School of Psychology Coursework Form

Year 1

Module Title or Number: PSY1017

Assignment Title: Beyond Faces: immunity of distractor hands to the effects of perceptual load.

Student URN: xxxxxx

Abstract

The perceptual load theory of attention accounts for contradictory research supporting both early and late selection models, but faces have been shown to be immune to the effects of perceptual load. This study addresses whether this exception applies to other body parts, specifically hands. Participants had to identify one of two target letters, ignoring hand distractors at varying levels of perceptual load. The hands were immune to the effects of perceptual load, with a significant difference between congruent and incongruent trials at all levels of perceptual load. This suggests there are more exceptions to perceptual load than first thought, which may include other body parts.

Introduction

A key debate in cognitive psychology considers at which point in processing attention is selected (Gazzaniga, Ivry & Magun, 2002). Early selection Models assume this takes place at a sensory level: complete perception is not necessary for selection (Gobet, Chassy & Bilatic, 2011; He & Chen, 2010). On the contrary, late selection models assume all stimuli are fully processed and their meaning encoded before selection (Gazzaniga, Ivry & Magun, 2002). The quantity of evidence for each approach is roughly equal (Driver, 2001).

Lavie (1995) suggested the contradictory results were due to the perceptual load used in research – studies using low perceptual load tended to support late selection, whilst those using high perceptual load supported early selection. This more flexible approach acknowledges the limited attentional resources of humans, and the varying amounts of attention needed for different tasks (Gobet, Chassy & Bilatic, 2011).

In the majority of research, perceptual load refers to the quantity of stimuli and is manipulated by varying display size and measuring time taken to respond appropriately to a choice of targets (Lavie, 1995). Research found that the difference in response time between congruent and incongruent trials was reduced at high perceptual load.

However, even with a more flexible framework, there are exceptions to the rule: Lavie, Ro and Russel (2003) found that the processing of distractor faces was not affected by load, but the processing of fruit and musical instruments was. They suggested that this was due to the special significance of faces, both biologically and socially. Opposing this, He and Chen (2009) questioned the 'special significance' of faces, instead attributing results to familiarity, due to the use of faces of famous individuals by Lavie, Ro and Russell (2003). They found that distracters were independent of perceptual load when participants were familiarised with faces, fruit or vegetables before completing the task. If the same stimuli were unfamiliar, perceptual load affected the responses.

Although some research found contradictory effects, most findings support those of Lavie, Ro and Russell (2003): neuroscientific research suggests separate systems for facial processing. Further support was provided by Ro, Friggel and Lavie (2007) using a visual search method. In addition to faces, they found a bias for body parts to hold attention compared to other objects. This research recognised the role of familiarity, but suggested that faces and other body parts were both distinguished as special.

The present study uses a response-competition method to investigate whether hands grab attention irrespective of perceptual load, or if this effect is specific to faces. It is hypothesised that when the distractor is a hand, response times will be slower for incongruent than congruent distracters at all levels of perceptual load. Two independent variables were manipulated to measure this: congruency and perceptual load. The null hypothesis is that the effect is specific to faces: there will only be a difference at low perceptual load.

Method

Participants. 18 female University of Surrey Undergraduates (15 right handed and 3 left handed) were recruited in partial fulfilment of a course requirement. The sample were aged 18 - 25 (Mean age = 19.06, SD = 1.63). Participants were randomly assigned to groups, counterbalancing which letter (N or X) corresponded to which response (index or middle finger).

Stimuli/Apparatus. The Stimuli were presented on a computer screen run with E-Prime software. A centrally positioned image of a left hand, with the index and middle fingers in a lifted position formed the irrelevant stimulus. The hand was positioned with its fingers pointed towards the right side of the screen, and the wrist to the left: this orientation ensured the stimulus and the participants responding hand were not spatially compatible. A single downward movement of either the index or middle finger formed the distractor stimulus.

Between the index and middle fingers, in a horizontal line, the target letter (N or X) was presented with no, one three or five accompanying letters (H, K, M, W or Z). For every trial both the accompanying letters and the location of the target amongst these was randomly varied. Participants responded via the computer keyboard.

There were 96 different possible trial types, through variations of the target letter (N or X), perceptual load (line of 1, 2, 4 or 6 letters), target location (6 possible) and congruency (congruent or incongruent between response finger and distractor finger). Each of these combinations was presented once in each block of trials.

Design. A within subjects, experimental design was used, manipulating the congruency (distractor hand movement congruent or incongruent with response hand movement) and attentional load (1, 2, 4 or 6 letters in central line), to measure the response time under different conditions. Participants were counterbalances for which target letter (N or X) corresponded to which response (index or middle finger).

