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Evaluative Pressure Overcomes Perceptual Load Effects

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## Abstract

Perceptual load has been found to be a powerful bottom-up determinant of distractibility, with high perceptual load preventing distraction by any irrelevant information. However, when under evaluative pressure, individuals exert top-down attentional control by giving greater weight to task-relevant features, making them more distractible from task-relevant distractors. One study tested whether the top-down modulation of attention under evaluative pressure overcomes the beneficial bottom-up effect of high perceptual load on distraction. Using a response-competition task, we replicated previous findings that high levels of perceptual load suppress task-relevant distractor response interference, but only for participants in a control condition. Participants under evaluative pressure (i.e., who believed their intelligence was assessed) showed interference from task-relevant distractor at all levels of perceptual load. This research challenges the assumptions of the perceptual load theory and sheds light on a neglected determinant of distractibility: the self-relevance of the performance situation in which attentional control is solicited.

Keywords : Evaluative pressure · Attentional set · Perceptual load · Top-down attention ·

Response conflict

## Evaluative Pressure Overcomes Perceptual Load Effects

The ability to ignore irrelevant information to focus on what is important is essential for everyday life. Being distracted from one's ongoing activity can have negative repercussions, from slight disturbance (e.g., breaking your reading flow) to some vital issue (e.g., taking your attention off the road). A great deal of research in psychology has attempted to identify the determinants of focused attention in order to better understand the conditions under which distraction occurs. The present article investigates an overlooked determinant of attentional distraction: the evaluative context of the performance situation.

The reasons why task-irrelevant stimuli can drift attention away from one's primary goal are multiple. Some stimuli have the potential to capture our attention in a bottom-up way, e.g. when they appear abruptly (Yantis, 1993), are of a specific color (Theeuwes, 1992), or are in motion (Folk, Remington, & Wright, 1994), but the extent to which they distract us can be modulated by top-down control settings that tune attention towards the most relevant features to task resolution (Folk & Remington, 1998). As you drive along and are searching for a green sign indicating a highway direction, you will be more distracted by a flashy billboard if it is green (i.e., a taskrelevant distractor) than if it is blue (i.e., a task-irrelevant distractor; see Gronau, Cohen, & Ben-Shakhar, 2009). Thus whether one distractor carries some prioritized features or not will determine its distracting effect.

Although much effort has been devoted to understanding how the features of irrelevant stimuli interact with the ongoing activity, research has only just begun to investigate the potential influence of external factors, such as the immediate situation of performance. Selective attention rarely operates in situations that are neutral for individuals. On the contrary, in many situations performing at one's best carries implications for both future opportunities and self-evaluation (DeCaro, Thomas, Albert, & Beilock, 2011). Research in

social cognition has well established that self-evaluative performance situations affect selective attention and the ability to resist cognitive distraction. Evaluative situations are known to trigger evaluative pressure and represent a potential threat to self image (DeCaro et al., 2011), which often brings about concerns that take away attention from the task at hand and reduces the amount of information that can be processed (Autin & Croizet, 2012; Crouzevialle & Butera, 2012). Attention must then be prioritized to the most relevant information at the expense of less relevant information, thereby generating attentional focusing (Muller & Butera, 2007). Initial evidence revealed that individuals in evaluative situations show less Stroop interference (Huguet, Galvaing, Monteil, & Dumas, 1999), make less illusory conjunctions (Muller, Atzeni, & Butera, 2004), and appear less sensitive to non-relevant abrupt onsets (Muller & Butera, 2007; Normand & Croizet, 2013).

Although evaluative pressure may enhance attentional engagement on relevant information at the expense of distractors, Normand, Bouquet and Croizet (2014) have demonstrated that this is actually dependent on the matching between distractors' attributes and task goals. When the task required locating a green target, participants under evaluative pressure gave greater priority to any green stimulus. Consequently, distractors that did not carry this prioritized feature (red distractors) were filtered out and did not disturb individuals' attention, while distractors carrying this prioritized feature (green distractors) received attention and created greater distraction (Normand et al., 2014; study 2). Under evaluative pressure, individuals' attentional processing becomes more contingent on distractor features, specifically at the response level (Normand et al., 2014; study 4). By reinforcing featurebased attentional sets, evaluative pressure results in more (or less) distraction by the irrelevant information when it matches (does not match) the individuals' attentional set.

