Contextual cuing in the presence of an overt instruction

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Abstract

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Main text here (Beesley et al., 2015)

Experiment 1

Experiment 1 sought to examine whether the learnt attentional behaviour developed contextual cuing was expressed when participants were directed with a top-down instruction to search in a particular region of the search space. Participants were first trained with a set of four repeating configurations

Method

Participants

Thirty-one undergraduate students from Lancaster University were recruited (mean age = 20.13, SD = 1.09; 17 identified as male and 14 as female) via the Psychology Research Participation System in the Department of Psychology at Lancaster University, in return for the opportunity to use the recruitment system for their own research in future years.

Materials

Participants were tested individually in a quiet room with a Dell laptop with a 15.6" screen, a screen resolution of 1920 x 1080, and a full size external keyboard for participants to use to respond to the task. Participants sat approximately 50 cm from the screen. Stimulus presentation was controlled by MATLAB using the Psychophysics Toolbox extensions (Brainard, 1997; Kleiner, Brainard & Pelli, 2007; Pelli, 1997). Responses to the target stimulus were made by pressing the 'c' or 'n' key on a standard keyboard. All experimental materials are available at the github repository for this study.

Distractor stimuli were an 'L' shape (rotated 0°, 90°, 180°, or 270°) while the target stimulus was a 'T' shape (rotated at either 90° or 270°). Stimuli were arranged in a square

grid of 144 evenly spaced cells (12 x 12) which was positioned centrally on the screen and was XXX mm (XX°) square. The grid itself was invisible to participants. The fixation cross (displayed centrally before each trial) was XX mm (X.X°) square. The stimuli were XX mm (X.X°) square. The background of the screen was grey (RGB: .6, .6, .6) and the stimuli were presented in black. There was a small offset in the vertical line of the 'L' distractors, which increased the similarity between the 'L' distractor and the target 'T', making the search task more difficult (Duncan & Humphreys, 1989).

Design

Procedure

Results

Our criterion for removing outlier data, at both the participant level and the trial level, was 2.5 standard deviations above or below the mean of the sample. On average, trials ended with a timeout on 1.97% of trials (SD = 2.53). Two participants had an usually high proportion of timeouts and were removed from the analysis. The mean accuracy of participants (not including timeout trials) was 98.10% (SD = 1.65%). One participants that had an unusually low proportion of accurate trials and were also removed. The only participant deemed to be an outlier in terms of mean response time (hereafter RT) was also excluded on the basis of the timeout criterion, noted above.

For the remaining twenty-eight participants we removed trials with a timeout and inaccurate trials, before removing outliers from the RT data. On average, the proportion of outliers removed was 3.03% (SD = 0.79%). zero participants had an unusual proportion of trials removed as outlier RTs.

Within-subject error bars were computed by a process of normalising the RT data for the sample (**cousineau2005?**). Figure 1 shows the RT data across the 10 epochs of the experiment. In phase 1 (epochs 1-5) a contextual cuing effect rapidly emerged. In phase 2,

the presence of the guiding arrow had a dramatic effect on the reduction of response times. Despite this, the underlying search configuration continued to play a role in the guidance of attention, with faster response times for (consistent) repeated configurations compared to random configurations.

These data were explored with a Bayesian ANOVA, using the *BayesFactor::anovaBF()* function (for all analyses in this study the priors were set at the default "medium" width). First taking the data from phase 1 (epochs 1-5), the model with the largest Bayes Factor (BF) contained the factors of epoch and configuration (repeated vs. random), BF_{10} = 2.3x10ˆ12. The addition of the interaction term did not substantially improve the model fit, BF_{10} 0.4.

```
## Bayes factor analysis
## --------------
## [1] TT + subj : 18.20867 ±0.73%
##
## Against denominator:
##   meanRT ~ subj
## ---
## Bayes factor type: BFlinearModel, JZS

## Bayes factor analysis
## --------------
## [1] TT + subj : 0.2778776 ±1.72%
##
## Against denominator:
##   meanRT ~ subj
## ---
## Bayes factor type: BFlinearModel, JZS
```

```
## Bayes factor analysis
## --------------
## [1] TT + subj : 10.34537 ±1.39%
##
## Against denominator:
##   meanRT ~ subj
## ---
## Bayes factor type: BFlinearModel, JZS
```

