Attention in emotion regulation
ATTENTION IN EMOTION REGULATION

Stefan Gelow

The concept of emotion and how to regulate it is a central aspect of modern psychology. Within the process model of emotion regulation (Gross, 1998), one issue is how attentional deployment affects emotion regulation and how this can be measured. In task 1, pictures of positive or negative valence were showed in two conditions, either attend or decrease emotional reaction, while participants’ eye movements were followed with an eye tracker. Ratings of arousal and valence were significantly affected by instruction, but dwell times were only significant for positive pictures. In task 2, participants were directed either to emotional or non-emotional parts of emotional pictures while skin conductance was recorded. Arousal and valence ratings decreased significantly in non-emotional areas, but no effect could be found for skin conductance data. Results were generally weak in regards to the effectiveness of measuring gaze to indicate emotion regulation in the form of attentional deployment. For future studies, research of individual differences in habitual usage of attentional deployment for emotion regulation was suggested.

A major part of psychology, now and in the past, has been the study of emotion, although how emotion directly or indirectly has come in in such studies has varied. A particular aspect of emotion is the question of how it is regulated, especially since this also can have applications in clinical psychology, in which some psychiatric conditions are accompanied by disturbances in such emotion regulation (see for example DSM-IV, American Psychiatric Association, 1994).

Emotion regulation and similar constructs
Among possible ways of researching the regulation of emotion, Gross (1998) has developed one of the more influential recent approaches, a process model based on the conceptual analysis of relevant processes involved in the management of emotion. In this he defines the construct of emotion regulation by five stipulations delineating the concept from similar ones used in other research. First, it encompasses the decrease, the increase and the maintenance of positive as well as negative emotions. Secondly no assumption can be made that different emotions or emotions of different valence are regulated in the exact same way, since neural pathways may differ. Thirdly Gross limits emotion regulation to regulation in self, thereby not including regulation of emotion in other individuals. Fourth, both conscious and unconscious processes are included giving a spectrum of emotion regulation from the effortful conscious to the automatic unconscious. Finally, there is no a priori good or bad in emotion regulation.

With these stipulations in mind, Gross (1998) tries to separate his construct of emotion regulation from similar constructs within the realm of research on emotion such as coping and mood regulation, by seeing them as three subordinate categories under the heading of affect regulation. While the three concepts will somewhat overlap, their focus differ in several ways such as that coping exclusively concerns the lessening of negative emotion.
whereas mood regulation tends for example to focus on longer time intervals and include distinctly non-neutral approaches to regulation of emotion.

**The process model of emotion regulation**

In his process model, Gross (1998) differentiates between processes of emotion taking place at different time points during the time span of an emotional event, and while these can somewhat overlap, they can be roughly categorised as taking place either before the inception of the event (*antecedent-focused* emotion regulation), or after the event has taken place (*response-focused* emotion regulation). Gross goes on to identify five main processes, four of them antecedent-focused and one of them response-focused. In a roughly chronological order in relation to the emotional event, the former category first includes *situation selection*, a process encompassing decisions on specific actions taken to avoid or change a potential emotional event before it has even begun. When a situation has started, the three processes of *situation modification*, *attentional deployment* and *cognitive change* will be active, differing rather in the type of activity associated with them than their timing. As for situation modification, this consists of such active decisions as will modify how a situation plays out and therefore indirectly will change the emotional response. Attentional deployment includes the various ways in which attention is steered towards or away from specific emotional elements, such as looking away from an emotional scene, or thinking about positive things in the face of a negative reality. Finally cognitive change is the process of how interpreting or thinking about a situation or about ones capacity to handle it, is used to influence an emotional event. This can include for example such classical psychological concepts as denial, intellectualization or social downward comparisons. Cognitive reframing, in which the failure of one goal is instead interpreted as the success of another, or *cognitive reappraisal* in which the entirety of the situation is reinterpreted in order to affect emotional response are also examples of cognitive change, where especially the latter has received special attention in recent research. Gross concludes his list of emotion regulation processes with one process going under the heading of response-focused emotional regulation, namely *response modulation*, a process which starts after an emotional response has already been initiated and which is used to directly affect the response in regards to psychophysiological, experiential or behavioural manifestations of emotion. This category would include activity such as taking drugs, exercise, physical relaxation, but also such activity that would mask or enhance outward appearance of the emotional response. An example of this would be the commonly researched concept of emotional suppression, which entails regulating the emotion-expressive behaviour to make the emotional response less apparent to others.

