CER-Paris Descartes

(Comité d’Éthique de la Recherche)

### Date de soumission :

16 Mars 2020

### Nom du protocole :

Etude sur l’effet régulateur de la motivation sur le processus/traitement attentionnel de stimuli émotionnel négatifs.

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### Résumé (en Français) :

## Scientific Project (in English) :

### Background: Theoretical Framework

Not only do our emotions greatly influence our everyday decision-making, they are also known to play a key role in many neuropsychiatric disorders and growing research points towards emotion dysregulation as the main mechanism. Indeed, difficulties regulating one’s emotions have been suggested to be at the core of anxiety and mood disorders. The capacity to efficiently regulate emotions, in contrast, has been linked to better psychological and physical outcomes.

Yet research in this field is complicated as questions about the nature of emotions continue to divide the scientific community. Its definition varies widely according to the theoretical framework but the consensus in Affective Neuroscience recognises an emotion as a cognitive, subjective and/or physiological state(s) arising from a system-level neural activity in response to a highly significant and relevant stimulus. In this context, emotion regulation can be seen as an explicit or implicit process aiming to initiate, terminate, or modulate the trajectory of an emotion. One of the most commonly studied regulatory techniques is selective attention in which a subject either shifts his/her visual-spatial attention away from the emotion-inducing stimulus to inhibit its effects or towards the stimulus to enhance them. This can be highly beneficial as the brain continuously monitors distractors to ensure optimal performance and emotionally salient stimuli are particularly effective in interferingwith the ongoing cognitive processing. Indeed, emotional items benefice from enhanced sensory representations by receiving prioritised attention impacting the attention dedicated to non-emotional stimuli. Thus, being able to utilise selective attention by either discarding irrelevant emotional distractors or focusing on relevant emotional targets might lead to better decision-making.

Despite growing recognition of the importance of emotion regulation, little is known about other higher-order cognitive function that might influence its impact on decision-making. One such omitted function is motivation which can be defined as an internal state encouraging individuals to obtain desirable outcomes like rewards and to avoid undesirable outcomes such as punishments. To the best of our knowledge, there has been no quantitative study evaluating the possible effect of motivation on emotion regulation. Yet it may seem very intuitive that variations in motivation may influence the regulation of the ongoing emotion especially if the emotions are not in line with the ongoing goal. For example, it may be more advantageous for a runner in a city to inhibit his fear when mistaking a stick for a snack; yet this could be deleterious for a hiker on a mountain. Thus, attentional regulation of emotional stimuli might be needed to achieve one’s goal, but this process of attention resource reallocation might be costly. Thus, we could wonder if emotion regulation is the outcome of a cost-benefit trade-off that motivation is altering.

Furthermore, alterations in motivation such as apathy and anhedonia are debilitating symptoms commonly found in a range of neuropsychiatric disorders and often co-altered with emotion dysregulation. Unrevealing the interaction between motivation and emotion regulation, and the specific symptomatic comorbidities might be key to explaining the underlying mechanisms of mental illnesses, especially anxiety and mood disorders

### Research Aim and Hypotheses

Project Aim

Our study aims to investigate how motivation influences the regulation of emotional attention. In particular, we want to address the lack of literature on the possible upregulating and downregulating effects of monetary incentives on the attentional regulation of emotionally negative stimuli.

Hypotheses

The motivational value of monetary incentives improves emotion regulation on at least one emotional expression level which is either invert (as measured by physiological techniques such as pupillometry data) and/or overt (as measured by behavioural recordings such as performance).

### Material and Method

Stimuli Set

One of the most commonly used stimuli to investigate attentional processing of emotions are faces due to their ecological validity and ease of use. In consequence, we adopt fearful faces of both males and females as emotionally negative stimuli and neutral faces of both males and females as neutral stimuli. We utilise the Chicago Face Database (CFD), which provides use with standardised and high-quality images. The normalising data allowed us to exclude individuals that were rated as looking too unusual, too afraid or too surprised even in a neutral facial expression (i.e. ratings being three standard deviations from the mean).

In summary, our stimuli set is composed of four different emotional faces categories (i.e. fearful male, neutral male, fearful female, neutral female.

Experimental Protocol Encompassing Two Behavioural Tasks

To implement the motivational incentives into the experimental design, participants are presented with low (i.e. 5 cents) or high (i.e. 2 euros) monetary incentives at the beginning of each tasks’ trials. The monetary bonus is conditional on the performance of X randomly selected trials. Thus, if the participants were correct, they will receive the sum that was allocated to this specific trial. If they were not, they would not receive anything. With a baseline of X euros, the participants could receive a bonus between X and X and thus, a total ranging between X and X.

First, we employ the methodological insights gained from the study of cognitive conflict while implementing emotional stimuli in the commonly used paradigm—the Rapid Serial Visual Presentation (RSVP). The close presentation in time (i.e. 200-400 milliseconds) of a first salient stimulus (i.e. critical distractor) to a second stimulus (i.e. target) embedded in a sequence of images (i.e. general distractors) often affects the target’s detection because of an attentional blink. This paradigm allows the emotionally salient stimulus (i.e. fearful face) to act as either a critical distractor or a target according to its relative position in the stimuli stream. The general distractors are scrambled version of the critical distractors. Particularly, a fearful face presented as a critical distractor will impair the detection of a neutral target because of an emotional attentional blink effect which has been robustly found in other studies. This blink can be very detrimental for the target detection rate and thus the performance. In contrast, when a fearful face acts as a target with a previously presented neutral distractor, it will enhance its detection due to its enhanced sensory representationsand be beneficial for the performance. This would allow us to investigate whether the effect of incentives on the detection rate might allow overcoming the detrimental effect of the emotional distractor or enhancing the beneficial effect of the emotional target. Finally, if both the target and the distractor are of the same emotional value (i.e. both fearful faces), then performance will probably not be impacted positively or negatively. To test these hypothesised effects, we varied the intact stimuli’s gender such that if the critical distractor was a woman, the target would either be a man or a woman and we would ask the participant to determine if they have seen “at least one man”. Conversely, the same process is utilised when the critical distractor was a man and the participant were asked to report if they saw “at least one woman”. This experimental design would allow us to test the detrimental or beneficial effect of emotional attention grabbing without XXX.

