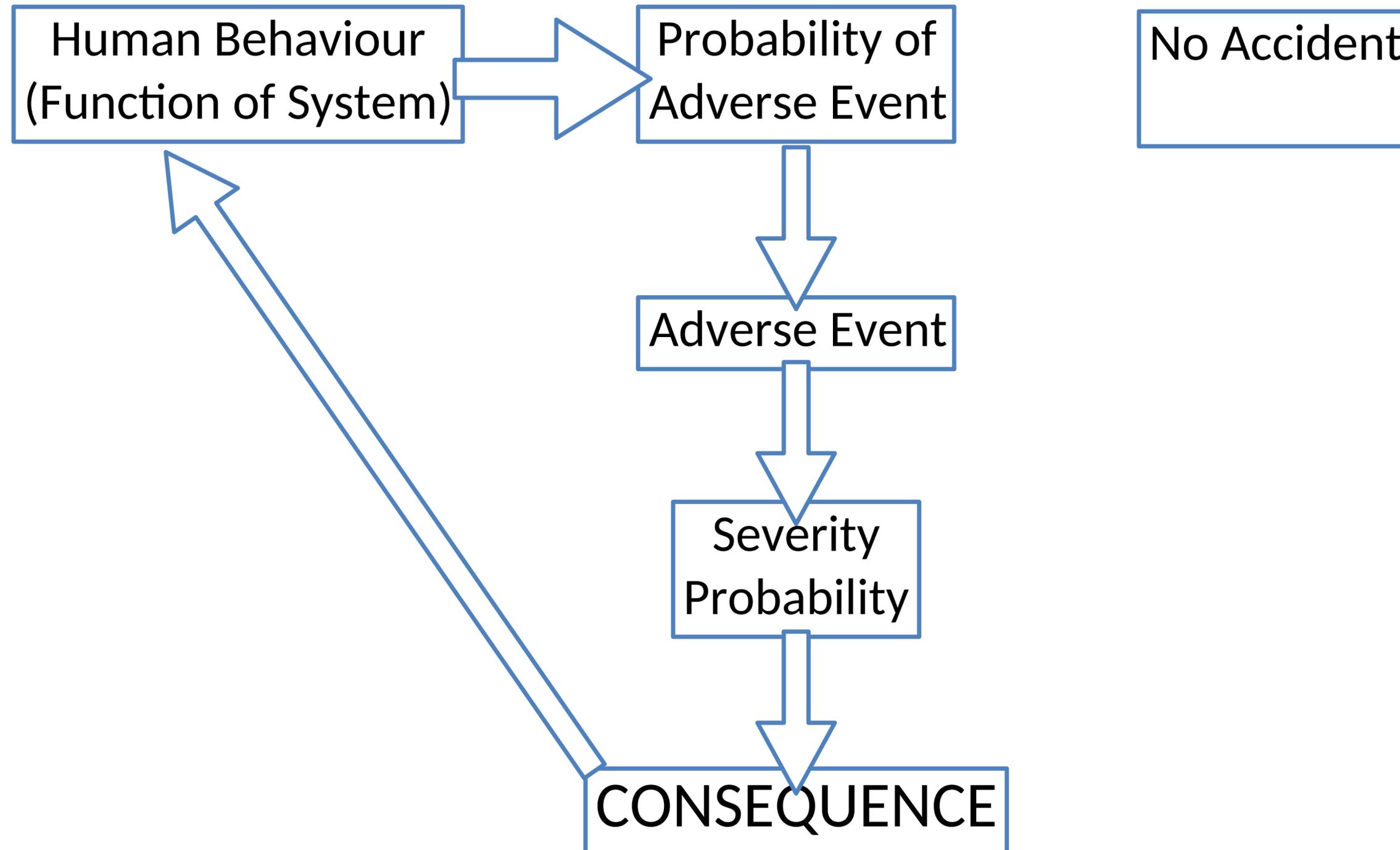
Many years without failure...



