Go- no-go decisions based on gradually revealed visual information

Clara Kuper [1,2], Martin Rolfs [1]

[1]Humboldt-Universität zu Berlin, [2]Berlin School of Mind and Brain

Control of manual movements…

… is well described as a decision making process.
Gallivan et al 2019, Nat Neurosci Reviews

… gradually changes with the decision variable.
Selen et al 2012, J Neurosci

… rapidly adjusts to new information even after movements are launched.
Nashed et al 2014, J Neurosci

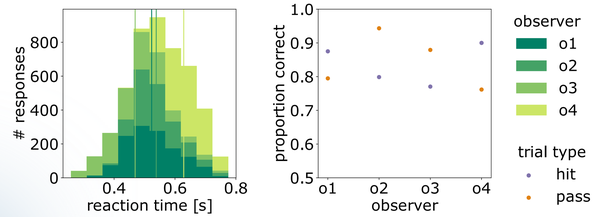
But what if new evidence requires a different response?

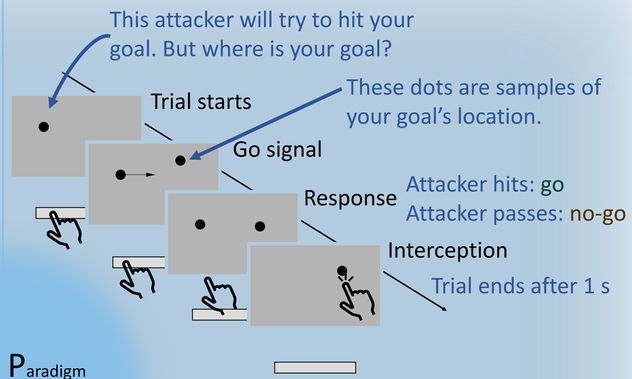
Does this also happen during response preparation?

How is new visual evidence used for the preparation of manual movements?

We collected data in a pilot study.

Observers: 4
Sessions: 3
Trials/session: 800
Final Datapoints: 9589





The **hit probability *p[H]*** for each sample is given by the cumulative density function of a uniform distribution, *with parameters that could be known by the observer*:

$$\text{cdf(x)} \begin{cases} 0 & \text{for } x > a \\ \frac{x-a}{b-a} & \text{for } x \in [a,b] \\ 1 & \text{for } x <= b \end{cases}$$

x: absolute distance between attacker and sample
a: width of the goal
b: sample position, normalized to zero.

Question Paradigm

Behaviour Mechanism

Human observers adjust to early new evidence, but not to late evidence.

Full models included:

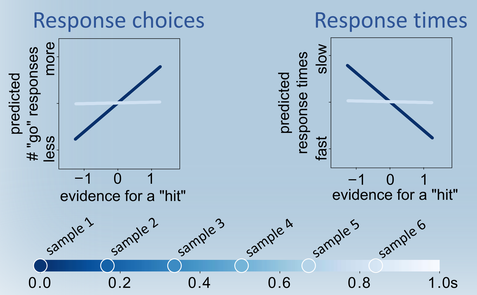
p[H] of each sample (sample 1-6)
Trial condition (hit or pass trial)
Fully specified random effects per subject

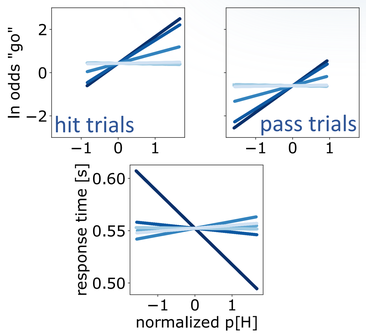
The best fitting linear models were:

response choice ~ sample 1+ sample 2 + sample 3 + trial condition + (1|subject)

response time ~ sample 1 + sample 3 + sample 6 + (1|subject)

Linear regression models describe response behaviour.

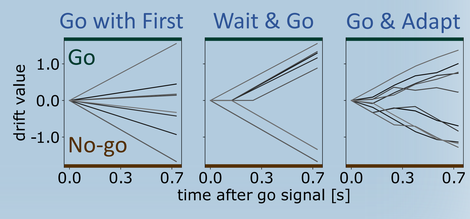




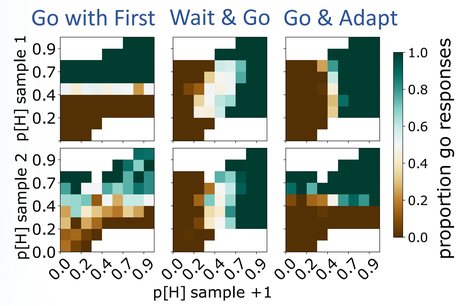
	Estimate	Z-stat	P-val
Intercept	-0.589	-1.952	0.05
sample 1	1.234	28.261	< 0.01
sample 2	1.067	24.900	< 0.01
sample 3	0.461	11.154	< 0.01
trialCondition	1.006	11.408	< 0.01

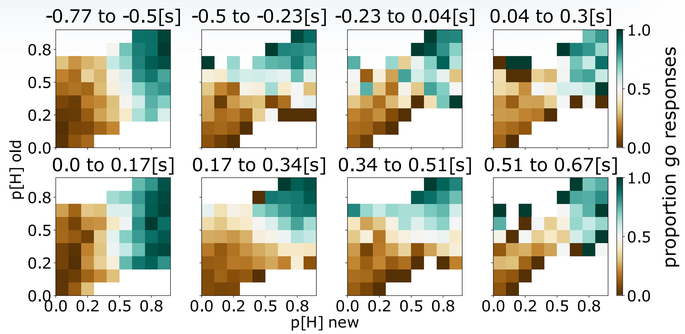
	Estimate	DF	T-stat	P-val
Intercept	0.56	3.00	17.23	< 0.01
sample 1	-0.034	4743.14	-23.53	< 0.01
sample 3	0.007	4743.05	5.57	< 0.01
sample 6	0.003	4743.01	2.69	< 0.01

Drift diffusion models describe how motor plans evolve in time.



Not all models adjust well to new evidence.





Response update patterns of human observers relative to the response onset …

… and relative to the go signal suggest that earlier samples can update the response choice, while later samples can't.

These patterns most closely match the predictions from Go & Adapt model.

See the code
https://github.com/ClaraKuper/VVSS2021