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 dispalyed in each type of cue was randomly asigned 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 where 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 where 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 where 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 where 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.

Phase 1	Phase 2	Phase 3	Test
AX - O1	0.8CW - O1 / 0.2CW - O2	Phases 1 & 2 intermixed	A vs *a*
AY - O1	0.8CZ - O1 / 0.2CZ - O2		B vs *b*
BX - O2	0.8DW - O2 / 0.2DW - O1		C vs *c*
BY - O2	0.8DZ - O2 / 0.2DZ - O1		D vs *d*
			X vs *x*
			Y vs *y*
			W vs *w*
			Z vs *z*

Results

Training phase

As can be seen in the Figure below, the accuracy to the certain was higher in phase 1, but it seems to decrease 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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```
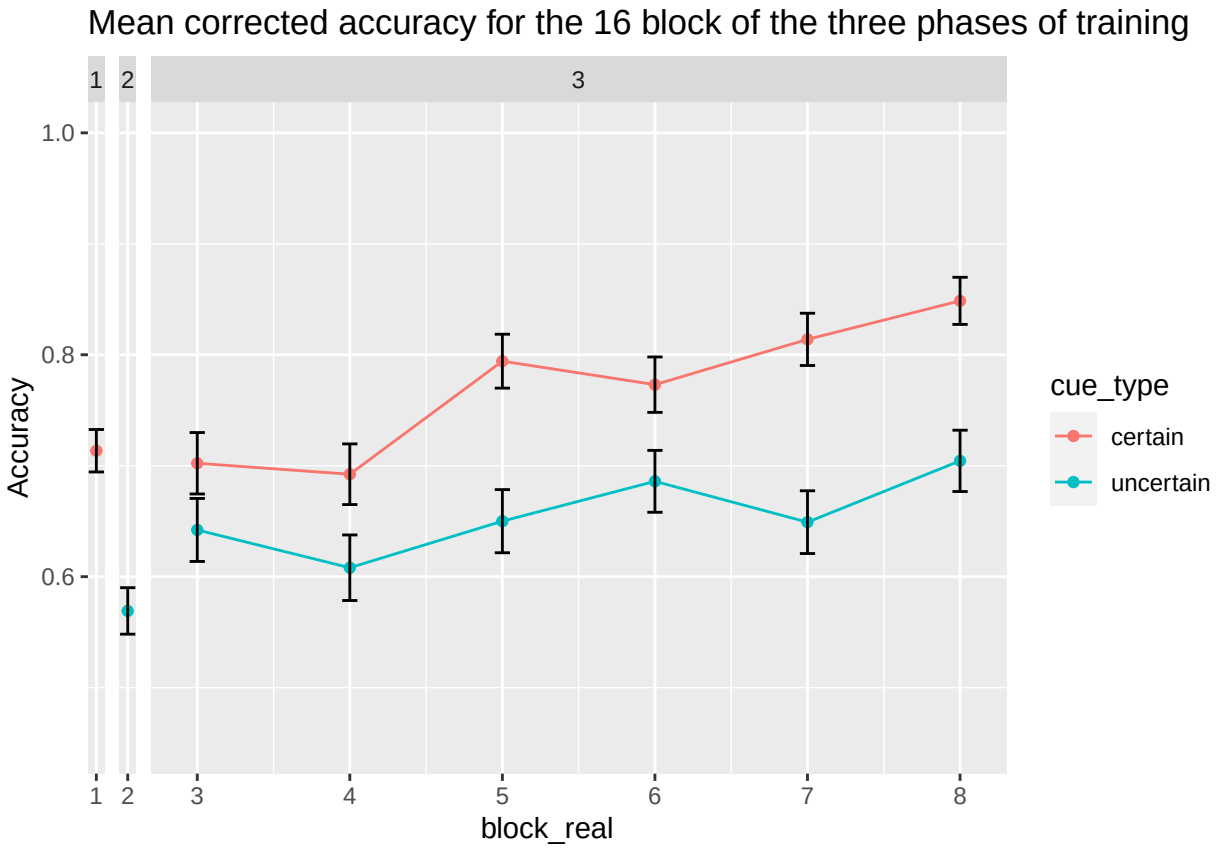



