

Recognition Memory

Design

28 subjects were used. Experiment consisted in 3 training phases, followed by a test phase. In training, for a total of 16 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 2 blocks, whereas phase 3 consisted on 12 blocks. All blocks were a sequence of 10 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 5 times across the phase (those that were presented 2 times in the first block were presented 3 in the second and vice versa). Cue 1 was always paired with outcome 1 (10 times total) 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 5 times across the phase (those that were presented 2 times in the first block were presented 3 in the second and vice versa). 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 (note that the distribution across blocks is uneven), 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, so each combination was presented 15 times (again, blocks were uneven). 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.

Phase 1	Phase 2	Phase 3	Test
AX - O1	0.8CW - O1 / 0.2CW - O2	Phases 1 & 2 intermixed	A
AY - O1	0.8CZ - O1 / 0.2CZ - O2		B
BX - O2	0.8DW - O2 / 0.2DW - O1		C
BY - O2	0.8DZ - O2 / 0.2DZ - O1		D
			X
			Y
			W
			Z

Results

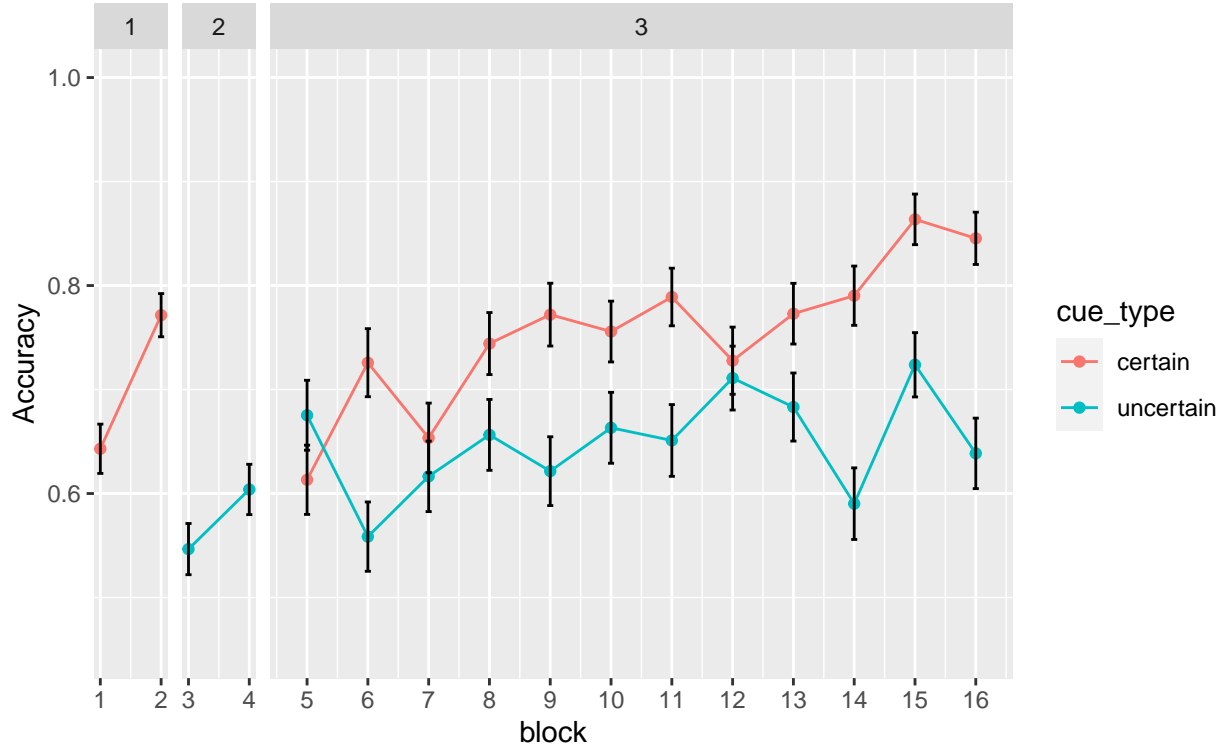
Training phase

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 0.65 at the end of it.

