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Sensori-motor choices based on a rapid judgment of expected gain

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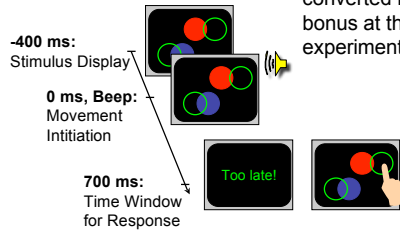
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Introduction



- Subjects rapidly selected one of two stimulus configurations differing in Maximum Expected Gain (MEG).
- The overall score was converted into a monetary bonus at the end of the experiment.

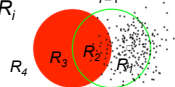


Choice between two configurations

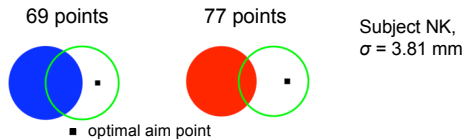
Planning a movement toward a single configuration is formally equivalent to maximizing the Expected Gain of a lottery:

The **expected gain (EG)** of this lottery is: $EG = \sum_{i=1}^4 p_i G_i$.

p_i : Probability of hitting inside Region R_i
 G_i : Gain associated with Region R_i



Selecting one of two configurations is formally equivalent to selecting between two lotteries. The two configurations differ with respect to the MEG associated with the optimal motor response.

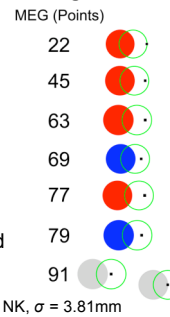


Experimental design

Basic Design:

- Practice session: decreasing time limit, penalty values 0, -100 (stabilization of reaction times, movement times, end point variability)
- Session 1: "Pointing Movements", single configuration, penalty values 0 (gray), -100 (blue), -500 (red)
- Session 2 and 3: "Selection Movements", pointing at one of two (novel) configurations
- Session 4 and 5: "Keypress Responses", selection by keypress, pay-offs simulated based on motor response in Session 2/3
- 1000 points = 10 cents; 6 subjects

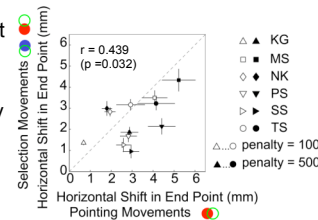
Set of stimulus configurations:



Movement end points are similar for Pointing and Selection Movements

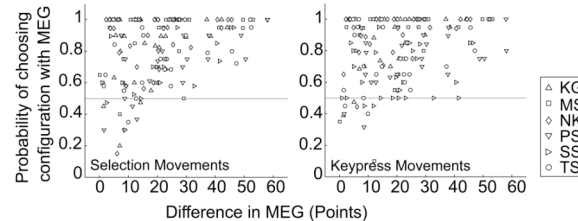
Subjects shift their mean movement end point from the target center for penalty values < 0.

This shift is larger for higher penalty values and closer penalty regions.



Preference for the configuration with higher MEG is independent of judgment type

Selection and Keypress Movements show the same preference for configurations with higher MEG.



Subjects select configurations based on a representation of MEG

Model 1:

$$\Delta = MEG_2 - MEG_1 + \epsilon$$

ϵ : Gaussian (0, σ_{dec})

Choose configuration 2 if $\Delta > 0$

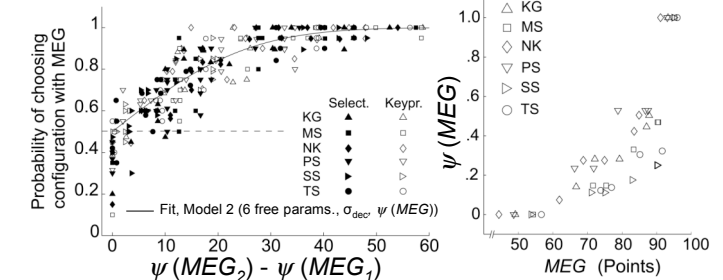
$\sigma_{dec} \sim 13$ to 28 points.

Model 2:

$$\Delta' = \psi(MEG_2) - \psi(MEG_1) + \epsilon$$

(ψ : increasing transformation)

Choose configuration 2 if $\Delta' > 0$



Conclusions

- Movement plans are decisions.
- Humans choose near-optimal strategies when planning movement under risk.
- Subjects rely on the same strategies for pointing at a single configuration and movements selecting one of two configurations.
- Humans base the selection of their strategy on a rapid judgment of maximum expected gain.

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