Piloting the use of the Modified Attention Network Task in Children

Here we will briefly report on the pilot study carried out to ascertain whether load effects could be achieved by adding an additional five arrows above or below the stimuli presented in both congruent and incongruent trials of the Attention Network Task (ANT) task. The effect of stimulus size and varying the target time below 120ms was also investigated.

Methods

Participants

Twelve children (7 female) aged between 7 and 10yrs (average age 8.33) were recruited from a school local to Reading University.

Materials

Participants were tested using a Toshiba lap-top running Eprime V2. Testing took place in a quiet, school library area. Furthermore testing took place during class time and there was little noise interference.

6.2.2.3 Procedure

Participants performed two blocks (each of 80 trials) of a modified ANT task with either large (157 font) or small (70 font) stimuli. Following an initial fixation screen shown for 2000ms, either a centre cue, a double cue, a spatial cue, or no cue, was displayed for 120ms and randomised so that each cue appeared with equiprobability. There was then a further short fixation period of 450ms. The stimuli were then displayed either above or below the fixation point for 120ms and could be congruent, incongruent or neutral depending on the direction of the arrow and whether there were flanker arrows or not (see Figure 1). Neutral trials (a single arrow) were considered to be low load with congruent and incongruent trials either being medium load (one row of 5 arrows) or high load (two rows of 5 arrows). Stimuli position, congruence, and load were randomised so that each were displayed with equiprobability. Participants were instructed to press the mouse button corresponding to the direction of the central arrow and had a 1000ms window to do so extending into the following fixation slide.

The duration of the test session was 20 minutes and included a practice trial with a target duration of 1000ms. Participants did not progress to the main tasks with a target duration of 120ms until they were able to perform the practice task with at least 60% accuracy. If they progressed through the initial training stage rapidly, and time therefore permitted, further trials were completed where target duration was varied. This was achieved with 6 participants completing further trials with the small stimuli and 4 with the large.