Nevertheless, according to the load theory of attention (Lavie, Beck, & Konstantinou, 2014), the contingency of attentional distraction only applies when the focus task does not exhaust perceptual resources (cf. Lavie et al., 2014; p. 2). The core assumption of the load theory of attention is that when the task exhausts the perceptual resources, it prevents attention from spilling over to distractors, which then no longer interfere (Lavie, 2010). Distractors would interfere with performance on low perceptual load tasks (e.g., involving just one relevant stimulus) but not on high perceptual load tasks (e.g., involving six or more stimuli; Lavie, 2005).

The load theory of attention does not address the possibility that distractor's properties and feature-based selection modulate the perceptual load effect on attentional distraction. In high perceptual load conditions, irrelevant information would not receive attention, regardless of the match between its features and the task at hand (Forster & Lavie, 2008; Experiment 4). Nevertheless, individuals under evaluative pressure are more sensitive to the match between one stimulus' features and the attentional set (i.e., the prioritized features that allow task resolution), which can increase interference from perceptually task- relevant distractors (Normand, Bouquet, & Croizet, 2014). The stricter attentional set hypothesis thus predicts that task-relevant distractors receive attentional priority and conflict with response selection when individuals are under evaluative pressure, regardless of the level of perceptual load. The present research aims to test the attentional impact of evaluative pressure under high perceptual load conditions, which according to the load theory (Lavie et al., 2014) should fully prevent attentional distraction.

To test the stricter attentional set hypothesis under different levels of perceptual load, we borrowed the modified flanker paradigm widely used in research on perceptual load (Lavie, 2005; Lavie, Hirst, de Fockert, & Viding, 2004). This task consists of identifying a

target letter (an X or an N) in low or high perceptual load sets flanked by a compatible or an incompatible distractor (a X or a N). Incompatible flankers conflict with response identification thereby creating a flanker-compatibility effect. Following the perceptual load hypothesis, we predicted that high perceptual load prevents individuals in a control condition from allocating attention to the flanker, thereby annihilating the flanker-compatibility effect. However, the flanker is a task-relevant distractor since it carries the important features for task resolution (i.e., it is identical to the targets; Buetti, Lleras, & Moore, 2014). According to the recent findings that evaluative pressure reinforces feature-based attention settings, we hypothesized that high perceptual load would not prevent individuals in the evaluative pressure condition from processing the flanker. We expected them to show greater flanker-compatibility effects under high perceptual load conditions than control participants.

## **Method**

**Participants and design.** Based on previous studies manipulating evaluative pressure, we set the sample size at 40. Two scheduled participants did not show up, leaving us with a sample of 38 undergraduates at the University of Poitiers who participated for course credit. They all had normal or corrected-to-normal vision. They were randomly assigned to one of the two experimental conditions: evaluative pressure or no evaluative pressure. Three participants were excluded from the analysis, two due to high error rates and abnormal reaction times (high studentized deleted residuals and Cook's distances) and one for expressing suspicion.

**Material and procedure.** On arrival, participants were informed that they were about to take an attentional task. In the evaluative pressure condition, the experimenter introduced the task as “an evaluation of attentional capacity that is linked to intellectual ability”. Participants were also led to believe that they would get a final score and the experimenter sat

next to them throughout the session (Harkins, 2006). In the control condition, the task was introduced as a device to “study the effects of training on perception” and the experimenter stated that individual performance would automatically be merged with the others’ performances, and left the participant alone in the cubicle (Normand et al., 2014).

