

# Recognition Memory

## Method

28 subjects were used. Experiment consisted in 3 training phases, followed by a test phase. In training, for a total of 8 blocks, 4 different types of cue1, 4 different types of cue2, and 2 outcomes were presented. The image displayed in each type of cue was randomly assigned for each participant. Both phase 1 and 2 comprised 1 blocks, whereas phase 3 consisted on 6 blocks. All blocks were a sequence of 20 trials. In each trial, a cue1 and a cue2 were presented, followed by an outcome. In phase 1, there were 2 types of cue1 (1 and 2) and 2 types of cue2 (5 and 6), thus creating 4 different combinations that were repeated 10 times across the phase. Cue 1 was always paired with outcome 1 and cue 2 was always paired with outcome 2, whereas cues 5 and 6 were paired with each outcome half of the times. In phase 2 there were 2 different types of cue1 (3 and 4) and 2 types of cue2 (7 and 8), thus creating 4 different combinations that were repeated 10 times across the phase. Cue 3 was paired with outcome 1 with a 0.8 contingency, being the rest of trials paired with outcome 2. The opposite was true for cue 4, and cues 7 and 8 were paired with each outcome half of the times. In phase 3, the stimuli combinations from the two previous phases were intermixed. The contingencies between cues and outcomes were maintained as in the previous phases. In this training phase, on each trial, the participants had to predict the probable outcome of the cues presented, and the response given as well as the reaction time (RT) were recorded. Based on the programmed contingencies, an additional measure of accuracy was computed, comparing the most probable outcome (that is, the outcome with a higher contingency with cue1) with the response emitted by the participant.

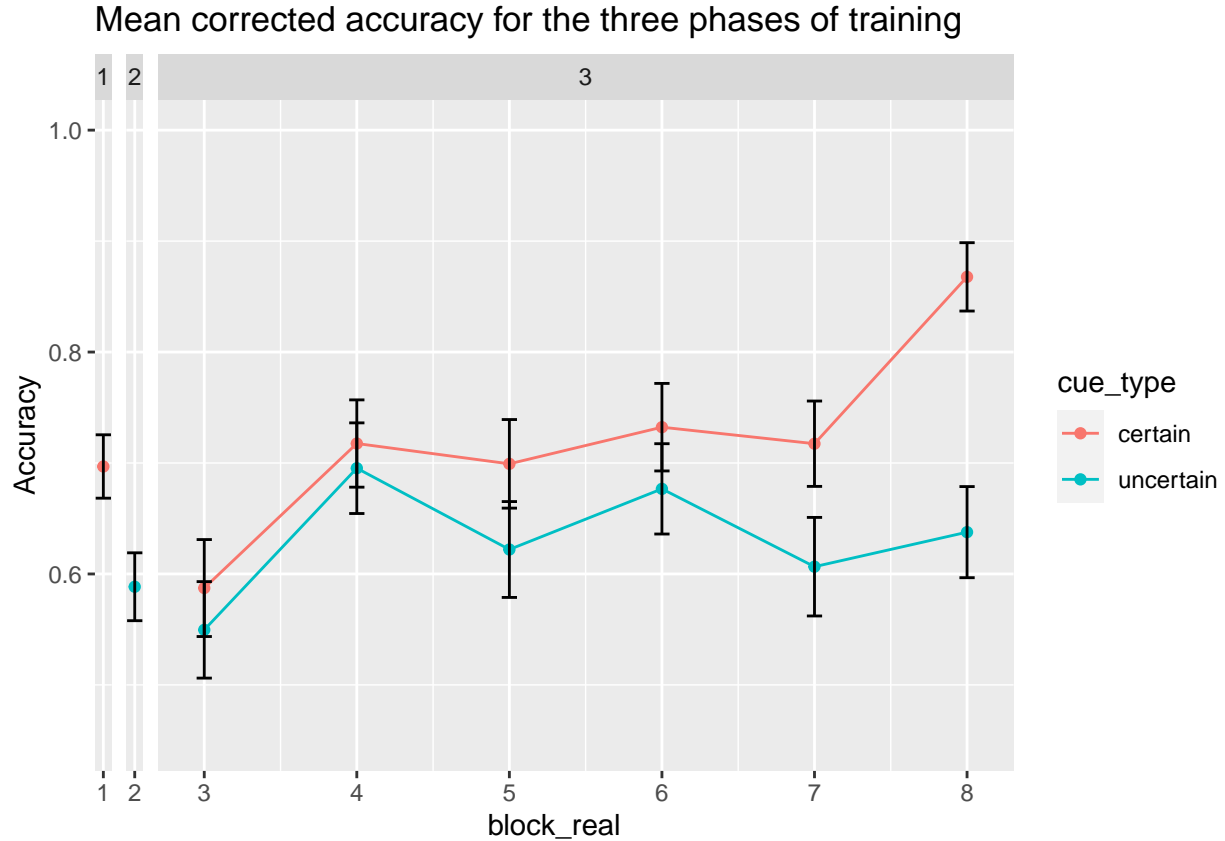
In test phase, the participants were presented each of the 8 cues twice, together with a similar yet new cue, and were asked to choose what cue they had seen before, as well as rating how sure they were of their response. The rating RT was also recorded. A memory score was computed, taking the rating given to the cue in positive when the response was right, and in negative when it was wrong. A corrected version of this score was also computed in order to clean the noise of errors, taking into account just the ratings of the trials in which the participant chose the right stimulus.