While the theories of Gross are formulated to encapsulate any type of stimuli or emotion regulatory activity, the current research, as much of that having followed Gross (1998), concerns short-term emotion regulation as a result of an emotional reaction to visual stimuli, partly because of its abundance in real-world situations and partly because of the ease with which it can be experimentally tested. This puts the focus on specific types of emotion regulation attributable to the processes of cognitive change, attentional deployment and to some extent response modulation, and specifically such aspects as can be thought to occur as a consequence of visual stimuli.

**Emotion regulation of visual stimuli and the issue of attention**

Most research with this focus has used some version of the paradigm introduced by Jackson, Malmstadt, Larson and Davidson (2000). In their study, participants were
exposed to visual stimuli in the form of pictures from the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 1995) of negative and neutral valence. Before each negative picture was shown, they were instructed auditorily by a digitized voice to either “suppress”, “maintain” or “enhance” their emotional reaction to the stimuli, using whatever emotion regulation strategy they chose. During this condition, corrugator activity and startle eyeblink magnitude, two ways of measuring psychophysiological effects of emotion, were recorded. Analysis showed significant effects of both suppression and enhancing of emotion, suggesting the paradigm was usable for the research of emotion regulation processes. The paradigm or a version thereof has been used frequently since then, with a variety of measures, such as in fMRI-studies (e.g. Krompinger, Moser, & Simons, 2008) and EEG-studies (e.g. Urry et al., 2006).

A common way in which these studies have been conducted is to induce some sort of emotion regulation process, either by simply instructing participants to use it, or to instruct as well as having taught them how to do it beforehand. This has typically been used to study various forms of cognitive change or suppression, emotion regulation processes lying close to each other in regards to timing. A problem with this type of research has been that the aspect of attentional deployment, has tended to interfere with the instructed process, and it has therefore been difficult to separate different processes from each other. This became particularly clear in the study of van Reekum et al. (2007), where a group of elderly participants watched emotional pictures and were instructed to up- or down-regulate emotion using a taught variation of cognitive reappraisal while fMRI was recorded. Additionally, their eyes were followed using an eye tracker, while they were doing emotion regulation, and what the study showed was that the effects of the cognitive reappraisal with regards to successful emotion regulation almost disappeared when eye movements were taken into account. That is, the effect seems to have been primarily one of attentional deployment rather than cognitive reappraisal, or in other words the fact that participants looked away from emotional stimuli as a result of, or as an addition to, regulating using cognitive reappraisal. Later studies, such as Urry (2010) has challenged this notion, by showing how cognitive reappraisal indeed has results on psychophysiological manifestations of emotion over and beyond that explainable by attentional deployment. However, the same study also showed that reappraisal always was more effective when accompanied by attentional deployment, than when it wasn’t, highlighting the difficulty to distinguish between the two when researching emotion regulation.

If nothing else, these studies have made clear that given the current research program in emotion regulation, the boundaries between attentional deployment and other emotion regulation processes are not clear. Furthermore the few studies that have used a direct measure of attentional deployment, such as an eye tracker, have produced varied results (see for example Isaacowitz, 2005; Isaacowitz, 2006; but compare Bebko, Franconeri, Ochsner, & Chiao, 2011), indicating that it might not be that effective in this type of research despite the fact that it has shown to at least to some extent be a working measure of attention. An eye-tracker is an apparatus used to record a number of data concerning where, and to what extent, subjects fixate their gaze in different areas of a shown stimuli. A typical way to use this is, as in one part of the current study, to allot areas-of-interest (AOI), to each picture stimuli shown, in which the time or number of gaze fixations is counted and compared to that of the entire picture or other AOI:s in the same picture. For the sake of measuring successful emotional regulation, these AOI:s are typically either specifically emotional parts of a picture or specifically non-emotional. A problem here
can be that attention can be both internal (not reflecting gaze) and overt (Grosbras, Laird, & Paus, 2005). Given a long enough time span following the gaze of participants is likely to give a good enough approximation of attention (Parkhurst, Law, & Niebur, 2002), but given the mixed results in emotion regulation studies, this might be one assumption that has to be questioned for measuring the relevant phenomenon.