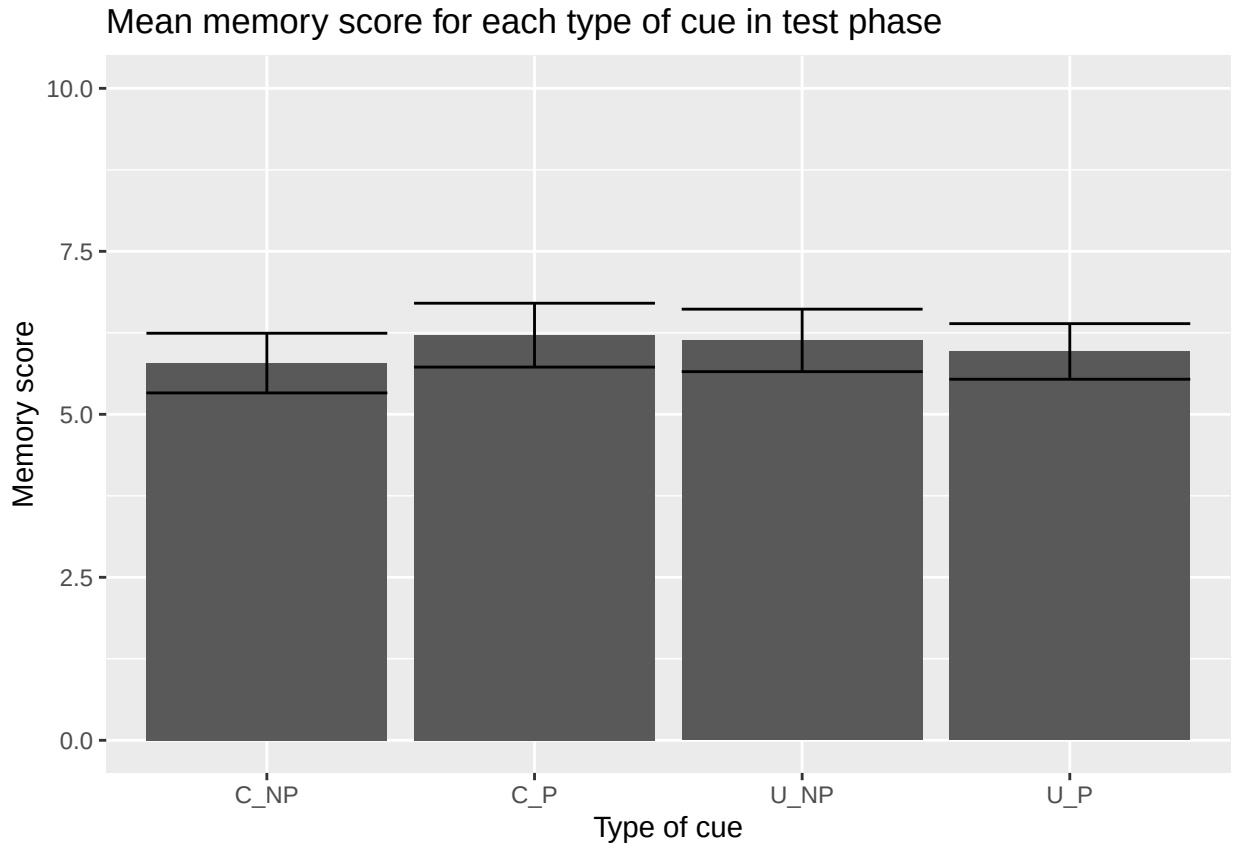
Mean responding throughout the experiment was significantly above chance for both certain and uncertain cues, as confirmed by a one sample t test (Certain: $t(55) = 5.92$, $p < .001$, $d = 0.79$, Uncertain: $t(55) = 5.92$, $p < .001$, $d = 0.79$).

A within-subject ANOVA for phase 3 with the type of cue (certain or uncertain) and the blocks was performed. This ANOVA found both the main effect of the type of cue and of the blocks significant (Blocks: $F(3.49, 94.11) = 4.80$, $p = .002$, $\eta_p^2 = .15$, Cue type: $F(1, 27) = 18.30$, $p < .001$, $\eta_p^2 = .40$), whereas the interaction between them was non significant ($F(5, 135) = 1.47$, $p = .202$, $\eta_p^2 = .05$). There was extremely strong evidence on the effect of the type of cue ($BF_{10} = 2.1x10^{7} \pm 12.4\%$), strong evidence in favor of the effect of block ($BF_{10} = 1.4x10^{1} \pm 0.67\%$) and that there was strong evidence of the non significance of the interaction ($BF_{10} = 8.7x10^{-2} \pm 1.79\%$).