Figure 1

Mean corrected accuracy for the 16 block of the three phases of training



In phase 1, nor the main effect of the experiment or it's interaction with the block were significant ($F(1, 39) = 0.09$, $p = .770$, $\eta_p^2 < .01$, $F(1, 39) = 0.00$, $p = .946$, $\eta_p^2 < .01$). For both, anecdotal evidence for the null hypothesis was found ($BF = 0.3483414 \pm 0.91\%$, $BF = 0.3277184 \pm 2.62\%$). Similar results were found in phase 2 ($F(1, 39) = 0.13$, $p = .721$, $\eta_p^2 < .01$, $F(1, 39) = 3.51$, $p = .068$, $\eta_p^2 = .08$), with still anecdotal evidence against the effect of the experiment ($BF = 0.3355596 \pm 1.02\%$), but anecdotal evidence in favor of the effect of the interaction of the experiment and block. Again, in phase 3, there were no significant effect of the experiment or any of the interactions with that effect (Exp: $F(1, 39) = 0.84$, $p = .365$, $\eta_p^2 = .02$, ExpxBlocks: $F(3.68, 143.60) = 1.96$, $p = .109$, $\eta_p^2 = .05$, ExpxCue: $F(1, 39) = 0.36$, $p = .555$, $\eta_p^2 < .01$, ExpxBlocksxCue $F(5, 195) = 0.87$, $p = .504$, $\eta_p^2 = .02$). Bayesian analysis yielded anecdotal evidence against the main effect ($BF = 0.3491084 \pm 0.79\%$), moderate null evidence for the ExpxCue and ExpxBlocks interactions ($BF = 0.2307687 \pm 7.63\%$, $BF = 0.1490516 \pm 1.47\%$), and very strong evidence for the null hypothesis in the ExpxBlocksxCue interaction ($BF = 0.06828904 \pm 3.2\%$). Given that the effect of the experiment did not seem to have a significant effect on the results, they were re-analysed without including the experiment as a factor.

A within-subject ANOVA for phase 1 showed a significant effect of the block ($F(1, 40) = 13.47$, $p < .001$, $\eta_p^2 = .25$), for which very strong evidence was found ($BF = 43.84792 \pm 1.13\%$). This indicated that the accuracy to certain cues increased from block 1 to block 2. However, in phase 2, there was not a significant effect of the block ($F(1, 40) = 2.60$, $p = .115$, $\eta_p^2 = .06$), finding anecdotal evidence for the null hypothesis ($BF = 0.7254381 \pm 0.97\%$), indicating that participants did not improved their accuracy in phase 2. Regarding phase 3, both the main effect of the type of cue and the block were significant (Block: $F(3.76, 150.45) = 7.11$, $p < .001$, $\eta_p^2 = .15$, Cue type: $F(1, 40) = 21.27$, $p < .001$, $\eta_p^2 = .35$), as well as the interaction between them ($F(5, 200) = 2.36$, $p = .041$, $\eta_p^2 = .06$). There was extreme strong evidence for both main effects ($BF = 496.378 \pm 0.52\%$, $BF = 893649670 \pm 0.84\%$), but there was moderate evidence for the null hypothesis