To ensure the effects of redirecting gaze when watching emotional pictures, another type of study can be conducted, where the eye tracking is more to be considered a control measure. An example of this is the EEG-study of Dunning & Hajcak (2009), in which participants had their gaze directed to within a designated area of negative emotional pictures, during which a certain ERP-component, a psychophysiological measure of emotion, was observed. This way they managed to show that the component in question was affected by direction of overt attention in such a way that it increased when their gaze touched the emotional area and decreased when it didn’t.

Further issues

When doing studies on emotion regulation, following Gross (1998) above, further issues include those of valence (positive or negative stimuli), types of measures and whether the regulation is to increase or decrease emotional response. These variations make it difficult to get a complete picture and therefore some choices have to be made. In the current studies a point has been made to minimize the pressure on participants to regulate in specific ways, so as to learn how the attentional aspect of the regulation can be measured in actual emotion regulation rather than in hypothetical but never in reality occurring situations. A result of this is that up-regulation of emotion has not been included, since it is not immediately apparent when this is used in real-life. Another result of this thinking is that both positive and negative pictures have been included, which is often not the case, since it is generally more difficult to get significant results using positive picture (Baumeister, Bratslavsky, Finkenauer & Vohs, 2001). Finally both a psychophysiological measure (skin conductance) and ratings of valence and arousal respectively have been included for diversity.

Current studies

The current study consisted of two tasks each addressing one of the two different approaches mentioned above, with the purpose of establishing some aspects of attention within short-term emotion regulation of visual stimuli, and how this can be studied using measures of gaze such that can be recorded using an eye tracker.

In the first task a variation of the paradigm from Jackson et al. is used, where participants view emotional pictures of positive and negative valence taken from the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 2005). For each picture, they are either instructed to view without trying to regulate emotion, or they are asked to lessen their emotional response to the picture. Ratings of arousal and valence, two aspects of emotion, as well as gaze data (dwell time, i.e. time spent in emotional areas of pictures as measured using an eye tracker) is collected. The initial purpose was to also include psychophysiological measures (ECG and skin conductance), but the quality of the data was not good enough to use.

Following most previous research, ratings both regarding valence and arousal, are expected to reflect successful emotion regulation such that for positive stimuli they both
decrease between the emotion decrease and the attend condition, while for negative stimuli valence increase and arousal decrease, also indicating weaker emotional reaction. More importantly, the same is expected with regards to dwell time using the eye tracker, such that less dwelling on emotional areas is expected in the decrease condition compared to the attend condition. Although this is the case in most research, although sometimes as a weak effect, the opposite is found in Bebko, Franconeri, Ochsner, and Chiao (2011).

In Urry (2010) there was an indication that attentional deployment, when used, was effective regardless of the success of cognitive reappraisal. This suggests that attentional deployment might be immediately effective in such a way that when participants themselves use it, regardless of other types of emotion regulation, this becomes apparent in emotion regulation success. In task 1 of the current study, this would indicate that those individuals who have the most difference in dwell time between attend and decrease condition also lessen their emotional reaction the most as regards to ratings of arousal and valence. This could in the current study be indicated by a high correlation between those two differences.

In the second experiment (emotion fixation task) a variation of the paradigm used by Dunning and Hajcak (2009) is used. Here positive, neutral och negative pictures taken from the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 2005) are showed, and participants are directed towards either emotional or non-emotional areas of pictures during which psychophysiological data are recorded and after which they are instructed to rate the pictures regarding arousal and valence.

The main purpose for the second part of the study is to confirm that when gaze is directed towards emotional rather than non-emotional areas of emotional pictures, this actually affects both ratings of valence and arousal respectively, as well as such psychophysiological measures as is deemed effective in regards to emotional response.

Method

Participants
A total of 30 participants (21 females and 9 males), age between 19 and 44 (M = 25.47, SD = 6.45) were recruited among students from the University of Stockholm and received movie vouchers or course credit for their participation. Of those, complete data for both study tasks were collected from 26 (18 females and 8 males), age 19 to 44 (M = 25.50, SD = 6.72). For participation in the study, the subjects received movie vouchers or course credits. Participants had normal or corrected to normal vision, and reported no history of neurologic illness.