Participants then completed the flanker task, which was identical to that of Forster and Lavie (2007). Each trial started with a 500-ms presentation of a fixation cross (“+”), which was immediately followed by the presentation of the task display for 100 ms. The task display consisted of a circle (1.61° radius) of six letters centered at the fixation cross, plus a peripheral distractor letter, the flanker, presented to the left or to the right of the circle, 1.41° away from the nearest circle letter. Each of the letters in the circle subtended 0.6° by 0.4°, and the distractor letter subtended 0.8° by 0.5°. Each circle contained one of the targets (X or N) and participants had to indicate which of the target letters was present in the circle by pressing a key on the numerical pad as quickly as possible without sacrificing accuracy. The flanker was equally likely to be X, N, or Z, and participants were instructed to ignore it. Then for one-third of the trials, the flanker was the same as the target letter – e.g., a flanker X and a target X (i.e., compatible trials) – and was not expected to conflict with response selection. For two-thirds of the trials, the flanker was different from the target letter: for half of these trials, the flanker was a neutral letter, Z (i.e., control trials). For the other half of these trials, the flanker was the alternate target letter – e.g., X for an N target or N for an X target (i.e., incompatible trials) – which could create a response conflict and delay in responding. In the high-load condition, the letters H, M, K, Z, and W were randomly placed in the non-target circle positions in a different order in one trial from the other. In the low-load condition, the non-target letters were all small o’s (0.15°). Target position, distractor position and identity, and their combinations were counterbalanced. Examples of the trials are presented in Fig. 1A. After two example trials and 12 practice trials for each load condition, participants completed



four blocks of 72 trials: two low-load (L) and two high-load (H) blocks in a counterbalanced order. Four versions of the task were then created: HLHL, HLLH, LHHL, and LHLH.

After the flanker task, manipulation checks were administered, and participants were thoroughly debriefed and thanked.

## Results

**Manipulation checks.** Participants in the evaluative condition reported the task measured intellectual capacities to a greater extent ( $M = 6.41$ ;  $SD = 0.71$ ) than control participants ( $M = 2.89$ ;  $SD = 1.94$ ),  $F(1, 33) = 49.84$ ,  $p < .001$ ,  $\eta^2_p = .60$ . They also reported feeling more evaluated ( $M = 4.65$ ;  $SD = 1.58$ ) than control participants ( $M = 3.44$ ;  $SD = 1.85$ ),  $F(1, 33) = 4.24$ ,  $p = .047$ ,  $\eta^2_p = .11$ .

**Reaction time.** Reaction times (RT) less or greater than 3  $SD$  from the individual mean reaction time were excluded from the analyses; eliminating less than 0.5 % of the data. Correct RTs<sup>1</sup> were subject to a 2 (evaluative pressure: evaluative, non evaluative) x 2 (flanker compatibility: compatible, incompatible) x 2 (perceptual load: high, low) mixed ANOVA, with the first factor varying between participants. Results indicated no main effect of evaluative pressure,  $F(1, 33) = 0.25$ ,  $p = .619$ . Analyses showed a main effect of flanker compatibility indicating longer RTs on incompatible trials ( $M = 671$ ;  $SD = 113$ ) than on compatible trials ( $M = 647$ ;  $SD = 106$ ),  $F(1, 33) = 20.66$ ,  $p < .001$ ,  $\eta^2_p = .20$ . Perceptual load also had a main effect on RTs,  $F(1, 33) = 80.81$ ,  $p < .001$ ,  $\eta^2_p = .71$ . RTs on high-load trials

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<sup>1</sup> Mean error rate was .14. Error rate was greater in the high-load condition than in the low-load condition,  $F(1, 33) = 49.71$ ,  $p < .001$ ,  $\eta^2_p = .60$  and the flanker compatibility effect on error rates was greater in the low-load than in the high-load condition,  $F(1, 33) = 5.15$ ,  $p = .03$ ,  $\eta^2_p = .13$ . No main effect or interaction with evaluative pressure was found,  $F_s < 1$ .