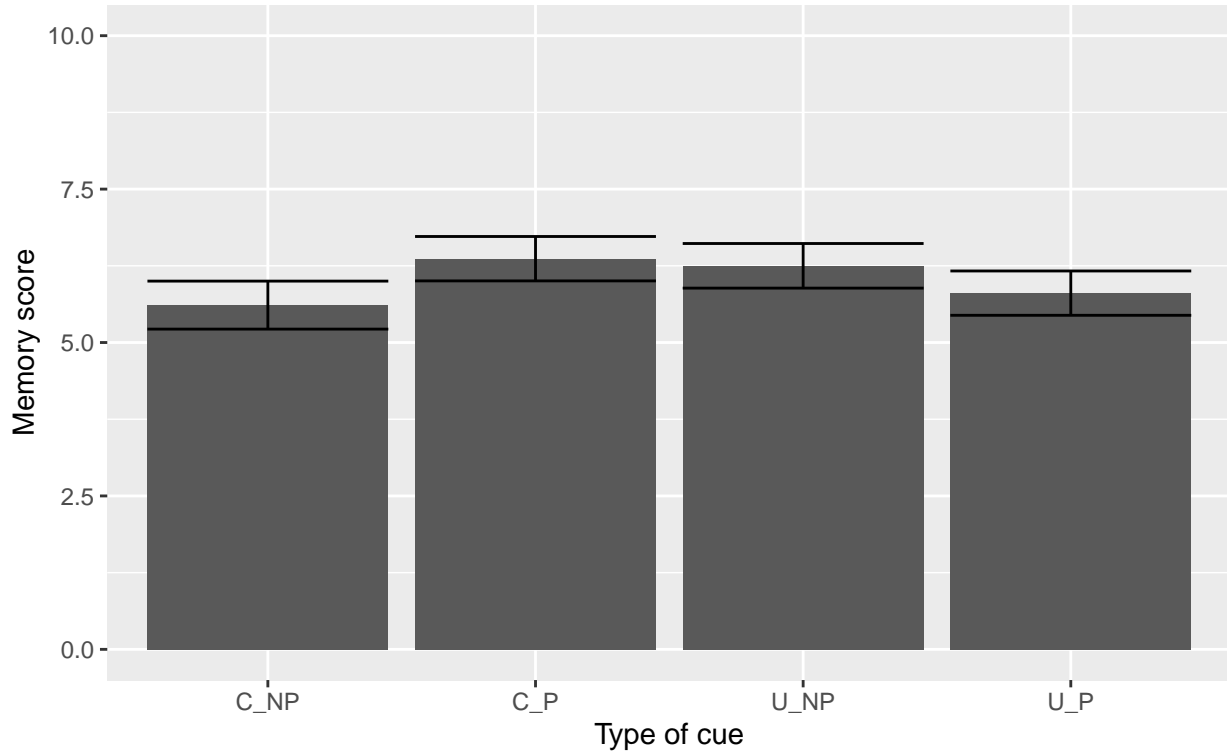
in the interaction ($BF = 0.1988564 \pm 2\%$). This indicates that all subjects improved their performance as training progressed, and that accuracy was better for certain than uncertain cues, especially at the end of the experiment.

Test phase

In the figure below, it can be seen that the memory score was the highest for the certain predictive cues, followed by the uncertain non predictive cues, then uncertain predictive cues, and finally, the certain non-predictive cues had the lowest memory score, but the differences were very subtle.

Figure 2

Mean memory score for each type of cue in test phase



In the test stage, nor the main effect of the experiment nor any of its interactions were significant (Exp: $F(1, 39) = 0.01$, $p = .935$, $\eta_p^2 < .01$, ExpxCertainty: $F(1, 39) = 0.00$, $p = .972$, $\eta_p^2 < .01$, ExpxPredictiveness: $F(1, 39) = 0.01$, $p = .922$, $\eta_p^2 < .01$, ExpxCertaintyxPredictiveness: $F(1, 39) = 1.14$, $p = .292$, $\eta_p^2 = .03$). The evidence for a null effect of the effect of the experiment and its interactions with certainty and with predictiveness was moderate (Exp: $BF = 0.2973762 \pm 9.06\%$, ExpxCertainty: $BF = 0.2352929 \pm 3.44\%$, ExpxPredictiveness: $BF = 0.2306399 \pm 4.19\%$), whereas regarding the threeway interaction there was only anecdotal evidence for the null hypothesis (ExpxCertaintyxPredictiveness: $BF = 0.4520292 \pm 20.98\%$).

When the analysis was repeated without taking into account the effect of the experiment, no significant main effects nor interaction were found (Certainty: $F(1, 40) = 0.01$, $p = .920$, $\eta_p^2 < .01$, Predictiveness: $F(1, 40) = 0.17$, $p = .686$, $\eta_p^2 < .01$, CertaintyxPredictiveness: $F(1, 39) = 3.03$, $p = .090$, $\eta_p^2 = .07$). However, the evidence in favor of the null hypothesis for both the main effect of certainty and predictiveness was moderate ($BF = 0.1666221 \pm 0.9\%$, $BF = 0.1786582 \pm 1.18\%$), being the evidence for the null effect of the interaction anecdotal ($BF = 0.6109978 \pm 2.81\%$).