Stimuli
A total of 100 pictures were selected from the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 2005). Normative ratings of IAPS pictures were used to define groups of negative, positive, and neutral pictures. In the norms, pictures were rated on a Likert scale from 1 to 9 in categories of valence and arousal, where the valence scale is from 1=most unpleasant to 9=most pleasant, while the arousal scale is from 1=least arousing to 9=most arousing. Of these 100 pictures, 40 were negative, 40 were positive and 20 were neutral pictures, with arousal and valence ratings below (Table 1).
For emotional (negative and positive) pictures, the emotionally relevant areas (AOI) were decided on in a preliminary study (described below).

### Table 1. Normative valence and arousal ratings of IAPS pictures

<table>
<thead>
<tr>
<th>Pictures</th>
<th>Valence Interval</th>
<th>Mean (SD)</th>
<th>Arousal Interval</th>
<th>Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative</td>
<td>1.62-3.77</td>
<td>2.47 (0.53)</td>
<td>5.08-7.29</td>
<td>5.97 (0.62)</td>
</tr>
<tr>
<td>Neutral</td>
<td>4.72-5.87</td>
<td>5.35 (0.32)</td>
<td>3.03-4.33</td>
<td>3.61 (0.34)</td>
</tr>
<tr>
<td>Positive</td>
<td>7.11-8.28</td>
<td>7.53 (0.35)</td>
<td>3.08-7.27</td>
<td>4.85 (1.00)</td>
</tr>
</tbody>
</table>

In the first study task, participants were shown a total of 75 of the 100 pictures prepared for the experiment. Of these, 30 were positive pictures picked randomly from the total of 40 positive ones, 30 were negative pictures picked randomly from the 40 negative ones and 15 were neutral pictures picked randomly from the 20 neutral ones. The remaining sample, comprised of 10 negative, 10 positive and 5 neutral pictures, were used in the second study task as described below.

#### Preliminary study

Six undergraduate students (3 males) were approached at the Psychology Department of the University of Stockholm and received course credit for their participation. They were shown pictures on a 17 inch portable computer, and using a picture editing program they marked areas they considered emotional. Although emotional content in neutral pictures was not relevant in the final study, the neutral images were included to provide diversity.

The 100 pictures (40 positive, 40 negative and 20 neutral) in the final experiment were divided in three parts containing approximately the same number of positive, neutral and negative pictures. The participating students were only required to evaluate two parts to get course credit, but were free to do all three if they chose to. Three of the students opted out after two batches of pictures, while the remaining three evaluated all of them. The order of the parts shown for the participants varied so that all pictures had been evaluated by at least four students after the study was completed. Based on these evaluations, any area chosen by at least two people was considered emotionally relevant enough to be treated as emotional in later analysis. The small number of subjects was due to the similarities between their ratings. However, in cases where there was some disagreement, an independent member of the lab was consulted to resolve the dispute. Note that these pictures were first used in Gelow (2009).

#### Apparatus and software

To measure gaze fixations, an iView X High-Speed Eyetracker was used. The head of the participant is fixated in a rack placed on the same table as the monitor on which stimuli are presented, to avoid head movements. Within this rack a camera is directed towards one or both eyes of the subject, with an update frequency of 500 Hz. The picture stimuli were presented on a 19 inch monitor with a screen resolution of 1024*768 and refresh rate of 100 Hz and the distance between the eyes of the participant and the monitor was 80 cm. The stimuli were presented using experiment software Presentation 10.3 (Neurobehavioral Systems, Inc., Albany, CA.). While the experiment is running, the picture of the eye is recorded by software connected to the Eyetracker, and is also
simultaneously available on a separate monitor for the experimenter to watch in real time. The recorded data were then analysed using software Begaze 2.0. For the purpose of analysis, areas-of-interest (AOI) can be inserted into this program, specifying specific areas of the stimuli to compare.