We invented the second task to adopt a similar structure to the previously described RSVP task while investigating another emotional attentional processing, recognition memory. In this new task, a search display of twenty faces positioned on an invisible grid is shortly presented (i.e. two seconds) to the participants. The display was composed such as there is a target gender and a distractor gender, thus either a majority of male or female faces. The total percentage of one gender over the other is always maintained so that discrimination is possible (e.g. 60% male, 40% female), however, according to the condition, the display is composed of different proportions of emotional or non-emotional faces categories (i.e. fearful male, neutral male, fearful female, neutral female). Indeed, in the beneficial condition, the proportion of fearful faces increased, and the proportion of neutral faces decreased in the target gender in contrast to the distractor gender (e.g. 80% fearful males, 40% neutral males, 20% fearful females and 60% neutral females). This change in proportion in favour for emotional faces will impact performance positively as focusing on emotionally salient stimuli will provide more evidence towards the correct discrimination than neutral faces. In the detrimental condition, the proportion of fearful faces decreased, and the proportion of neutral faces increased in the target gender in contrast to the distractor gender (e.g. 40% fearful males, 80% neutral males, 60% fearful females and 20% neutral females). This change in disfavour for emotional faces will impact performance negatively as focusing on emotionally salient stimuli will provide less evidence towards the correct discrimination than neutral faces. Finally, in the control condition, the proportion of neutral and fearful faces remains the same as the mean proportion of the target or distractor gender (e.g. 60% fearful males, 60% neutral males, 40% fearful females and 40% neutral females). Thus, the goal of the participant is to determinate if the array was mainly composed of female or male faces.

To evaluate the impact of possible attentional regulation on these tasks, we provide instructions on each block of trials about whether the emotional information of faces will be helpful for the detection or discrimination, or it is will be misleading. This information is provided at the same time as the incentives the next block is probable to provide. The control conditions are randomly integrated into those beneficial or detrimental instructions blocks, so that

Behavioural Recordings

The measure of interest is the performance and the reaction time in each of the two behavioural tasks. Piloting will be carried out to ensure good calibration of the parameters (e.g. duration of stimuli presentation) in order to avoid any floor or ceiling effect on performance.

Psychophysiological Recordings

An eye-tracker device will be used to measure participants’ pupil diameters while they are performing the behavioural tasks. It is well known in the literature that pupil dilation is sensitive to emotional component and likely reflects emotional arousal. It is important to point out that cognitive demand and effort can also lead to pupil dilation. Nonetheless, a recent study found that pupillary response might comprise two temporal components reflecting cognitive emotion regulation effort and emotion regulation success.

Skin conductance also represents a well-established autonomic indicator of the emotionally aroused state with both enhanced and reduced patterns during regulation compared to controls.

A possible shortcoming of these techniques is that their temporal resolution might be relatively poor.

### Expected Results

In both the tasks, when the emotionally salient stimuli act as distractors and have an emotion-disturbing (ED) effect on attention, we expect a bigger relative increase in performance between the low incentives condition versus the high incentives condition for ED compared to emotionally-neutral (EN) stimuli even if the average performance is still higher for the EN. In this case, motivation would lead to the salience downregulation of the emotionally distracting stimuli. Conversely, when the emotionally salient stimuli act as targets and have an emotion-enhancing (EH) effect on attention, we expect a higher average and bigger relative increase between the low incentives condition versus the high incentives condition for EH compare to EN. In this case, motivation would lead to the salience upregulation of the emotionally enhancing stimuli. Thus, we expect that the possible beneficial and detrimental effect of emotional objects would be exacerbated and inhibited respectively by higher incentives compared to lower incentives.

### Experimentation location & Participants Recruitments

The experiment will take place in the human behaviour exploration core facility PRISME at the ICM. PRISME consists of several rooms and facilities, we will mainly utilise the main testing room which provides 12 monitoring devices for tracking gaze position and 12 computer-equipped seats for multi-subject simultaneous testing.

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### Participants Recruitment

The participants are recruited through RISC, which is a specialised platform on which many people who take part in Cognitive Science experiments of various institutes in Paris are registered. Our exclusion criteria are as following:

* The participants need to be aged between 18 and X.
* The participants cannot have any history of neurological or psychiatric disorder.
* The participants cannot be under any psychotropic medication.
* …

### Information Treatment Conditions

The results of this study can be presented during conferences or published in scientific papers. However, no personal data will ever be revealed and the anonymity of the participants will always be respected and preserved.

In a first time, the raw participant data will be stored on the local laboratory computer (only accessible with the adequate credentials). The raw data will also be stored on the ICM server and the analysis scripts will be saved on the ICM OwnCloud. After analysis, the raw data may be deleted from the local lab computer. The corresponding researcher is the only person who has read-and-write access; other people from the ICM cannot edit these directories, but may view them.