were longer ( $M = 805$ ;  $SD = 184$ ) than RTs on low-load trials ( $M = 513$ ;  $SD = 93$ ). A non-predicted interaction between evaluative pressure and perceptual load reached significance,  $F(1, 33) = 4.23$ ,  $p = .048$ ,  $\eta^2_p = .11$ . Focused contrast comparisons revealed that, when perceptual load was low, participants under evaluative pressure were slower ( $M = 556$ ;  $SD = 89$ ) than control participants ( $M = 471$ ;  $SD = 78$ ),  $F(1, 33) = 8.98$ ,  $p = .005$ ,  $\eta^2_p = .21$ . When perceptual load was high, RTs did not differ according to pressure conditions,  $F(1, 33) = 0.59$ ,  $p = .447^2$ . The interaction between flanker compatibility and perceptual load predicted by the load theory of attention did not reach significance,  $F(1, 33) = 1.78$ ,  $p = .191$ . However the expected three-way interaction between evaluative pressure, flanker compatibility and perceptual load was significant,  $F(1, 33) = 5.47$ ,  $p = .026$ ,  $\eta^2_p = .14$ . This interaction, shown in Figure 1B, was further decomposed by pressure conditions. Reproducing previous findings from Lavie et al. (2004), participants in the control condition showed a reduced flanker-compatibility effect as perceptual load increased ( $M_{\text{low perceptual load}} = 41$  ms and  $M_{\text{high perceptual load}} = -18$  ms),  $F(1, 33) = 6.95$ ,  $p = .013$ ,  $\eta^2_p = .17$ . However and as predicted by the stricter attentional set hypothesis, participants in the evaluative pressure condition showed a persistent flanker effect regardless of perceptual load level ( $M_{\text{low perceptual load}} = 31$  ms and  $M_{\text{high perceptual load}} = 47$  ms),  $F(1, 33) = 0.48$ ,  $p = .489$ . While evaluative pressure did not moderate the effect of the flanker at a low-level of perceptual load [ $F(1, 33) = 0.62$ ,  $p = .435$ ], the flanker-compatibility effect at a high level of perceptual load was stronger for participants under evaluative pressure (47 ms) than for control participants (-18 ms),  $F(1, 33) = 4.29$ ,  $p = .046$ ,  $\eta^2_p = .11$ . In other words, being under evaluative scrutiny made participants more prone

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<sup>2</sup> Slowing down responses could be interpreted as a motivation to be accurate (McFall, Jamieson, & Harkins, 2009). Yet even if evaluated participants were slower on the low-load trials, they were neither more accurate nor slower on the high-load trials precluding a clear interpretation in terms of motivation.

to the attentional interference of the flanker even in a high-perceptual load condition that usually exhausts perceptual capacity.

## **Discussion**

The present study investigated the effect of evaluative pressure on attentional distraction in task load conditions that normally prevent individuals from being distracted. Individuals under the scope of evaluation exert higher control over their attention by being more selective (Muller & Butera, 2007). Recent research showed that this higher selectivity translates into stricter feature-based priority settings that are contingent on task requirements (Normand et al., 2014). The goal of the present study was to investigate whether the higher sensitivity to task-relevant distractors in conditions of evaluative pressure remains at a high level of perceptual load, known to reduce distractibility. The load theory of attention proposes that distraction diminishes as perceptual load – usually the number of task goal-relevant items – increases (Lavie, 2005). Perceptual load would exhaust perceptual resources, leaving no resource for distractor processing, which no longer interfere. To put together the predictions from the evaluative pressure and perceptual load frameworks, we used a flanker task with a manipulation of perceptual load. In this response conflict task, the distractors are task-relevant distractors (i.e., they are identical to the targets; Buetti, Lleras, & Moore, 2014). As evaluative pressure enhances feature-based selection, we hypothesized that participants in an evaluative situation process the flankers to a greater extent than control participants, irrespective of the level of perceptual load.

Replicating previous findings from the literature, we found the bottom-up effect that increasing perceptual load decreased the flanker-compatibility effect for participants in the control condition. Nevertheless and in line with the stricter attentional- set hypothesis, perceptual load did not moderate the flanker interference for participants under evaluative

pressure. As compared to control participants, participants who believed that their intelligence was being assessed kept on processing the flanker even though the level of perceptual load was supposed to prevent them from doing so. This finding supports the idea that evaluative pressure biases individuals' attention and response elaboration towards any stimuli that carry task-relevant features such as the flankers, especially as task difficulty increases (i.e., when the perceptual load is high). This top-down influence on attention overcomes the bottom-up effect of perceptual load. Our paper thus contributes to refining the conditions under which distractibility is reduced by pointing out an overlooked alternative factor influencing attentional selection even at high levels of perceptual load: the situational context in which selective attention occurs, and more specifically its potential threat for self-evaluation.