A Bayesian ANOVA on the data from phase 2 (epochs 6-10) found significant support for the model containing the factor of configuration, BF_{10} = 3.8x10^2. There was evidence to suggest that the addition of the factor of epoch did not substantially improve the model predictions, BF_{10} 0.0.

```
## Anova Table (Type 3 tests)
##
## Response: meanRT
##     Effect           df       MSE       F  ges p.value
## 1       TT  1.95, 52.75  70324.29 7.17 ** .021    .002
## 2    epoch  2.18, 58.91 125085.52    0.88 .005    .430
## 3 TT:epoch 5.14, 138.75  48674.61    1.22 .007    .304
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '+' 0.1 ' ' 1
##
## Sphericity correction method: GG

##
##  Welch Two Sample t-test
```

```
##
## data:  meanRT by TT
## t = -2.6582, df = 277.56, p-value = 0.008311
## alternative hypothesis: true difference in means between group Repeated: consistent a
## 95 percent confidence interval:
##  -180.04444  -26.83853
## sample estimates:
## mean in group Repeated: consistent               mean in group Random
##                           1272.598                           1376.039

##
##  Welch Two Sample t-test
##
## data:  meanRT by TT
## t = -0.037309, df = 276.73, p-value = 0.9703
## alternative hypothesis: true difference in means between group Repeated: inconsistent
## 95 percent confidence interval:
##  -79.22693  76.27970
## sample estimates:
## mean in group Repeated: inconsistent                 mean in group Random
##                             1374.566                             1376.039

##
##  Welch Two Sample t-test
##
## data:  meanRT by TT
## t = -2.5333, df = 277.78, p-value = 0.01185
## alternative hypothesis: true difference in means between group Repeated: consistent a
```

```
## 95 percent confidence interval:
##  -181.20322  -22.73253
## sample estimates:
##   mean in group Repeated: consistent mean in group Repeated: inconsistent
##                              1272.598                              1374.566
```

Experiment 2

Experiment 2 sought to examine ...

Method

Participants

Thirty-one undergraduate students from Lancaster University were recruited (mean age = 20.13, SD = 1.09; 17 identified as male and 14 as female) via the Psychology Research Participation System in the Department of Psychology at Lancaster University, in return for the opportunity to use the recruitment system for their own research in future years.

Materials

The materials and stimuli were identical to Experiment 1.