Test phase

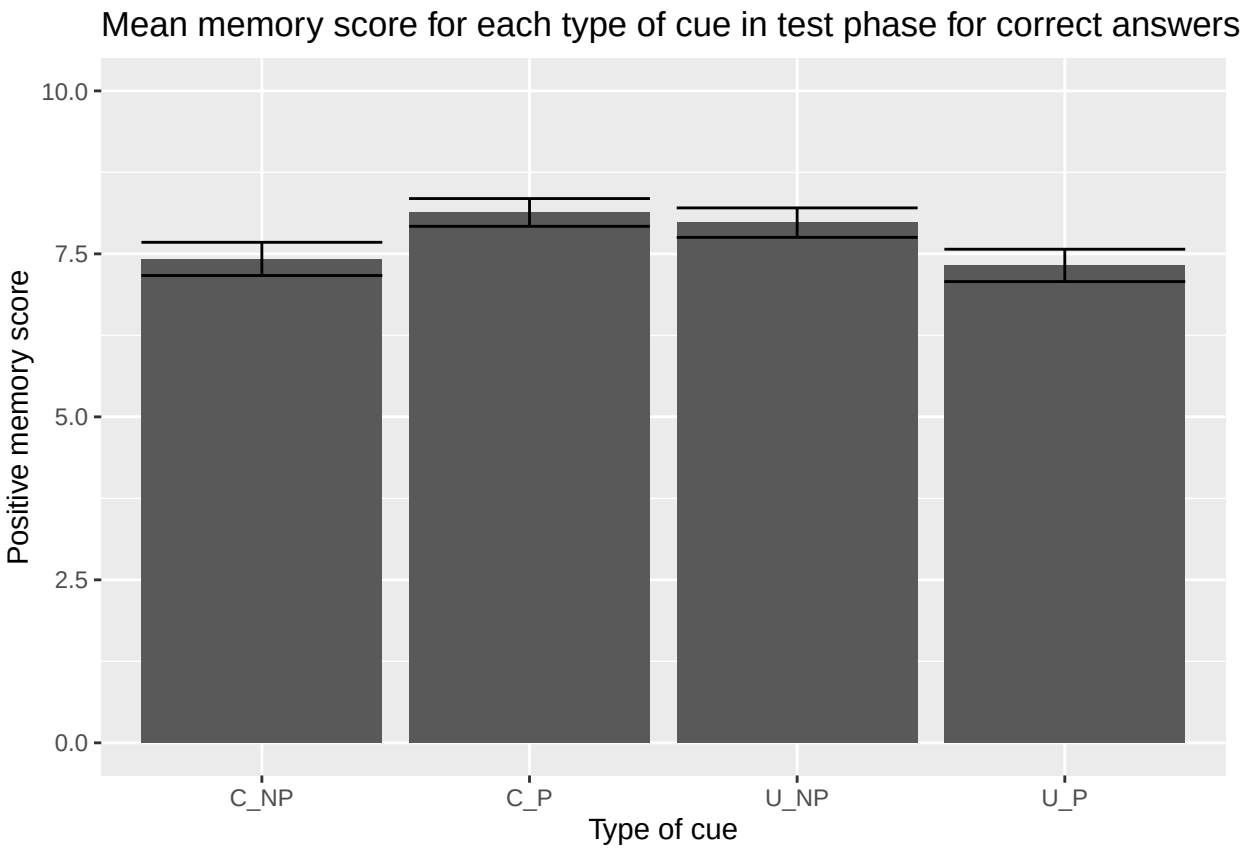
Memory score

In the figure below, it can be seen that the memory score was very similar for all cues, all receiving a score of around 6.



The absence of differences was confirmed by the results of the ANOVA, that yield no significant effect of the certainty or predictiveness the cue, neither their interaction ($F(1, 27) = 0.01$, $p = .928$, $\eta_p^2 < .01$, $F(1, 27) = 0.07$, $p = .792$, $\eta_p^2 < .01$, $F(1, 27) = 0.34$, $p = .564$, $\eta_p^2 = .01$, respectively). There was moderate evidence that the main effects were non significant ($BF_{10} = 2x10^{-1} \pm 3.84\%$, $BF_{10} = 2.1x10^{-1} \pm 1.26\%$), and anecdotal evidence that the interaction was non significant ($BF_{10} = 3.1x10^{-1} \pm 2.76\%$). This indicated that all the cues were remembered similarly.