The present finding that perceptual load did not reduce participants' distraction when they were under evaluative pressure challenges the theoretical assumptions of the perceptual load theory (Lavie, 2005). Using the resource limitation metaphor, the load theory of attention makes the assumption that when perceptual load is high, relevant items capture all attentional resource in a bottom-up way, leaving no resource to distractors. Such a unitary resource view of attentional selection cannot account for the present findings. Indeed, when participants were under evaluative pressure, a high load of relevant processing did not prevent them from allocating attention to the distractors. To reconcile this finding with the resource view of the load theory, one would need to assume that evaluative pressure increases attentional resources, which not only does not find any support in the literature but also contradicts numerous studies showing that evaluative threat actually exhausts cognitive resources (see Schmader, Johns, & Forbes, 2008 for a review). In fact, our results echo fairly well a growing body of studies that have obtained similar interference effects in both low and high load conditions as a result of negative emotional stimuli (Srinivasan & Gutpa, 2010; study 2) or top-down attentional sets (Benoni, Zivony & Tsal, 2014; Theeuwes, Kramer & Belopolsky,

2004) and that have consequently raised conceptual issues for the perceptual load theory (see Benoni & Tsal, 2013 for a review). Tsal and Benoni (2010) demonstrated that what were conceived as perceptual load effects were simply ‘dilution’ effects. Based on the attention gradient theory (LaBerge & Brown, 1989; Logan, 2004), the dilution account argues that a distractor causes interference when its representation is strong enough to activate the target opposite-response. When neutral stimuli are added to a display to increase perceptual load, their features compete with those of the distractor, thereby degrading the quality of its representation. A degraded representation of the distractor may not be strong enough to activate any response and to create interference. It would therefore be the dilution of distractor interference, not the unavailability of spare perceptual resources that eliminates the flanker interference in large set-size displays (Benoni & Tsal, 2013; Chen & Cave, 2013). The dilution account of distractor processing is in better accordance with our findings. Increasing the number of items to scan in order to identify the target in the flanker task would dilute the distractor effect to a lesser extent for participants going through evaluative stress. Indeed, their higher prioritization of task-relevant features (Normand et al., 2014) may contribute to lower thresholds that allow behavioral interference from a task-relevant distractor (Gronau et al., 2009; Gronau, Cohen, & Ben-Shakhar, 2003; Ro, Machado, Kanwisher, & Rafal, 2002). As a result, evaluative pressure would make people more disturbed by task-relevant distractors even when their attention is diluted by an increased number of relevant stimuli.

Finally, the present research has important implications with regard to the impact of evaluative situations on performance. During an important test or exam, individuals will process and answer in priority any information that carries relevant features for task resolution, even when the information is potentially misleading. Such a feature-based selection is inappropriate for filtering out highly distracting stimuli whose features are identical to the important features for the task. Here we highlight the robustness of this

selection bias under evaluative pressure by demonstrating that it keeps on creating distraction even though there is much relevant information to deal with in the task at hand. Unlike the perceptual load theory's claim that high perceptual load makes everybody equal (Forster & Lavie, 2007), the present research suggests that increasing processing load of important information in high-stake evaluative situations does not prevent individuals from unwanted distraction.

