

# EFFECTS OF DIFFERENT TIME DELAYS IN DECISION MAKING UNDER RISK

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## INTRODUCTION

Imagine a hurdler participating in a race under one of the following two conditions:

- 1) The hurdler sits in his starting block and awaits the sound of the starter's gun. He can see all the hurdles on the track. These are the conditions of a normal race.
- 2) Again, the hurdler sits in his starting block, awaiting the sound of the starter's gun. But this time, all the hurdles are placed at slightly different positions and hidden by a curtain. The hurdler sees the hurdles for the first time when he hears the starter's gun.



We wanted to find out whether human motor responses differ if knowledge about WHERE to move (first hurdle) is separated from knowledge about WHEN to move?

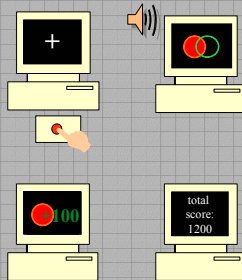
## METHOD

Win as many points as possible...

In our experiment, six subjects (N=6) performed a **rapid pointing movement** towards a **green circle** on the computer screen. If they hit the target in time they earned **100 points**, if they accidentally hit a nearby **red penalty circle** or responded too slowly, they lost points, like in a game. To separate the knowledge **where** to move from movement initiation (**when** to move), an acoustic go-signal separated information about position of the movement (visual display of the configuration) from information about when to move (time of presentation of the beep).

### PROCEDURE:

- 1) Look at fixation cross in the middle of the screen.
- 2) Press red start button on a board until the go-signal appears.
- 3) Try to hit the **green target circle** on the screen within a time window of 750ms.
- 4) Region that is hit explodes graphically indicating if one or both of the circles are hit.
- 5) Points awarded for one trial are shown followed by the subjects total accumulated points.



- ▶ The **penalty value** for the red circle varied among three conditions:



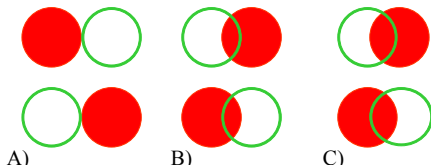
- A) penalty: 0 points      B) penalty: -200 points      C) penalty: -500 points

- ▶ The **time window (delay)** between seeing the target and hearing the go-signal varied also in three conditions:

- A) go-signal together with the visual stimulus (0ms)
- B) 400ms there after
- C) 1000ms after display of the visual stimulus.

- ▶ **Layout of the target circle:** Three different spatial conditions either on the right or left side:

- A) next to the penalty circle
- B) half the radius of the penalty circle
- C) whole radius of the penalty circle

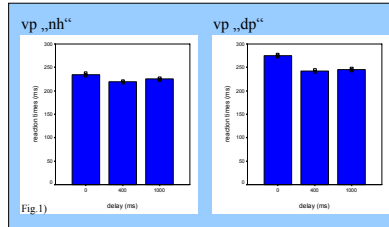


### DESIGN:

3 spatial conditions x 3 penalty conditions (0, -200, -500) x 3 delay conditions (0ms, 400ms, 1000ms) resulting in a 6 x 3 design.

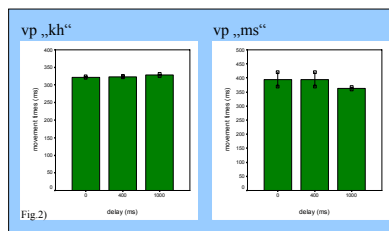
## RESULTS

### Reaction times are not different



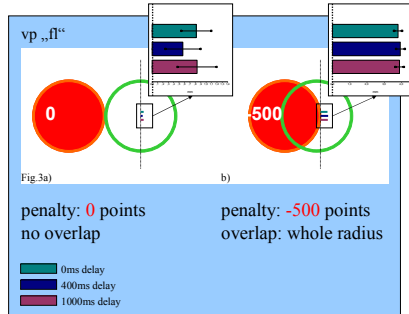
Subjects' **reaction times** did not differ significantly between the three delay conditions among four of seven participants. Three T-tests were calculated for each subject, comparing the mean values of the reaction times in the 0ms/400ms, 400ms/1000ms and the 0ms/1000ms condition (for  $df = 280$ ) at a level of significance of 0.05/3 (Bonferroni-corrected for three tests).

### Movement times are not different



Mean values of the **movement times** were calculated with a Univariate Analysis of Variance with the delay conditions as the independent variable. Although the Analysis showed that in five of seven cases the movement times differed significantly among the delay conditions this seems to be due to the high statistical power of our test.

### Movement end points are not different



The mean values of the **movement end points** among the same spatial and the same penalty conditions did not differ significantly between the different delay conditions. In Fig. 3b) you can see the deviation from the middle of the target for vp "fl" in three different delay conditions in the most difficult configuration: -500 penalty points and most overlap. Fig. 3a) shows the control condition with no penalty points and no overlap to demonstrate that subject "fl" was able to hit the middle of the target.

## DISCUSSION

### Do human motor responses differ if the knowledge where to move is separated from the time of movement initiation?

No, it makes no difference whether the knowledge of where to move is separated from the knowledge of when to actually initiate the movement – at least up to a delay 1000 milliseconds between display of visual information and acoustic go-signal.

### Possible reasons for this outcome:

- 1) time delay of 1000ms still too short to test effects of additional cognitive load
  - 2) participants too concentrated not to miss the start signal
- they did not think about possible "best" pointing movement strategies at all