Psychophysiological data were recorded using Biopac MP100 and included skin conductance readings and ECG. Electrodes for the measurement of skin conductance were placed on the right palmar sites of the non-dominant hand of participants, while ECG were recorded from two electrodes such that the right arm electrode was placed in the proximity of the right collarbone, and the left leg electrode was placed on the left side of the navel.

Procedure
In advance participants had received information on what the study would entail. On arrival, they were first instructed to wash their hands and remove eye shadow or similar to facilitate eye-tracker-recording. Thereafter they were seated and given a written consent form in which they were informed on their right to withdraw from the experiment at any time without explanation, plus a short questionnaire regarding age, occupation, handedness, and neurological history.

After this, they were led into the main experiment room and fitted with electrodes as described in the apparatus section and seated so that the eye tracker equipment and seating position could be adjusted. A calibration for the skin conductance recordings ensued. This was conducted such that participants inhaled deeply, held their breath for approximately 3 seconds and then exhaled, while the experiment leader monitored the skin conductance readings. This was repeated three or four times, between which participants were breathing normally.

At this point, participants were instructed orally on the principal details of the experiment, and were fitted into the eye tracker to commence the experiment. They were then prompted to read the instructions on the monitor and affirming their understanding of them. To ascertain good gaze data, a 13-point calibration of the eye-tracker equipment was performed, such that subjects were required to focus on each of 13 circles appearing in random order in 13 fixed positions evenly distributed on the screen, until gaze readings were thoroughly calibrated. Directly following this, a trial session of 5 pictures not included in the experiment stimuli were shown to make sure that participants understood the procedure.

Emotion regulation task
The instructions shown to participants at this point only covered the first study task, in which participants would regulate emotion while watching positive, neutral or negative pictures. To do so, they would be prompted either to “attend” or “decrease” their emotional experience to the picture, where “attend” was further explained to entail “looking at the picture without reducing emotional reaction” while “decrease” was described as “looking at the picture while trying to reduce emotional reaction”. To avoid misunderstandings, the experiment leader queried participants during trial pictures to ensure that they understood that the point was to lessen emotional reaction, whether positive or negative, rather than always make it lower. Participants were further instructed to keep their eyes on the monitor and not to shut their eyes other than for normal blinking.
Each trial started with a regulation instruction shown on-screen centre in black on a white background for 2000 ms prompting participants either to “attend” or “decrease” their emotional experience to the picture, or in the case of neutral pictures, “attend” the picture. A fixation cross was thereafter shown for 2000 ms, presented randomly in one of 6 positions on screen, centre-placed in the left, middle or right third of either the upper or lower part of the screen. A picture of positive, negative or neutral valence was then shown for 6000 ms during which participants followed regulation instructions. Directly after the picture presentation participants rated their emotional reaction to the pictures on a SAM scale (Lang, 1980), for valence (on a scale from 1 to 9, where 1 indicated that they felt very negatively affected, and 9 that they felt very positively affected, with 5 indicating no positive or negative affect) and for arousal (on a scale from 1 to 9, with 1 indicating that they felt very calm when watching the picture, and 9 they felt very aroused by watching the picture). The emotional rating screen was divided in two, with figures indicating affect level and arousal level respectively, and participants had unlimited time in which they used the left mouse button to perform the two ratings. When this had been done, the session continued with the instruction screen indicating the beginning of the next trial.

Emotion fixation task
In all, the first task took between 20 and 40 minutes with participants allowed a short break after half the pictures had been presented. After completion, another short break ensued, followed by instructions on the second task, first orally and then on-screen for participants to read through. When they had confirmed their understanding of the task, another calibration of the eye tracker equipment was completed, directly followed by the 25 pictures comprising the emotion fixation task.

In this second task, participants were instructed to attend the pictures without regulation of emotion, but while being directed to areas of the picture placed either on emotionally neutral or emotion eliciting areas, being demarcated by a blue circle, 5 cm in diameter with a thickness of two mm. Participants were specifically instructed to not look outside the circle, but were still required to make ratings of their emotional reactions following picture presentations. The trial structure mimicked the first task, with an initial fixation cross shown for 2000 ms, followed by the picture, either positive, negative or neutral, being shown for 6000 ms, and completed with the untimed SAM screen allowing subjects to indicate felt arousal and positive or negative feelings.