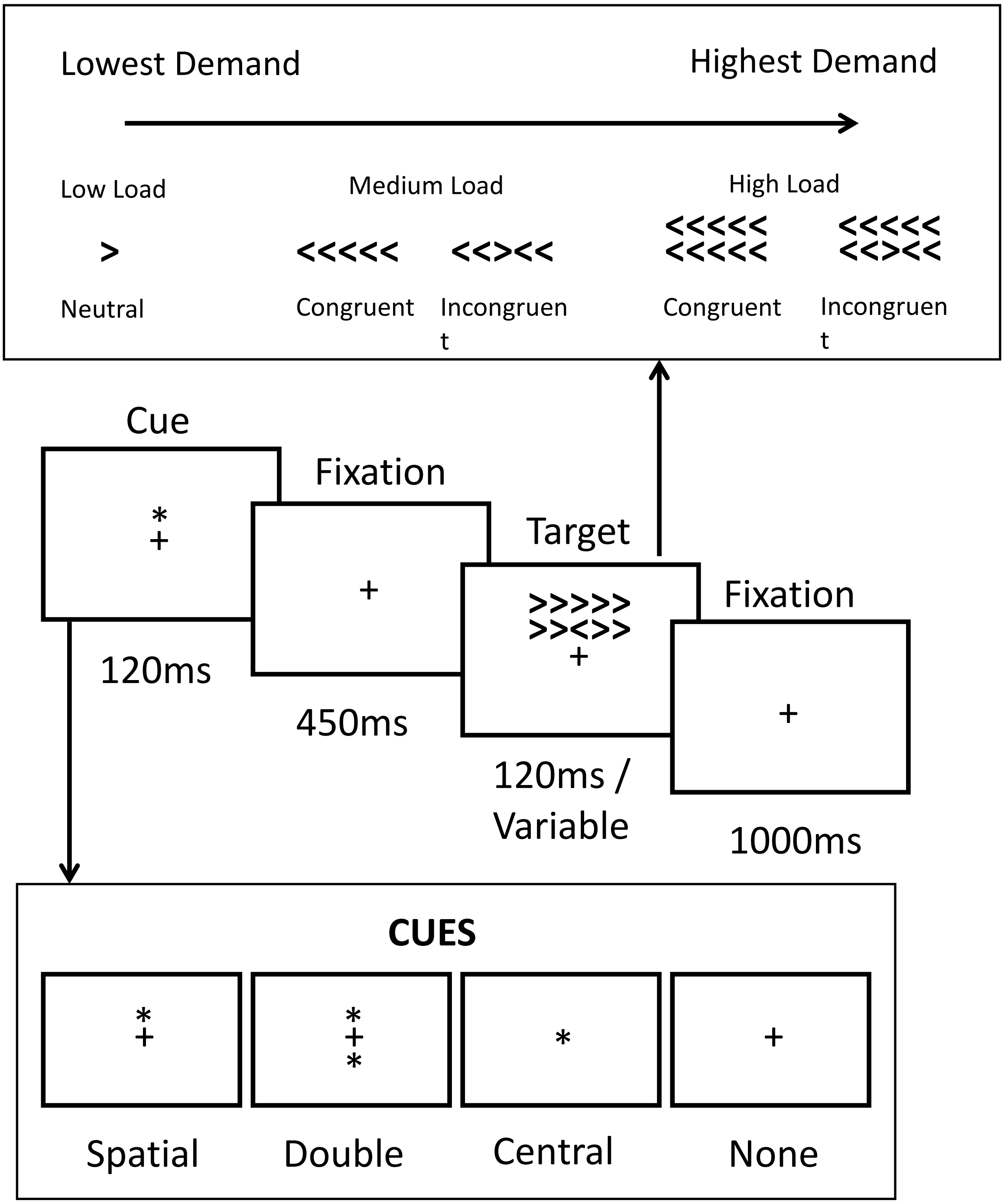

Figure 1 Schematic of the MANT. Stimuli were presented in separate blocks at font sizes of either 70 or 157. Cognitive demand was considered to be lowest for neutral/low load trials, and highest for incongruent/high load trials.

Data Treatment

In order to confirm whether load and congruency effects had been effectively manipulated, separate one way ANOVAs for both small and large stimuli on both measures were performed for both small and large stimuli with response times and accuracy as dependent variables. Given the exploratory nature of this analysis it was decided to employ the less parsimonious LSD post-hoc test. To confirm the effects of cueing, separate t-tests for the double and no cue comparison, and the central and spatial cue comparison were performed. These t-tests were performed for both small and large stimuli with response times and accuracy as dependent variables.

6.2.3 Results

Response time: A one way ANOVA found a significant response time (RT) effect of load for both large, $F(2,22) = 31$, $p < .001$, $\eta_p^2 = .738$, observed power = .1.00, and small stimuli, $F(2,20) = 9.42$, $p = .001$, $\eta_p^2 = .485$, observed power = .958. As can be seen from Figures 2A and 2B, post hoc analysis revealed significant differences between all loads for the large stimuli block with the low load showing the fastest RT and the high load the slowest. However for the small stimuli block there was little difference between the medium and high loads, thus indicating that large stimuli presentation is particularly sensitive to load at all levels (significance levels for all post hoc contrasts are given in Table 2 below).

As would be predicted from Rueda et al. (2004), a one way ANOVA found a RT effect of congruence for both large, $F(2,22) = 50.9$, $p < .001$, $\eta_p^2 = .822$, observed power = 1.00, and small stimuli, $F(2,20) = 22.8$, $p < .001$, $\eta_p^2 = .695$, observed power = 1.00**.** All congruence comparisons as shown in Figure 2D were significant for the large stimuli with the neutral trials showing the fastest RT and incongruent trials the slowest., However, the comparison between neutral and congruent trials (Figure 2C) failed to reach significance for the small stimuli thus indicating that large stimuli are particularly sensitive to all congruence manipulations (significance levels for all post hoc contrasts are given in Table 1 below).

As shown in Figure 2E and 2F below, within subject t-test analyses revealed that, for the large stimulus condition, there was a significant difference between Double and No cue conditions for both large, $t(11) = -5.27$, $p <.001$, $r = .84$, and small stimuli, $t(10) = -3.84$, $p = .003$, $r = .932$. No significant differences were found for either stimulus size for the central and spatial cue comparisons. There is therefore a reliable alerting effect for both stimulus sizes, however, there is little orientation effect.