## Results

### Training phase

As can be seen in the Figure below, the accuracy to the certain cues increased during phase 1, but it seems to decrease again at the start of phase 3, then gradually increasing to reach a value of around 0.85 at the end of training. The accuracy to uncertain cues, although not as better as for the certain groups, increases throughout the training phase, reaching a level of around 0.7 at the end of it.

```
## `geom_line()`: Each group consists of only one observation.  
## i Do you need to adjust the group aesthetic?  
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```



Mean responding throughout the experiment was significantly above chance for both certain and uncertain cues, as confirmed by a one sample t test (Certain:  $t(25) = 4.08$ ,  $p < .001$ ,  $d = 0.80$ , Uncertain:  $t(25) = 4.08$ ,  $p < .001$ ,  $d = 0.80$ ).

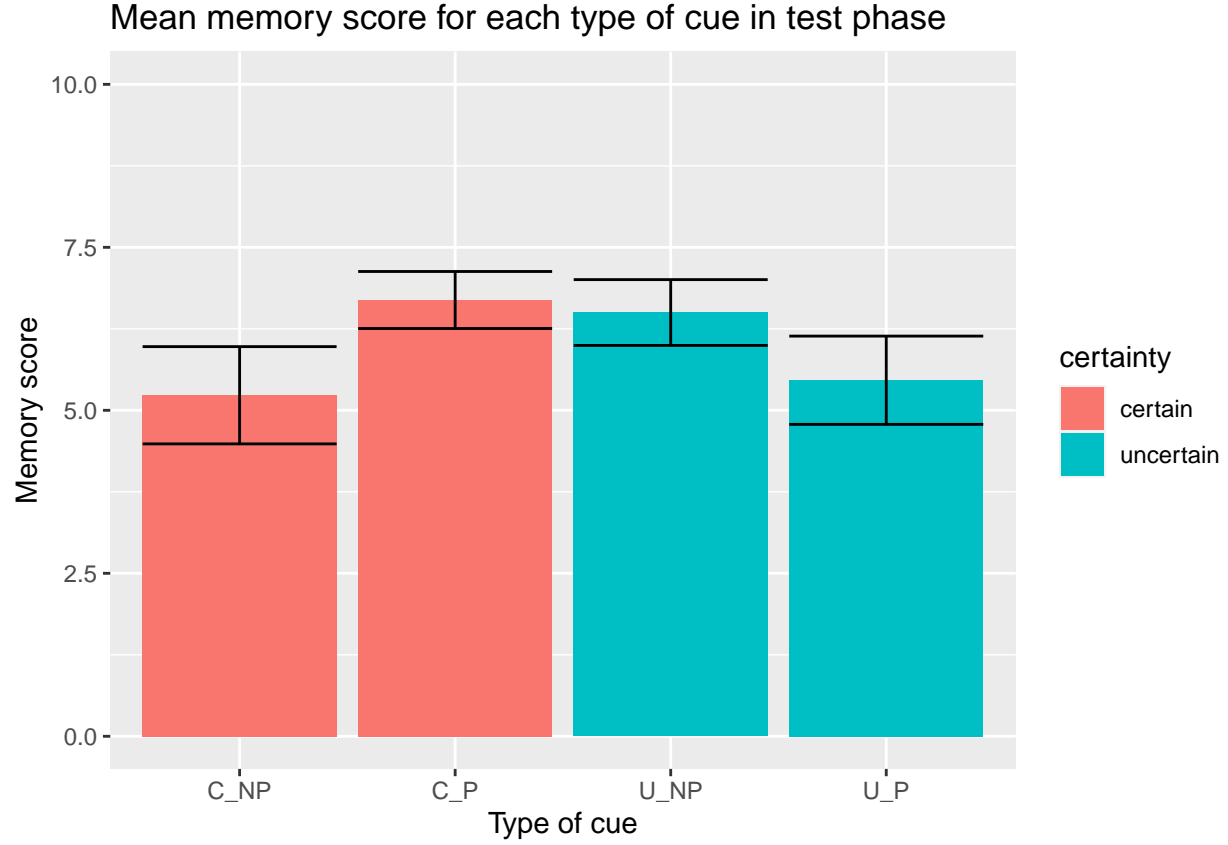
A within-subject ANOVA for phase 3 with the type of cue (certain or uncertain) and the blocks was performed. This ANOVA found the main effect of the type of cue and of the blocks significant ( $F(1, 12) = 3.72$ ,  $p = .078$ ,  $\eta_p^2 = .24$ ), whereas the main effect of the block and interaction were non significant ( $F(5, 60) = 4.63$ ,  $p = .001$ ,  $\eta_p^2 = .28$ ;  $F(5, 60) = 1.64$ ,  $p = .164$ ,  $\eta_p^2 = .12$ ). There was strong evidence on the effect of the type of cue ( $BF_{10} = 1.3 \times 10^1 \pm 2.19\%$ ), moderate evidence in favor of the effect of block ( $BF_{10} = 6.9 \times 10^0 \pm 0.39\%$ ) and that there was moderate evidence of the non significance of the interaction ( $BF_{10} = 2.9 \times 10^{-1} \pm 2.16\%$ ).

## Test phase

### Memory score

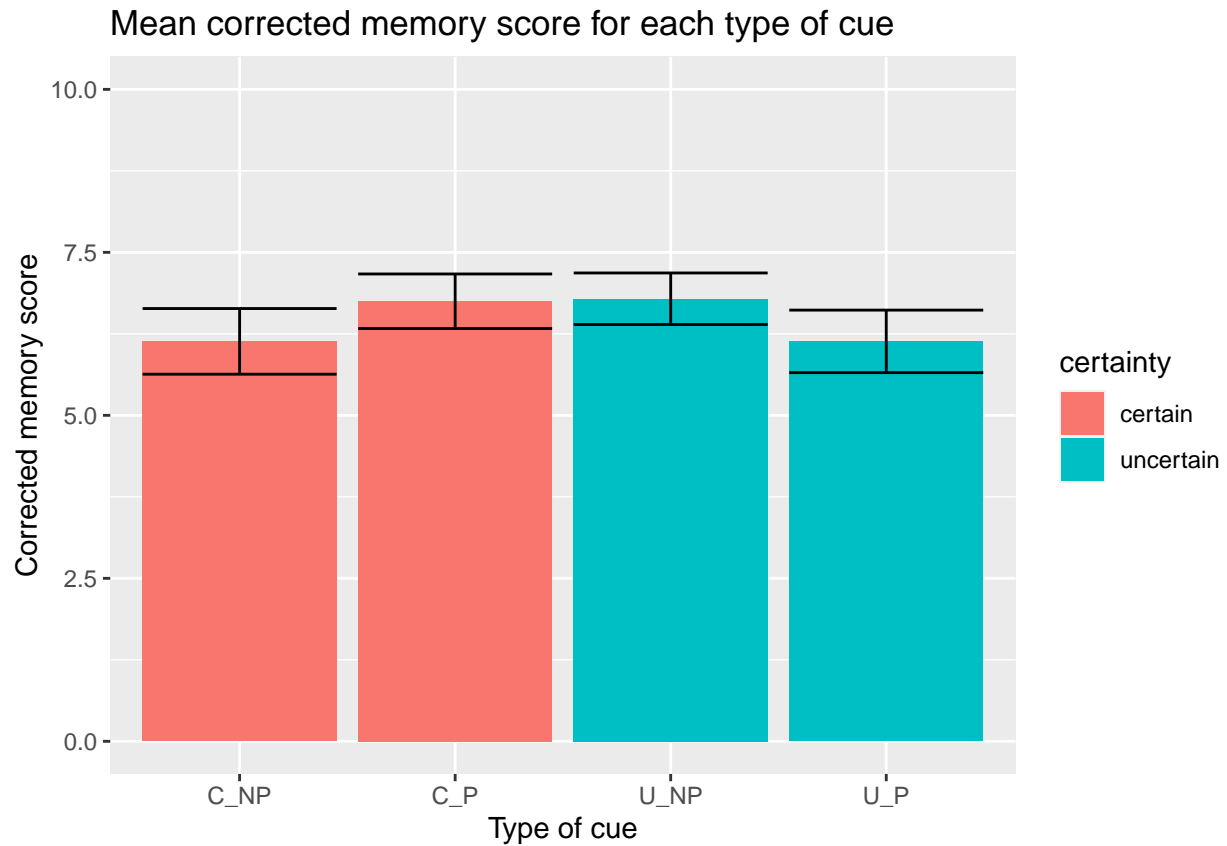
In the figure below, it can be seen that the memory score was lower for the certain non-predictive and the uncertain predictive cues (around 5) than for the uncertain non-predictive and the certain predictive cues (around 7).

```
## `summarise()` has grouped output by 'cue_type'. You can override using the
## `.groups` argument.
```



However, in regard to the ANOVA, no effect or interaction were significant (Certainty:  $F(1, 12) = 0.00$ ,  $p = .969$ ,  $\eta_p^2 < .01$ , Predictiveness:  $F(1, 12) = 0.12$ ,  $p = .738$ ,  $\eta_p^2 < .01$ , CertaintyxPredictiveness:  $F(1, 12) = 3.23$ ,  $p = .098$ ,  $\eta_p^2 = .21$ , respectively). There was moderate evidence against the main effects and the interaction ( $BF_{10} = 2.9 \times 10^{-1} \pm 2.97\%$ ;  $BF_{10} = 2.9 \times 10^{-1} \pm 0.95\%$ ), but anecdotal in favor of the interaction ( $BF_{10} = 1.9 \times 10^0 \pm 2.29\%$ ). Given these analysis, there is not enough evidence in favor or against the effect of the manipulations performed in these experiment.

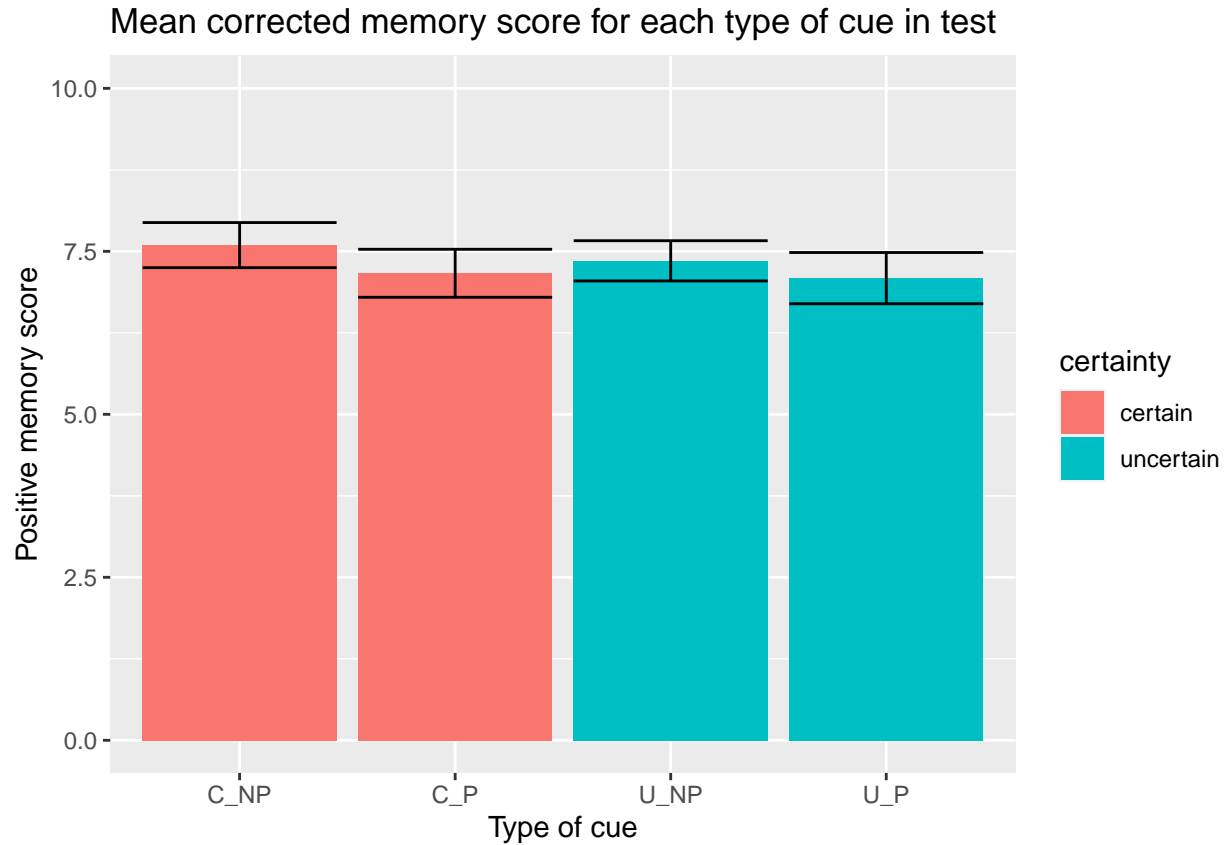
Corrected memory score (hits x1, errors x0)



A mixed method ANOVA found no significant effect of neither the Certainty or the Predictiveness, nor the their interaction. Furthermore, the bayesian evidence was moderate for the null hypothesis in the case of the main effects and anecdotal null for the interaction (Certainty:  $F(1, 12) = 0.00$ ,  $p = .960$ ,  $\eta_p^2 < .01$ ,  $BF_{10} = 2.8 \times 10^{-1} \pm 1.74\%$ ; Predictiveness:  $F(1, 12) = 0.00$ ,  $p = .965$ ,  $\eta_p^2 < .01$ ,  $BF_{10} = 3 \times 10^{-1} \pm 5.15\%$ ; interaction:  $F(1, 12) = 1.58$ ,  $p = .233$ ,  $\eta_p^2 = .12$ ,  $BF_{10} = 7.7 \times 10^{-1} \pm 4.17\%$ ).