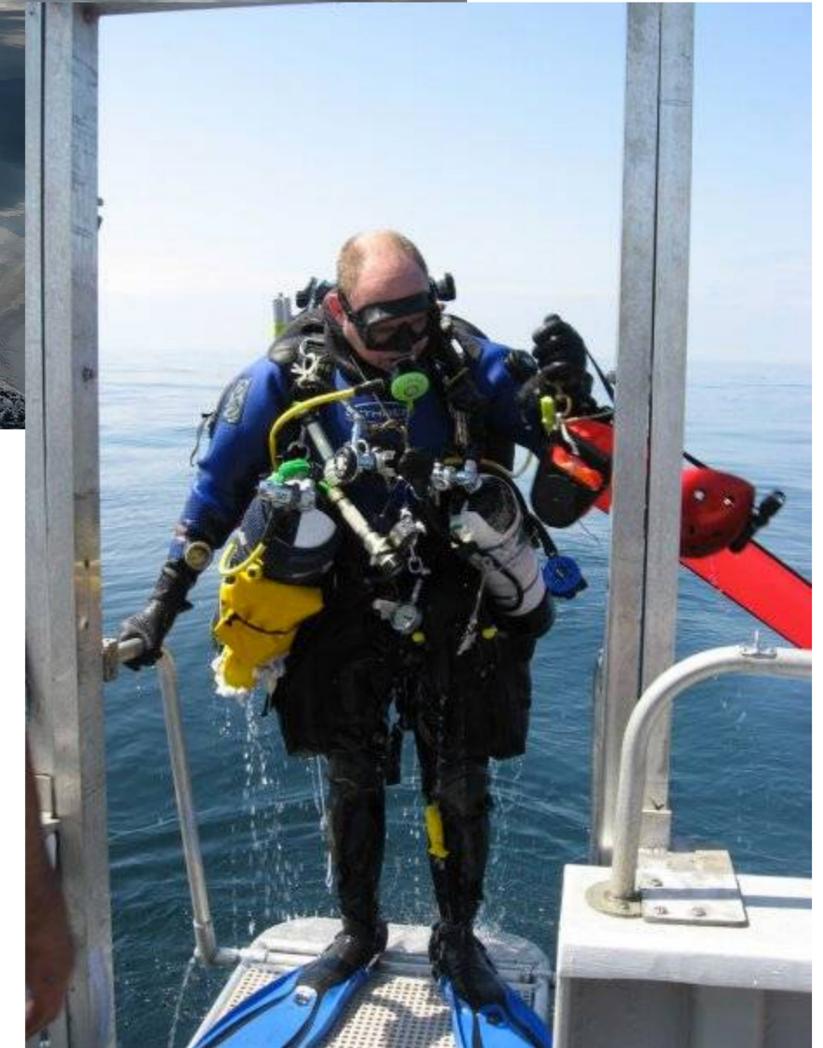
Feedback reinforces behaviour



Feedback reinforces behaviour



Feedback can change behaviour



Hindsight Bias Doesn't Help Learning



This is not hindsight bias!!

“There is almost no human action or decision that cannot be made to look flawed and less sensible in the misleading light of hindsight. It is essential that the critic should keep himself constantly aware of the Hidden QC. Clapham Junction enquiry

Outcomes are a fx(...)



X

CONTEXT (Environment, Task, Equipment Design)