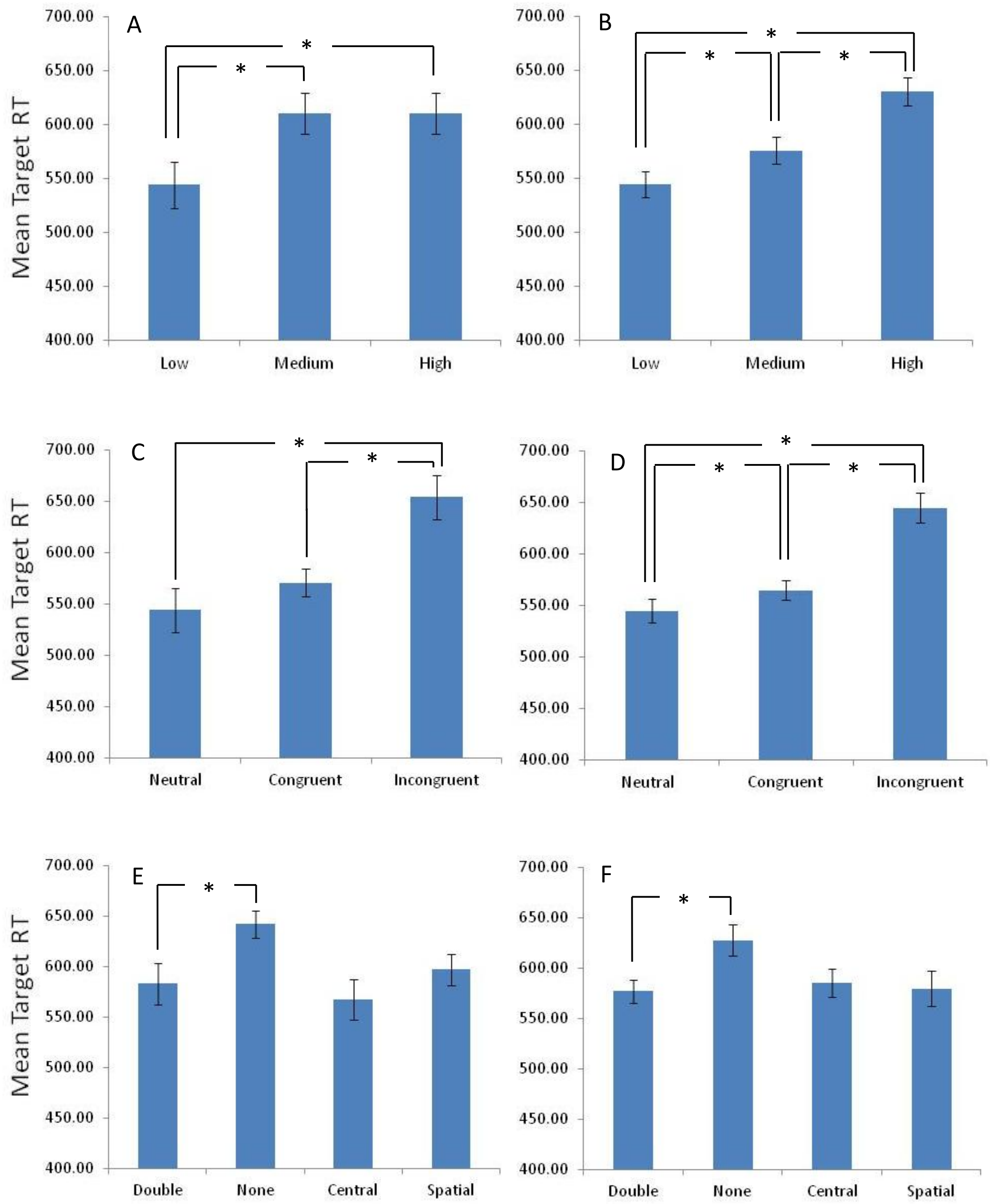

Figure 2: Mean RT (±CI) as a function of load for A) small stimuli and B) large stimuli, as a function of congruence for C) small stimuli and D) large stimuli, and as a function of cue type for E) small stimuli and F) large stimuli. Significant differences can be seen between all loads for B) large stimuli, however there is no difference between medium and high loads for A) small stimuli. Significant differences can be seen between all congruency comparisons for D) large stimuli, however there is no difference between neutral and congruent trials for C) the small stimuli. Significant differences can be seen for both stimuli sizes, E) and F), between double and no cue conditions but not for central and spatial conditions.