Corrected memory score (errors out)

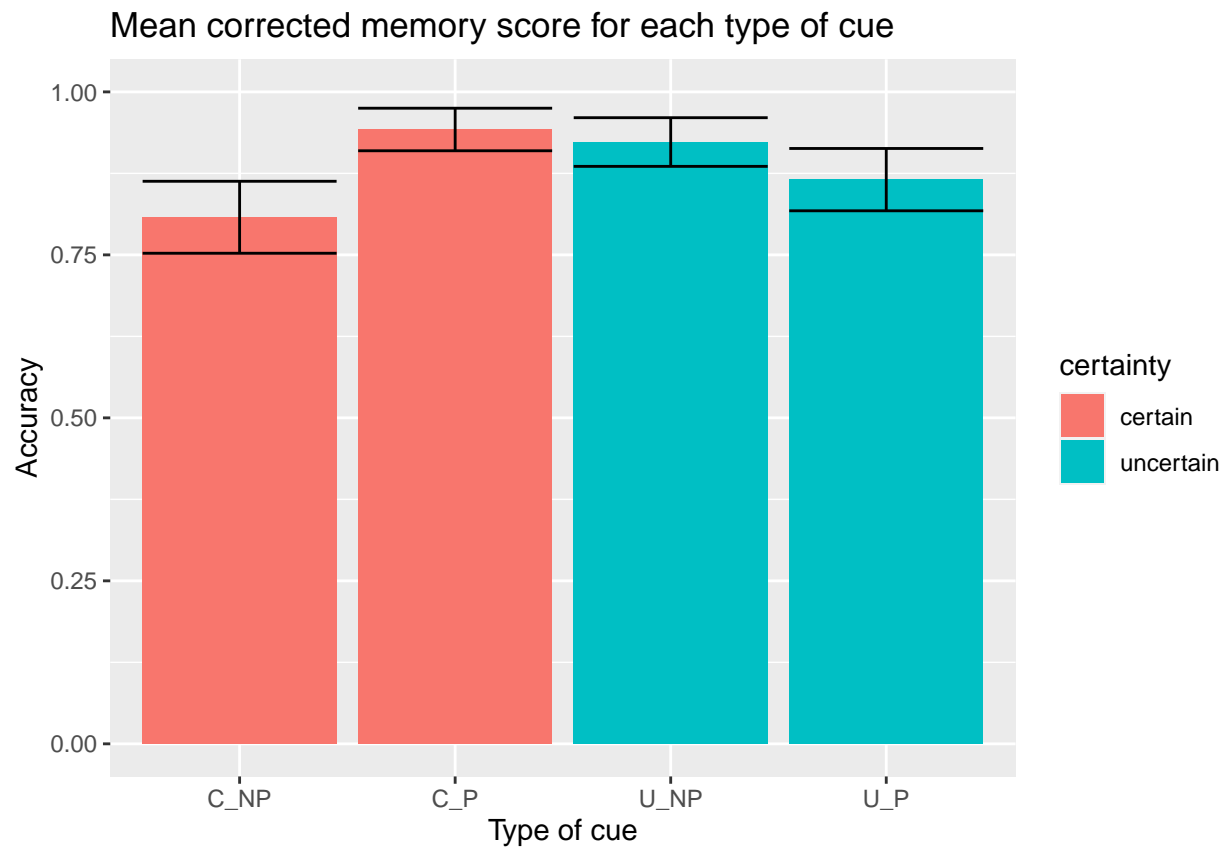
```
## `summarise()` has grouped output by 'cue_type'. You can override using the
## `.groups` argument.
```



## `summarise()` has grouped output by 'pNum', 'certainty'. You can override using  
## the `.groups` argument.

However, in the knights there are no significant effects with bayesian evidence ranging from anecdotal to moderate in favor of the null hypothesis (Certainty:  $F(1, 12) = 0.06$ ,  $p = .809$ ,  $\eta_p^2 < .01$ ,  $BF_{10} = 2.8 \times 10^{-1} \pm 2.4\%$ ; Predictiveness:  $F(1, 12) = 1.59$ ,  $p = .232$ ,  $\eta_p^2 = .12$ ,  $BF_{10} = 5.2 \times 10^{-1} \pm 1.84\%$ ; interaction:  $F(1, 12) = 0.44$ ,  $p = .520$ ,  $\eta_p^2 = .04$ ,  $BF_{10} = 4.1 \times 10^{-1} \pm 3.45\%$ ).

## Accuracy



A repeated measures ANOVA found no significant effects nor interaction. The bayesian evidence was moderate null for Certainty ( $r$  `apa(acc_test_ANOV, effect = "certainty")`,  $BF_{10} = 3.8 \times 10^{-1} \pm 1.32\%$ ), anecdotal null for Predictiveness ( $F(1, 12) = 0.65$ ,  $p = .436$ ,  $\eta_p^2 = .05$ ,  $BF_{10} = 2.9 \times 10^{-1} \pm 0.88\%$ ), and anecdotal alternative for the interaction ( $F(1, 12) = 4.55$ ,  $p = .054$ ,  $\eta_p^2 = .27$ ,  $BF_{10} = 2.6 \times 10^0 \pm 3.89\%$ ).