Design

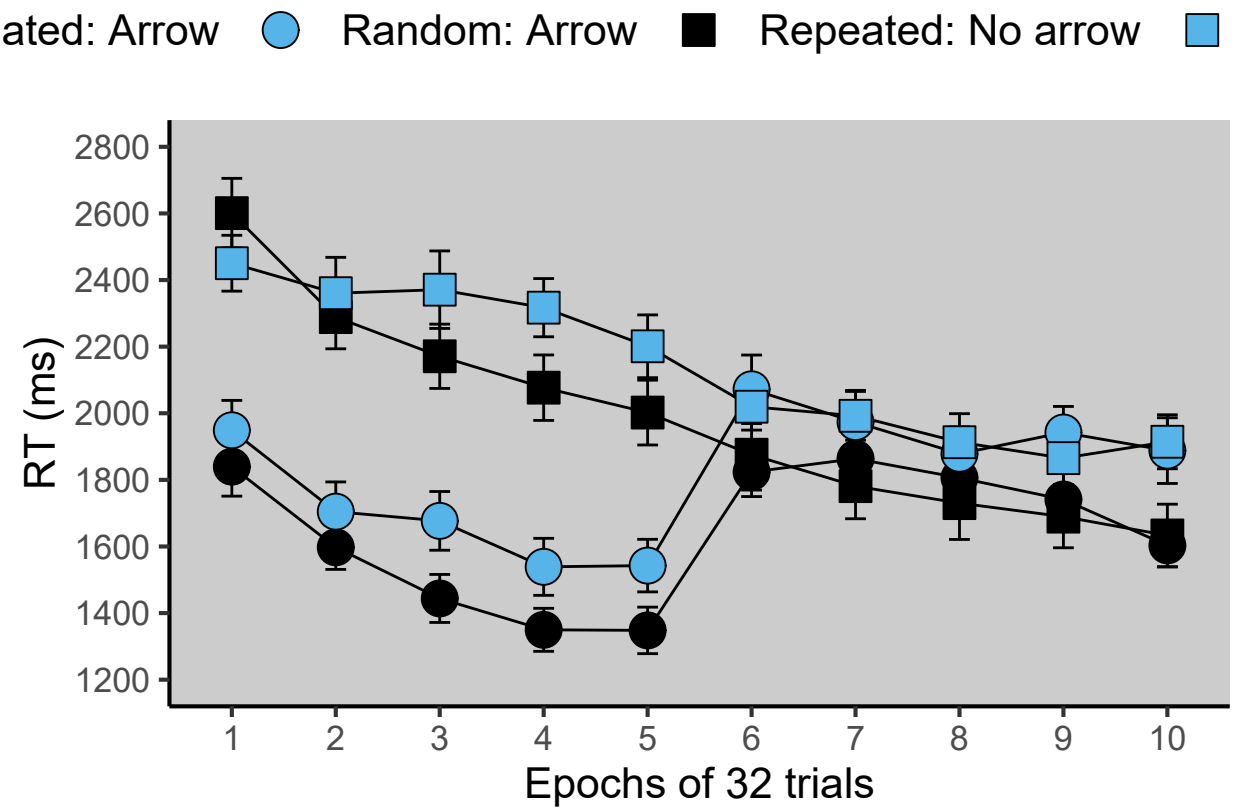
Procedure

Results

Our criteria for removing outlier data were identical to Experiment 1. On average, trials ended with a timeout on 2.13% of trials (SD = 1.83). Zero participants had an usually high proportion of timeouts. The mean accuracy of participants (not including timeout trials) was 95.85% (SD = 6.10%). One participants that had an unusually low

proportion of accurate trials and were also removed. Zero participants were deemed to be an outlier in terms of mean RT.

For the remaining thirty-three participants we removed trials with a timeout and inaccurate trials, before removing outliers from the RT data. On average, the proportion of outliers removed was 2.81% (SD = 1.04%). one participants had an unusual proportion of trials removed as outlier RTs and were not included in the final analysis.




```
## Anova Table (Type 3 tests)
##
## Response: meanRT
##                Effect           df       MSE          F   ges p.value
## 1          patArrowP1        1, 32 442144.07 175.06 ***  .313   <.001
## 2                  TT        1, 32 151825.16  21.10 ***  .019   <.001
## 3               epoch 3.13, 100.03 200796.66  24.76 ***  .084   <.001
```

```
## 4       patArrowP1:TT        1, 32 164480.86       0.74 <.001    .395
## 5    patArrowP1:epoch 3.34, 107.03 147265.04       0.61  .002    .630
## 6            TT:epoch 3.48, 111.28  89997.46    4.53 **  .008    .003
## 7 patArrowP1:TT:epoch 3.39, 108.43  62430.81     2.24 +  .003    .080
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '+' 0.1 ' ' 1
##
## Sphericity correction method: GG

## Bayes factor analysis
## --------------
## [1] patArrowP1 + TT + patArrowP1:TT + subj : 0.1670034 ±4.86%
##
## Against denominator:
##   meanRT ~ patArrowP1 + TT + subj
## ---
## Bayes factor type: BFlinearModel, JZS

## Anova Table (Type 3 tests)
##
## Response: meanRT
##                Effect           df       MSE         F   ges p.value
## 1          patArrowP1        1, 32 107851.75      0.48 <.001    .493
## 2                  TT        1, 32 117763.13 51.20 ***  .035   <.001
## 3               epoch 3.44, 109.95  79887.36 10.79 ***  .017   <.001
## 4       patArrowP1:TT        1, 32 284015.04      0.04 <.001    .850
## 5    patArrowP1:epoch 3.58, 114.51  94104.45      0.47 <.001    .737
## 6            TT:epoch 3.39, 108.54  89788.68      1.46  .003    .227
```

```
## 7 patArrowP1:TT:epoch 3.70, 118.33  97123.16      0.75  .002    .549
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '+' 0.1 ' ' 1
##
## Sphericity correction method: GG

## Bayes factor analysis
## --------------
## [1] patArrowP1 + TT + patArrowP1:TT + subj : 0.13439 ±7.56%
##
## Against denominator:
##   meanRT ~ patArrowP1 + TT + subj
## ---
## Bayes factor type: BFlinearModel, JZS
```

Experiment 3

Experiment 3 sought to examine ...