X

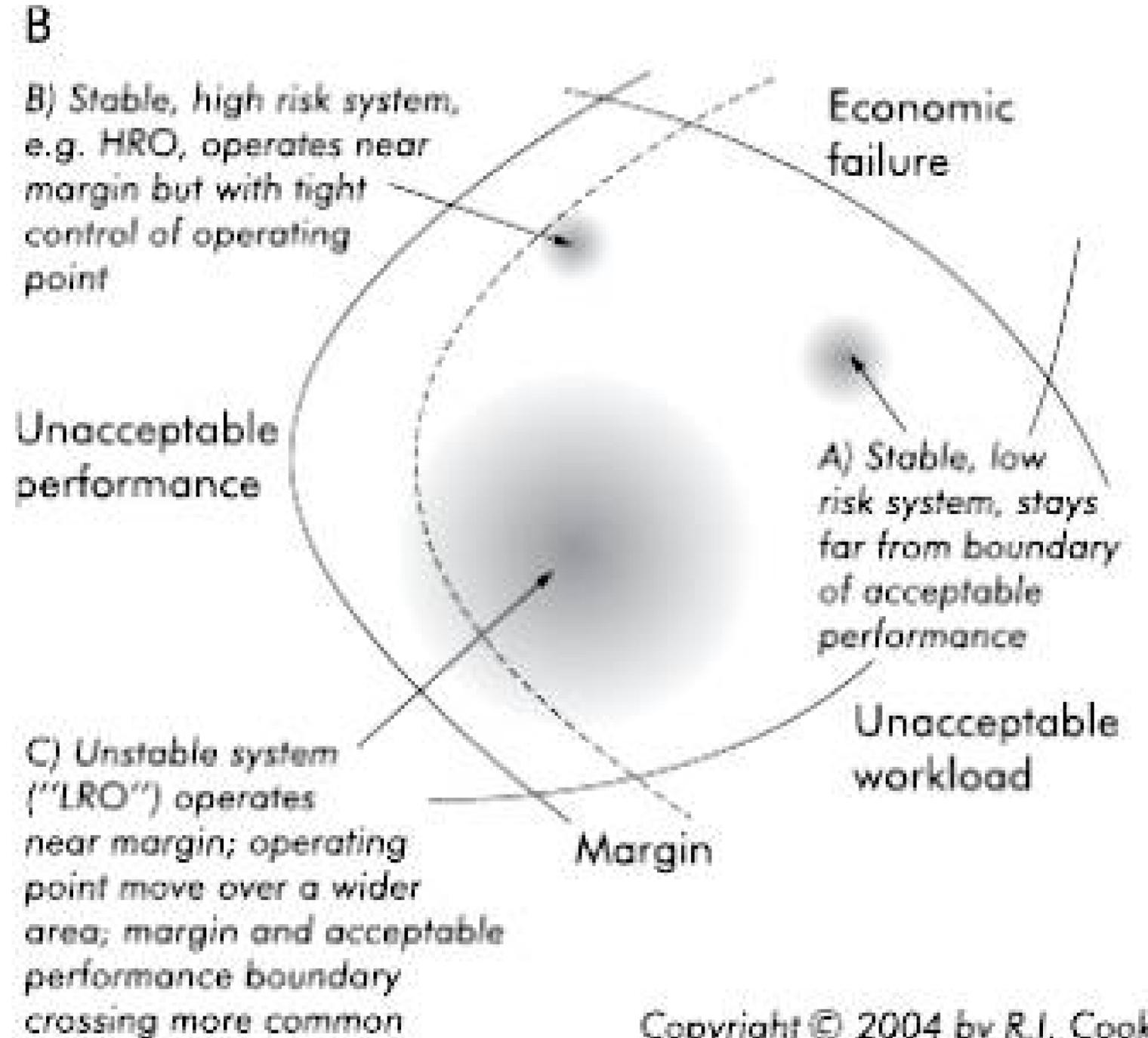
RANDOMNESS (c.f. Luck)

X



Minimising Uncertainty and its Effects

- Standards, Protocols and Processes



Minimising Uncertainty and its Effects

- Standards, Protocols and Processes
- Debriefs
- Checklists (reduce System 1 errors)



Minimising Uncertainty and its Effects



- Standards, Protocols and Processes
- Debriefs
- Checklists (reduce System 1 errors)
- Telling 'stories'

Minimising Uncertainty and its Effects



- Standards, Protocols and Processes
- Debriefs
- Checklists (reduce System 1 errors)
- Telling 'stories'
- Medical Insurance (teleports don't exist!)

Minimising Uncertainty and its Effects

- Standards, Protocols and Processes
- Debriefs
- Checklists (reduce System 1 errors)
- Telling 'stories'
- Medical Insurance (teleports don't exist!)
- Life Assurance/Income Protection
 - Diving
 - 'Normal life'



“Safety is not the absence of accidents or incidents, rather the presence of barriers and defences and the ability of the system to fail safely.”