When both tasks were completed, participants completed a Swedish version of ERQ, a scale of habitual use of cognitive reappraisal and suppression, and answered four exploratory questions regarding their impression of the experiment. Finally they were given a short description of the experiment, were thanked for their participation and were given the possibility to receive further information once the study was completed.

Results

Task 1
A repeated-measures 2x2 ANOVA was performed with instruction (attend/decrease) and emotion (positive/negative) as independent variables and the SAM-rating of arousal as dependent variable. Most importantly, there was a main effect of instruction (F(1,26) = 41.42, p < 0.001) such that the arousal rating was higher in the attend condition compared
to the decrease condition. Furthermore there was a main effect of emotion, such that the arousal rating of negative pictures was higher than that of positive pictures ($F(1,26) = 45.51, p < 0.001$). There was no significant interaction ($F(1,26) = 3.25, p = 0.083$).

A similar analysis using a $2 \times 2$ ANOVA with instruction (attend/decrease) and emotion (positive/negative) as independent variables and the SAM-rating of valence as dependent variable was performed. This revealed a main effect of instruction ($F(1,26) = 13.06, p < 0.001$) such that pictures were rated differently (less negative and positive respectively depending on stimuli) in decrease condition compared to attend condition. As a natural consequence of the ratings, there were also a main effect of emotion (positive pictures rated higher than negative pictures) and an interaction effect of instruction and emotion (with negative pictures increasing in valence rating in decrease condition compared to attend condition, i.e. going towards the center, and negative pictures decreasing in valence), $F(1,26) = 177.95$ for emotion and $F(1,26) = 35.50$ for the interaction, both $p < 0.001$.

Finally a repeated-measures $2 \times 2$ ANOVA with instruction (attend/decrease) and emotion (positive/negative) as independent variables and dwell time (period spent in emotional areas, AOI, for the 6 seconds the picture was shown) as dependent variable was performed. A main effect was obtained for emotion, such that subjects spent more time in emotional areas of negative pictures than of positive pictures ($F(1,26) = 5.68, p = 0.025$). No interaction effect of emotion and instruction was found ($F(1,26 = 1.82, p = 0.188)$, but a trend for a main effect of instruction such that subjects spent less time in emotional areas when decreasing emotion than when attending ($F(1,26) = 3.97, p = 0.057$).

To better understand how different people acted in order to regulate emotion, correlations were run for arousal and valence ratings respectively compared to dwell time, separately for positive and negative pictures, such that differences between attend and decrease conditions were the compared variables. Correlations are shown in Table 2. Note that all correlations correspond to expected movements such that less dwell time means less arousal or a lessening of valence, but the construction of the SAM scale means that a lessening of valence ratings to negative pictures will give a negative sign to the correlation.

<table>
<thead>
<tr>
<th>Type of rating</th>
<th>Valence (dwell time)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Positive</td>
</tr>
<tr>
<td>Arousal difference pos. pic.</td>
<td>0.162 (ns)</td>
</tr>
<tr>
<td>Valence difference pos. pic.</td>
<td>0.520 ($p &lt; 0.01$)</td>
</tr>
<tr>
<td>Arousal difference neg. pic.</td>
<td></td>
</tr>
<tr>
<td>Valence difference neg. pic.</td>
<td></td>
</tr>
</tbody>
</table>

To further investigate the effects of instruction on dwell times, simple t-tests were run for positive and negative stimuli respectively, comparing dwell times for the attend condition and the decrease condition. For positive pictures, there was a significant effect of instruction ($p = 0.044$), while there was no significant effect for negative pictures.
Regarding psychophysiological measures, artefacts related to eye movements made data unusable and is therefore not reported.

**Task 2**
In the second study task the main measurements were the ratings of arousal and valence and the skin conductance measure, with the eye tracker data mainly used for confirmation.

As for the ratings, separate analyses were made for valence and arousal, with main comparisons of ratings between when the area to which attention was drawn was positioned in an emotional part of the stimuli and when it was positioned in a non-emotional part. The neutral pictures were used as a baseline which ratings of the non-emotional part of positive and negative stimuli were expected to close in on from above and below respectively. Complete data was obtained from 25 participants.