Procedure. All trials took place in exam conditions. After giving informed consent, participants were instructed to look at an on screen fixation cross throughout trials, pressing the appropriate key both quickly and accurately whilst ignoring distracters. Counterbalancing group one were instructed to press one on the numerical keyboard with their index finger in response to the letter X and two with their middle finger in response to the letter N. The second group received the same instructions, with the letter-response mapping opposite.

On each trial a fixation cross was presented for 500ms, followed by the fixation cross in addition to the irrelevant hand stimulus – the duration of presentation for this stimulus varied between 960ms and 1980ms. Next, the target letter, plus additional (perceptual load) letters were presented for 500ms along with the distractor finger movement. Finally, a blank screen was presented until a response was detected, or for a maximum of 1500ms.

A Practice block of 16 randomly selected trials was presented first, in which feedback was given - 80% accuracy was needed in this block to progress to the main experiment, and the block was repeated until this criterion was achieved. In the main experiment, no feedback was given: there were three blocks of 96 randomly ordered trials, which each took around seven minutes. Participants were allowed a short break between each block, with the experiment taking a maximum total time of 25 minutes or less.

Results

Within the scores for each participant, trials with no response or an incorrect response were discarded, as were any trials in which the response time was further than 2.58 standard deviations from the mean. Furthermore, participants with a z-score outside the boundaries of ±2.58 for each mean response time (1 participant) or who had an accuracy rate lower than 80% (0 participants) were excluded from the analysis. The overall mean response times were computed for each combination of congruency and perceptual load. These are displayed with their respective standard deviations in Table 1.

All variables were normally distributed, with z-scores for skewness and kurtosis in the boundary of ±1.96, and a within subjects design was used, so a dependant t-test was selected for analysis. A significant difference with a small-medium effect was found between congruent and incongruent response times at all levels of perceptual load, low load, $t(16) = 2.48$, $p = .013$, $d = 0.29$; medium-low load, $t(16) = 2.60$, $p = .010$, $d = 0.37$; medium-high load, $t(16) = 2.47$, $p = .013$, $d = 0.29$; high load, $t(16) = 2.30$, $p = .018$, $d = 0.31$. For each pair, the response time for incongruent trials was significantly longer than the response time for congruent trials.

Discussion

The present study investigated whether non-facial biological stimuli remain unaffected by perceptual load, or if this effect is specific to faces. The alternative hypothesis was supported: there was a significant difference between congruent and incongruent trials at all levels of perceptual load. These results contradict the perceptual load theory, showing that like faces, a distractor hand affects response times at all levels of perceptual load.

These findings suggest that faces are not unique in their ability to attract and hold attention: hands also have this effect. These findings support research by Ro, Friggel and Lavie (2007) suggesting an attentional bias towards body parts. However the present study used a forced choice design with distracters as opposed to a visual search task categorising images.

One possible explanation for these findings is the social and biological significance of faces, hands and other body parts. An alternative is the role of the extrastriate body area (EBA): a selective visual processing area for the human body (Downing, Jiang, Shuman & Kanwisher, 2001). This specialised neural area may give priority in attention toward its preferred stimulus (Downing, Bray, Rogers & Childs, 2003). The authors suggest this area would be active in the present experiment, as the EBA responds in the same way to hands and to other body parts. Based on this assumption, the results of the present study may be applicable to all human body parts. However, further research would be needed for confirmation.

A limitation of this study was the artificial nature of the task, which lacked ecological validity. Furthermore, the task was repetitive, so responses may have been affected by boredom or fatigue. Although the study was conducted under exam conditions, all participants were tested simultaneously, with experimenters moving round the room to help with running the computer program. This may have caused additional distraction, and so affected response times. The sample in the present study was fairly small, and consisted only of female psychology students: it is not representative of the population as a whole, so only moderatum generalisations should be made from results. To overcome the above limitations, future researchers should aim for a more representative sample, which could be achieved by using a random sampling method. In addition, the participants should complete the experiment individually, to avoid any unnecessary distraction.

One avenue for future research may be the combination of behavioural and neuroimaging techniques to confirm whether areas such as the EBA are active during manipulation of perceptual load, as opposed to passive viewing of stimuli, and to examine the nature of such activation. Another possible extension of this research is to consider other body parts using a similar method, to examine further exceptions to perceptual load.

In conclusion, the collected data revealed that hands, in addition to faces are immune to the effects of perceptual load. This reveals faces are not unique in their attentional bias, and suggests further possibility of finding exceptions through future research.

References

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Appendices

Table 1: Summary of the Means and Standard Deviations of each condition

	Congruent		Incongruent	
	Mean	SD	Mean	SD
Low Perceptual Load	570.82	68.79	596.81	89.68
Medium-Low Perceptual Load	625.83	70.03	654.08	77.13
Medium-High Perceptual Load	725.03	89.75	756.71	109.33
High Perceptual Load	810.60	120.19	857.71	149.80