Todd Conklin, Los Alamos



Barriers/Defences

System Design

Technical Skills

Non-Technical Skills/Human Factors

Attitude

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Failing Safely

Non-Technical Skills/Human Factors

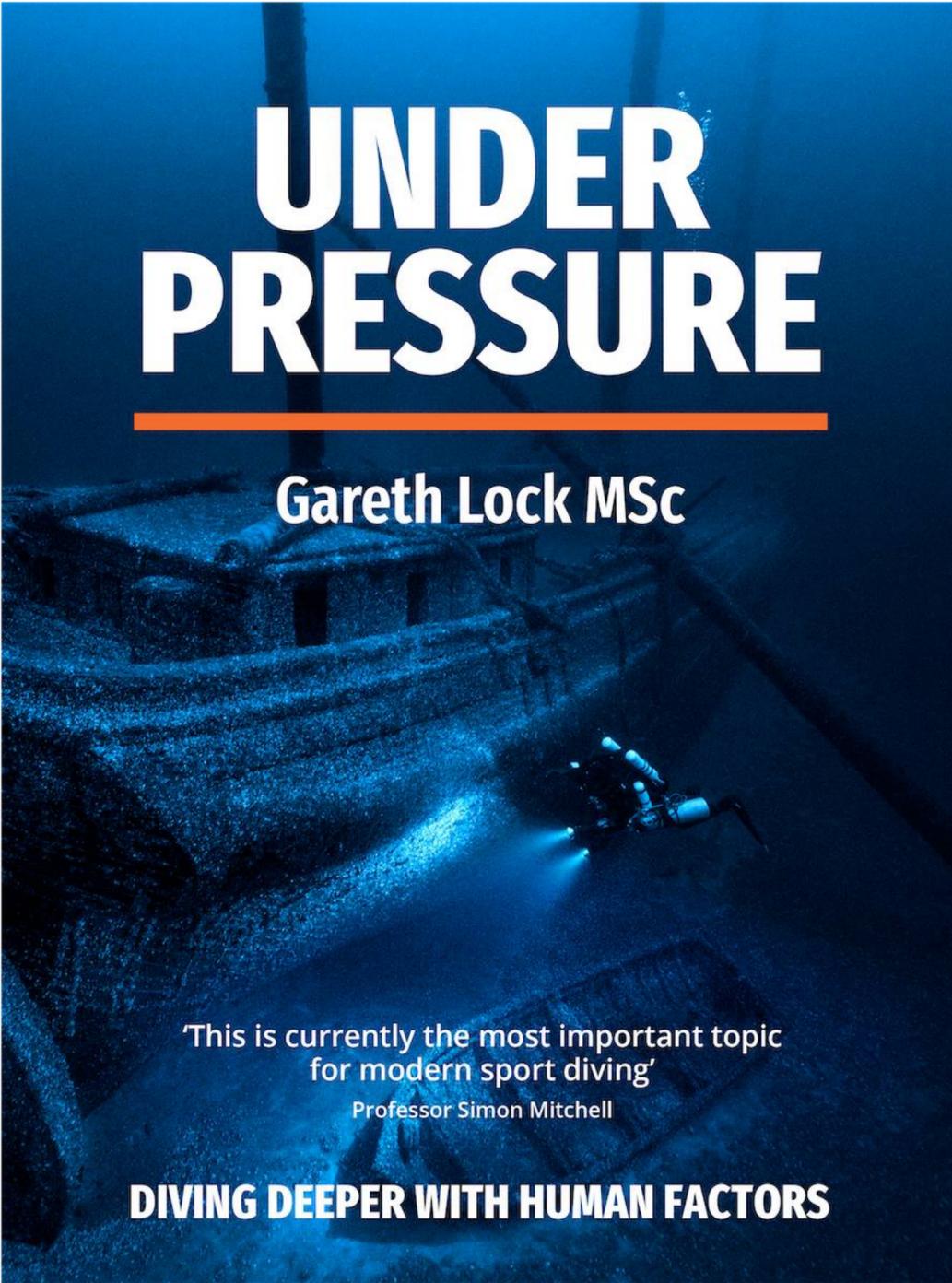
Bailout/Contingencies

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What I do to help you as divers



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diver

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<https://www.thehumandiver.com>

Online Training



quality is stellar. I have never seen such a well-presented programme.” Jill Heinerth

Face-to-face Training





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Questions?

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