*Positive stimuli, valence and arousal:* For positive stimuli, a paired-sample t-test between valence-ratings when watching emotional areas and non-emotional areas of pictures was significant \((t_{24} = -3.274, p = 0.003)\). A similar paired-sample t-test between arousal-ratings of positive stimuli was not significant \((t_{24} = 1.713, p = 0.1)\).

*Negative stimuli, valence and arousal:* For negative stimuli, a paired-sample t-test between valence-ratings when watching emotional areas and non-emotional areas of pictures was significant \((t_{24} = 2.274, p = 0.032)\). A similar paired-sample t-test between arousal-ratings of negative stimuli was also significant \((t_{24} = 2.457, p = 0.022)\). See Figure 1.

![Figure 1](image_url.png)

**Figure 1.** Mean values for task 2, valence and arousal ratings for positive and negative pictures. Comparisons between neutral AOI and emotional AOI.

For psychophysiological data, analyses of skin conductance data were made for positive and negative stimuli separately. A paired-sample t-test between non-emotional and emotional areas of positive stimuli was non-significant \((t_{21} = 0.0035, p = 0.083)\). A similar paired-sample t-test for negative stimuli was also non-significant \((t_{21} = 0.0013, p = 0.565)\). ECG data could not be analyzed due to quality of signal.
Discussion

Task 1
For ratings both of arousal and valence, there was an effect of instruction, indicating successful emotion regulation following predictions. Unfortunately psychophysiological data was not available to generalize this result. The prediction that dwell times also would be affected by instruction and indicate emotion regulation was not supported, although there was a trend to this effect, suggesting a larger sample might have meant a significant result. Note also how a significant effect was achieved for positive pictures but not for negative. However, this was far from the strong effect the emotion regulation instruction had on ratings, suggesting gaze was not the best explanation for effective emotion regulation. Note that the predictions for correlations between dwell times and valence and arousal ratings respectively mainly held for valence, but generally not for arousal, which is somewhat interesting given the high correlation between arousal and valence ratings in the study.

Task 2
With regards to ratings, both of arousal and of valence, predictions were met. However, although significant, the results were relatively weak, suggesting that participants in general were quite affected by the whole picture despite having been directed towards specific parts of it. Skin conductance data did not yield any results, but very small changes in skin conductance suggest that the stimuli was not strong enough to make this measure useful in the current study.

General discussion
The result of the first task in the current study was overall somewhat disappointing as to the nature of attentional deployment in instructed emotion regulation. One of the reasons was the lack of psychophysiological data that could have made for further analysis as regards to the eye tracker data. The same goes for task 2, where skin conductance did not show any effects, although data from ratings at least followed predictions. Overall, the relatively small number of participants could have been the reason for the weak results, but the strength of the change of ratings indicate that this was not true for all of the data.

However, the study can be seen as an introduction to further research of emotion regulation where attentional deployment is concurrently measured or is the main part of the study. To do so there are several different approaches that could be taken, where one could be to explore how the timing of different emotion regulation processes could affect results of studies such as the current one with a focus on attentional deployment. Another approach would be to start focusing on individual differences and the consequences this could have in the study of emotion regulation. Note for example how the studies that most strongly could see an effect of gaze on successful emotion regulation, van Reekum et al. (2007) and Isaacowitz (2006) both used elderly participants. Here also the possible effects of habitual use of attentional deployment as the main emotion regulation strategy could be expanded upon.

One issue raised about the design in the current study concerns the lack of counterbalancing between tasks 1 and 2 and how this could have enhanced the risk of a type 1 error. While it is not apparent how this would have affected the result, which (in task 2, which would be the one that could have been negatively affected) is also in line with previous results of this type (Dunning & Hajcak, 2009), it might however have been
appropriate with counterbalancing in the circumstances. Note though that, as the experiment took place, what was most apparent was the tendency for subjects to lose concentration during the second task, which might be the reason for the weak results of the skin conductance measure. In retrospect, the design was ill suited for the psychophysiological measures decided upon, and future studies will have to be done with this in mind. Another issue to be considered in future studies is to have the same arousal levels of positive and negative emotional pictures, which was not the case in the current study. This would allow comparisons between arousal effects from emotion regulation of negative and positive pictures.

References