Table 1. Summary of the RT significance values for load, congruence and cue manipulations by stimulus size.

Contrast	Small	Large
High/Low Load	$p = .009$	$p < .001$
High/Medium Load	*ns*	$p < .001$
Medium/Low Load	$p = .002$	$p = .016$
ANOVA Load	$p = .001$	$p < .001$
Con/Incon	$p < .001$	$p < .001$
Neut/Incon	$p < .001$	$p < .001$
Con/Neut	*ns*	$p = .021$
ANOVA Congruence	$p < .001$	$p < .001$
Double/None	$p = .013$	$p = .001$
Central/Spatial	*ns*	*ns*

Accuracy: A one way ANOVA found a significant accuracy effect of load for both large, $F(2,22) = 13.3$, $p <.001$, $\eta_p^2 = .548$, observed power = .994, and small stimuli, $F(2,20) = 22.1$, $p < .001$, $\eta_p^2 = .689$, observed power = 1.00. As can be seen in Figure 3A below, post hoc analysis revealed significant differences between all load comparisons for the large stimuli with low load responses being the most accurate and high load the least. However there was no significant difference between the medium and high loads for the small stimuli thus indicating that, for accuracy, large stimuli presentation is particularly sensitive to load at all levels (significance levels for all post hoc contrasts are given in Table 2 below).

A one way ANOVA found a significant accuracy effect of congruence for both large, $F(1.14,12.5) = 22.6$, $p < .001$, $\eta_p^2 = .672$, observed power = 1.00, and small stimuli, $F(1.09,10.9) = 27.5$, $p < .001$, $\eta_p^2 = .733$, observed power = .998**.** Post hoc analysis for both stimulus sizes, revealed significant differences were constrained to incongruent/congruent trials and incongruent/neutral trials, but not for neutral congruent trials (see Figure 3C and 3D). This indicates that, regardless of stimuli size, for accuracy measures, there is little difference in performance between neutral and congruent trials.

The different types of cue had no effect on accuracy with there being no significant difference between the alerting or orienting comparisons. This finding replicates those reported by Rueda et al. (2004) who also only found RT but not accuracy effects for their cueing measures.