Method

Participants

Forty-three undergraduate students from Lancaster University were recruited (mean age = 18.65, SD = 2.81; 29 identified as male and 12 as female) via the Psychology Research Participation System in the Department of Psychology at Lancaster University, in return for the opportunity to use the recruitment system for their own research in future years.

Materials

The materials and stimuli were identical to Experiment 1.

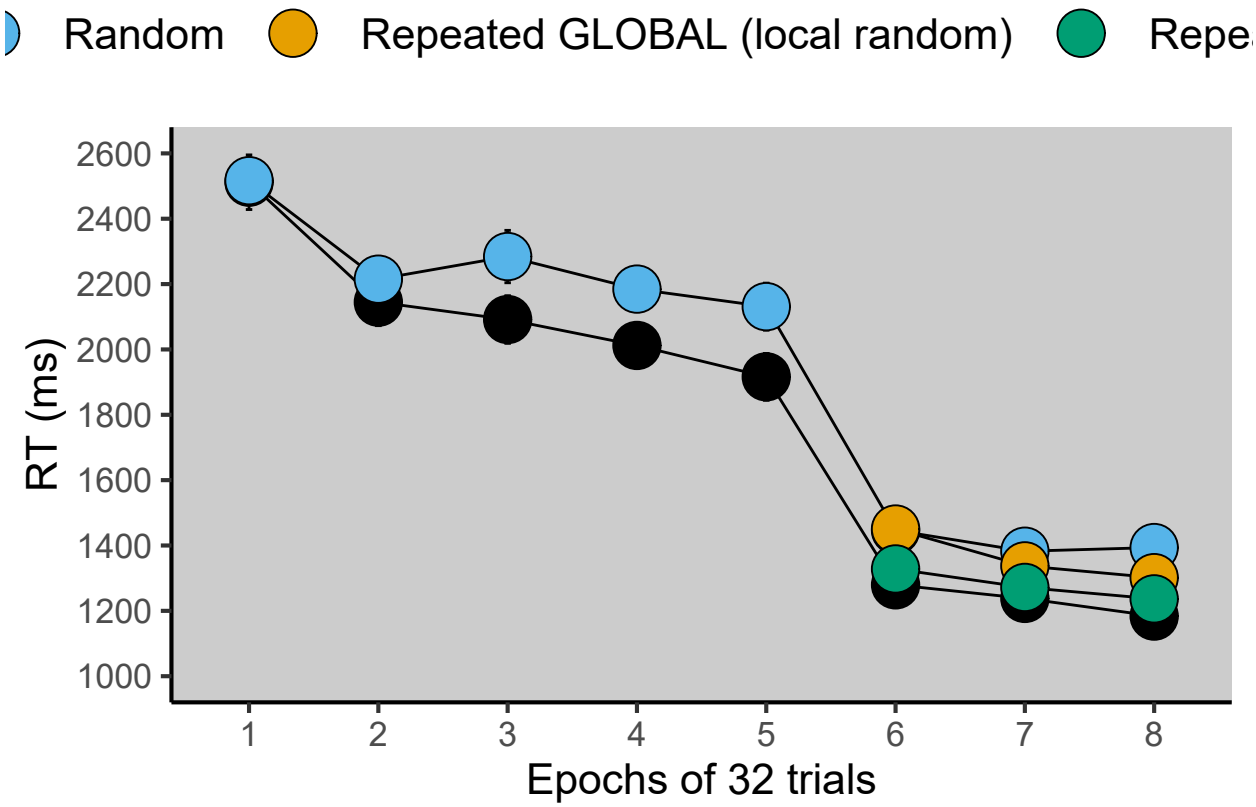
Design

Procedure

Results

Our criteria for removing outlier data were identical to Experiment 1. On average, trials ended with a timeout on 3.33% of trials (SD = 4.08). One participants had an usually high proportion of timeouts. The mean accuracy of participants (not including timeout trials) was 96.12% (SD = 8.47%). Two participants that had an unusually low proportion of accurate trials and were also removed. Zero participants were deemed to be an outlier in terms of mean RT.