Corrected memory score

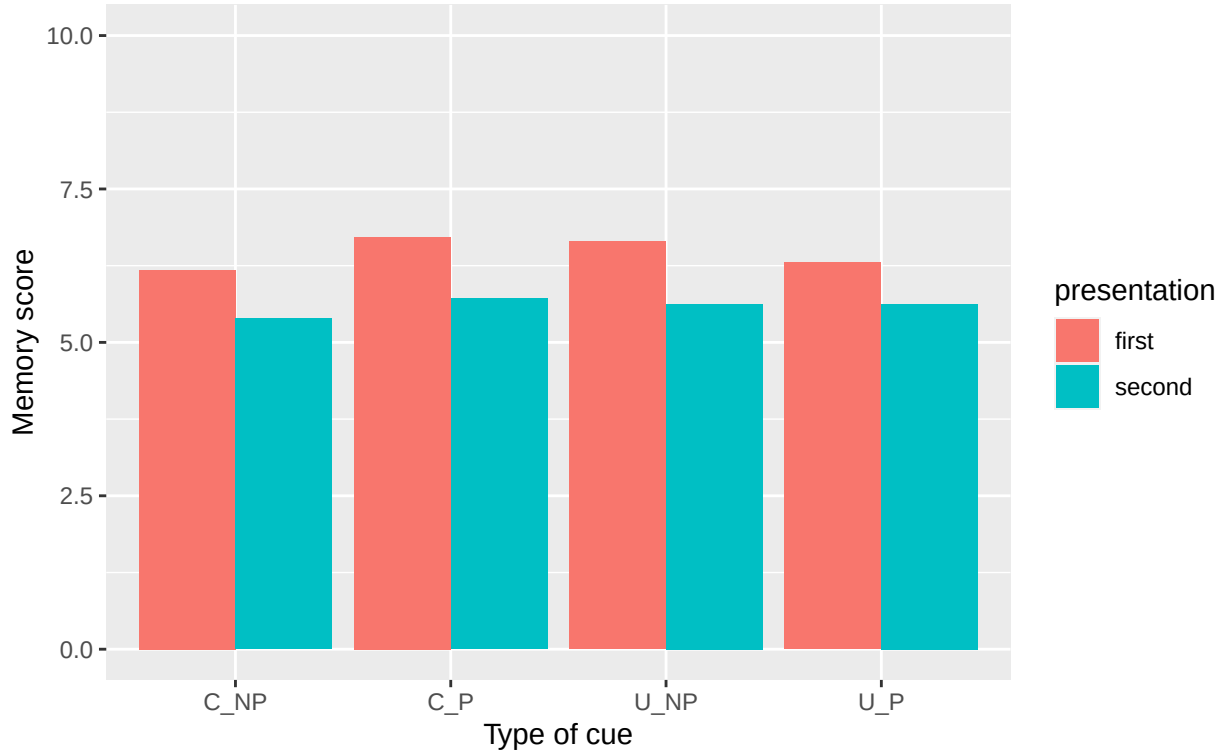


With this measure, a significant effect of the interaction is found ($F(1, 27) = 9.35$, $p = .005$, $\eta_p^2 = .26$)), with moderate bayesian evidence ($BF_{10} = 9.1x10^{0} \pm 2.92\%$). Post hoc comparisons found that there was a significant difference between predictive and non-predictive cues when those were certain ($t(27) = -0.729$, $p = 0.0149$), but not when the cues were uncertain ($t(27) = 0.688$, $p = 0.0913$). Both the main effect of certainty and the main effect of predictiveness were non significant with moderate bayesian evidence ($F(1, 27) = 0.16$, $p = .689$, $\eta_p^2 < .01$, $BF_{10} = 2.1x10^{-1} \pm 0.73\%$; $F(1, 27) = 0.01$, $p = .934$, $\eta_p^2 < .01$, $BF_{10} = 2x10^{-1} \pm 0.79\%$).

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

Figure 2

Mean memory score for each type of cue in test phase




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

```
## Bayes factor analysis
## --------------
## [1] certainty + predictiveness + certainty:predictiveness + pNum : 0.2532305 ±5.68%
##
## Against denominator:
##   mean_mem_score ~ certainty + predictiveness + pNum
## ---
## Bayes factor type: BFlinearModel, JZS
```

```
## Bayes factor analysis
## --------------
## [1] certainty + presentation + certainty:presentation + pNum : 0.1842538 ±4.29%
##
## Against denominator:
##   mean_mem_score ~ certainty + presentation + pNum
## ---
## Bayes factor type: BFlinearModel, JZS
```

```
## Bayes factor analysis
## --------------
## [1] certainty + predictiveness + certainty:predictiveness + presentation + certainty:presentation + p
##
## Against denominator:
##   mean_mem_score ~ certainty + predictiveness + certainty:predictiveness + presentation + certainty:p
## ---
```

```
## Bayes factor type: BFlinearModel, JZS
```