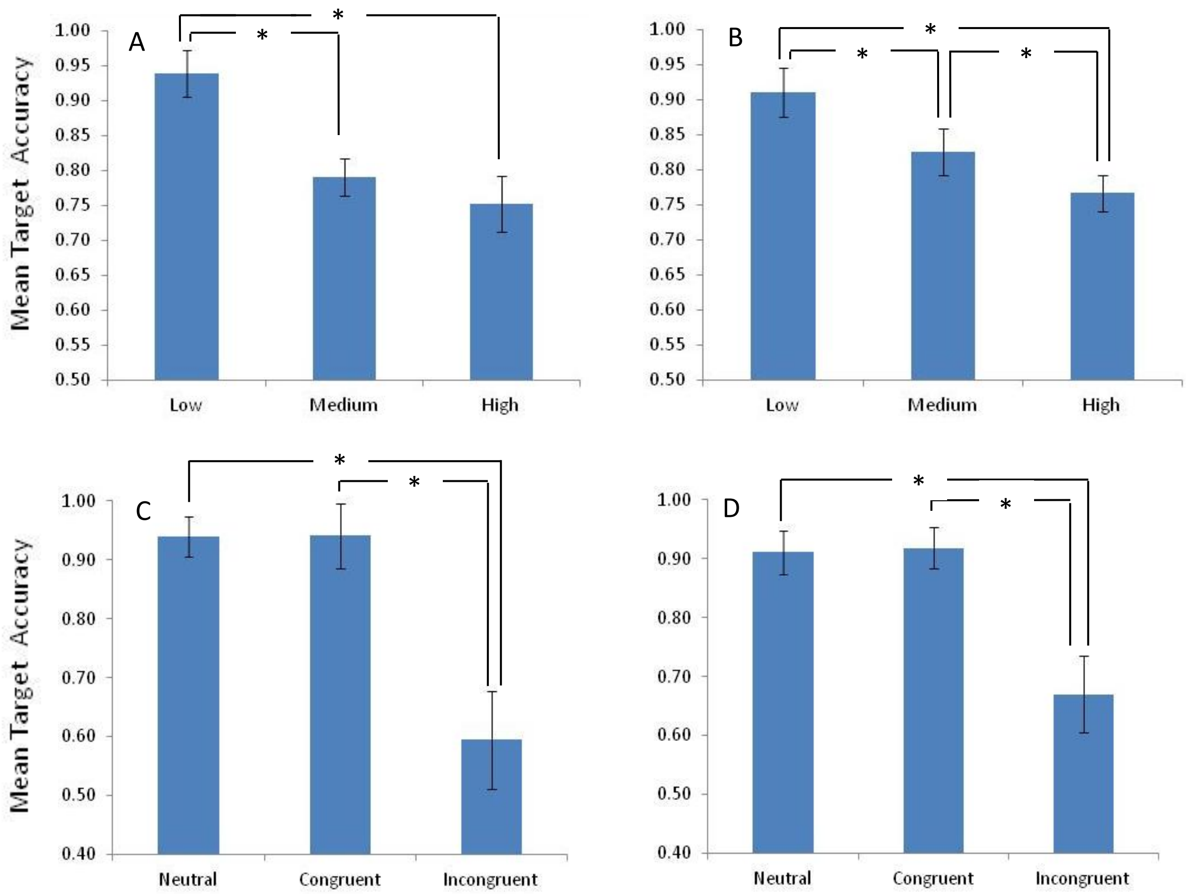

Figure 3: Mean accuracy (±CI) as a function of load for A) small stimuli and B) large stimuli, and as a function of congruence for C) small stimuli and D) large stimuli. Significant differences can be seen between all loads for B) large stimuli, however there is no difference between medium and high loads for A) small stimuli. Significant differences can be seen for both stimulus sizes C) and D) for neural/incongruent and congruent/incongruent but not for neutral/congruent comparisons.

Table 2. Summary of the accuracy significance values for load, congruence and cue manipulations by stimulus size.

Contrast	small	large
High/Low Load	$p < .001$	$p < .001$
High/Medium Load	*ns*	$p = .024$
Medium/Low Load	$p < .001$	$p = .042$
ANOVA Load	$p < .001$	$p < .001$
Con/Incon	$p = .001$	$p < .001$
Neut/Incon	$p < .001$	$p = .001$
Con/Neut	*ns*	*ns*
ANOVA Congruence	$p < .001$	$p < .001$
Double/None	*ns*	*ns*
Central/Spatial	*ns*	*ns*

Finally, when comparing the different durations of stimuli presentation no significant difference between the 120ms and 90ms (n= 6 small stimuli; n = 4 large stimuli) were seen on any measure with the exception of central cueing RT and double cueing accuracy for the large stimulus. On the whole the pattern of results was similar between the two speeds. Given that one effect of the faster speed was to slightly reduce the congruence and load effects, the 120ms duration would seem to be adequate to be progressed to the main task.

6.2.4 Discussion

The results from this pilot show that differences in RT performance can be successfully manipulated dependent on levels of visual load and congruence. This effect can be found for both large and small stimuli, however, it is particularly sensitive for the large stimuli where significant differences between all visual load and congruence levels were recorded. Differences between the alerting network measures (double/no cue) but not the orienting measures (central/spatial cue) were found for both stimulus sizes. This finding is perhaps not surprising, as Rueda et al. (2004), whilst finding an overall significant cue effect on their version of the ANT, report less difference between the orienting central and spatial measures than the alerting double and no cue measures for children for children in the 7 – 10 year old bracket.

Similar effects were also found for the accuracy measures, where, it can be seen that performance can be successfully manipulated dependent on levels of visual load and congruence. Again this effect was found to be particularly sensitive for visual load with the large stimuli, though on this occasion performance was similar for both stimuli sizes for congruency. No significant effects were found for the cueing measures.

It would therefore seem that this task is particularly sensitive to both to RT and accuracy measures using large stimuli and would be suitable for measuring the cumulative effects of load and congruency together.