For the remaining forty participants we removed trials with a timeout and inaccurate trials, before removing outliers from the RT data. On average, the proportion of outliers removed was 3.13% (SD = 0.72%). zero participants had an unusual proportion of trials removed as outlier RTs and were not included in the final analysis [EAF4S].




```
## Anova Table (Type 3 tests)
##
## Response: meanRT
##     Effect           df       MSE         F  ges p.value
## 1       TT        1, 39  84371.29 20.35 *** .021   <.001
## 2    epoch 3.41, 132.99 110399.09 29.89 *** .121   <.001
## 3 TT:epoch 3.69, 144.06  67824.76    2.57 * .008    .045
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '+' 0.1 ' ' 1
##
## Sphericity correction method: GG
```

```
## Bayes factor analysis
```

```
## --------------
## [1] TT + subj : 173.5747 ±1.06%
##
## Against denominator:
##   meanRT ~ subj
## ---
## Bayes factor type: BFlinearModel, JZS

## Anova Table (Type 3 tests)
##
## Response: meanRT
##     Effect           df      MSE         F  ges p.value
## 1       TT 2.71, 105.61 31057.96 26.59 *** .043   <.001
## 2    epoch  1.78, 69.46 51362.09  8.72 *** .016   <.001
## 3 TT:epoch 4.44, 173.24 38443.76      0.77 .003    .558
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '+' 0.1 ' ' 1
##
## Sphericity correction method: GG

## Bayes factor analysis
## --------------
## [1] TT + subj : 50854626647 ±0.58%
##
## Against denominator:
##   meanRT ~ subj
## ---
## Bayes factor type: BFlinearModel, JZS
```

```
## Bayes factor analysis
## --------------
## [1] TT + subj : 0.8317226 ±1.52%
##
## Against denominator:
##   meanRT ~ subj
## ---
## Bayes factor type: BFlinearModel, JZS

## Bayes factor analysis
## --------------
## [1] TT + subj : 1029916 ±0.93%
##
## Against denominator:
##   meanRT ~ subj
## ---
## Bayes factor type: BFlinearModel, JZS

## Bayes factor analysis
## --------------
## [1] TT + subj : 10499.63 ±0.99%
##
## Against denominator:
##   meanRT ~ subj
## ---
## Bayes factor type: BFlinearModel, JZS

## Bayes factor analysis
```

```
## --------------
## [1] TT + subj : 0.7493755 ±1.46%
##
## Against denominator:
##   meanRT ~ subj
## ---
## Bayes factor type: BFlinearModel, JZS

## Bayes factor analysis
## --------------
## [1] TT + subj : 38.51458 ±1.1%
##
## Against denominator:
##   meanRT ~ subj
## ---
## Bayes factor type: BFlinearModel, JZS

##
##  Paired t-test
##
## data:  meanRT by TT
## t = 4.0807, df = 119, p-value = 8.159e-05
## alternative hypothesis: true mean difference is not equal to 0
## 95 percent confidence interval:
##   43.40317 125.22884
## sample estimates:
## mean difference
##        84.31601
```

References

Beesley, T., Vadillo, M. A., Pearson, D., & Shanks, D. R. (2015). Pre-exposure of repeated search configurations facilitates subsequent contextual cuing of visual search. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *41*(2), 348–362. https://doi.org/10.1037/xlm0000033

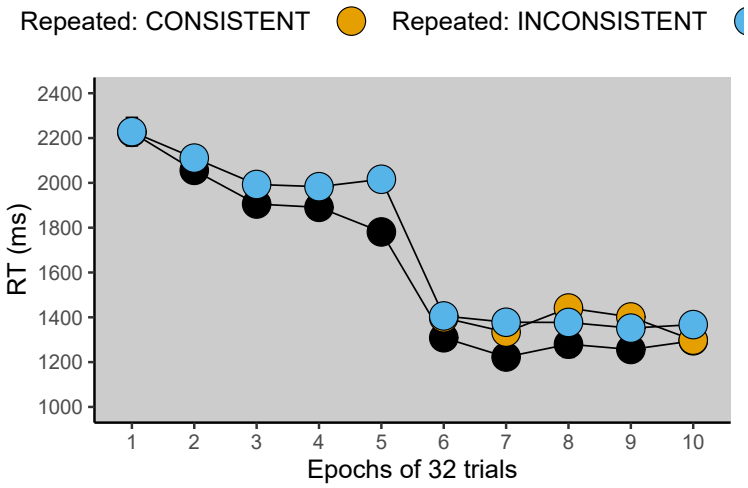


Figure 1

RT data for Experiment 1.