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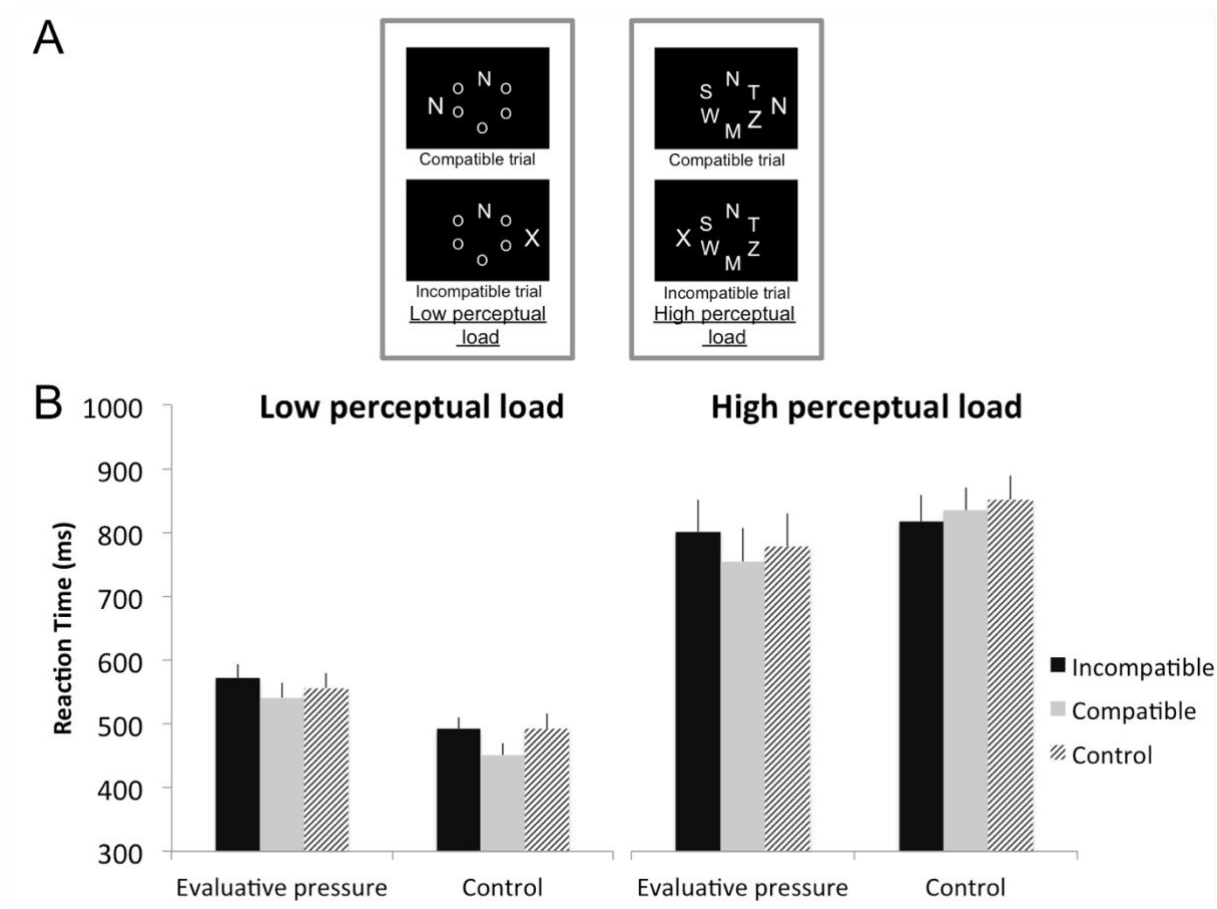
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*Figure 1.* Sample of trials in the flanker task as a function of perceptual load and flanker compatibility (Panel A) and mean reaction time as a function of evaluative pressure, flanker compatibility and perceptual load (Panel B). Error bars represent standard error.

**Table 1.** Percentage of errors (standard deviations) on the flanker task as a function of evaluative pressure, perceptual load and flanker compatibility

	Low perceptual load				High perceptual load			
	I	C	N	I-C	I	C	N	I-C
<b>Evaluative pressure</b>								
<i>% errors</i>	9 (7)	6 (5)	7 (6)	<b>4</b>	20 (14)	21 (16)	15 (11)	<b>-1</b>
<b>Control</b>								
<i>% errors</i>	13 (14)	5 (4)	8 (8)	<b>8</b>	23 (14)	21 (7)	18 (8)	<b>2</b>

*Note.* I = incompatible, C = compatible.