The Effect of Observers' Mood on Level of Processing of Emotional Schematic Faces

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Abstract

The thesis examined the effect of mood on the processing of local details of emotional faces. In a series of experiments, this effect was investigated in different mood valences, intensities, and persistency. Happy, neutral and sad schematic faces were presented to happy or sad participants, who were asked to count particular features of the presented faces. It was assumed that the time needed to count the parts of each facial expression would reveal the ease of attentional resources allocation to the local elements of that facial emotion. The results showed that counting the parts of sad faces needed more time; it is likely that the global level processing of sad faces captured attention and interfered with fast access to local elements. The results also showed that higher intensity mood inductions (using music clips and recall tasks) and longer exposure to mood inductions might guide attention in different ways. Data showed that when happy and sad mood were induced in low intensity, attending to the local details was faster in happy mood compared to sad mood. On the contrary, when happy mood was experienced for a longer time, local processing was slower, although local processing was enhanced as the sad mood intensified or was experienced for longer period. This research concluded that the global interference effect is not a fixed phenomenon, but is influenced by contextual factors. Moreover, it was suggested that mood attributes (e.g., valence, intensity, or persistency) influence attentional strategies in processing of a compound shape.

This work is dedicated to my parents “Eftekhar” and “Ahmad”, my brother “Soroush” and my sister “Saba”. Without their support, this work would not exist.

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The research design and procedure was approved by Massey University Human Ethical Committee: Northern (MUHEC: N) no.08/066R.

Table of contents

List of Graphs

List of Tables

Chapter 1

Introduction

The goal of this study is to investigate how affective states, facial expression and global/local level perception affect one another. Affective states have varied and distinctly different impacts on cognitive processes, this means that mood can influence the way we perceive our environment. This effect is more noticeable when we encounter social stimuli like the human face. This research has aimed to consider whether affective states tend to conduct attention to the whole (global level) or towards the features (local level) of emotional faces. This research intended to fill a gap in previous findings which has looked at these three factors in relative isolation by studying them together.

Overview of the Current Study

Among all visual stimuli, the human face is significantly important in terms of providing useful information very quickly. This information defines the direction of social communication. Moreover, rapid extraction of facial signals leads to generate efficient responses in the appropriate time. These characteristics make the human face a unique stimulus and have received a great deal of research interest.

Studying face perception is accompanied by considering the notions of automaticity and holism. Many investigations have considered face perception as automatic because it takes place quickly, in a mandatory and non-conscious fashion (e.g., Dimberg, Thunberg, & Elmehed, 2000; Murphy & Zajonc, 1993; Suzuki & Cavanagh, 1995; Vuilleumier, 2000). Other recent research indicates that face perception is not necessarily automatic, but it relies on the availability of attentional resources. For example, parameters of the task and its demands (Pessoa, McKenna, Gutierrez, & Ungerleider, 2002) as well as contextual factors (Eastwood et al., 2008) can influence the perception of the face in the early stages of processing.

Many research studies have proposed that the human face is perceived as a whole which means that processing of the overall structure dominates the processing of the component parts (Tanaka & Farah, 1993).

The processing priority of the overall structure seems to be influenced by contextual factors. For example, it has been shown that affective states of the observers influence the level of processing (Baumann & Kuhl, 2005; Gasper & Clore, 2002). It is still unclear if an observer's mood has the same effect on face perception and whether it manipulates or prevents prior global processing. In this context, the present study looked to understand mood, attention and perception interaction for emotional face stimuli.

This research has been driven by some initial aims: First, to focus on the visual perception of the human face with different emotional expressions; Second, to investigate emotional face perception when an observer was experiencing a happy or sad mood; Third, to study whether different mood intensity or various mood length influences emotional face perception. The primary motivation in conducting this research was to make a contribution to the fundamental knowledge of mood, perception and attention. However, the effect of the affective states of the observer on perception and attention could also be useful in some applied fields of science such as in the field of consumer behaviour. This is because the target audience of an advertising campaign is broad and may experience a variety of mood states when viewing an advertisement. The interaction of mood and face perception could also provide fruitful knowledge for psychopathology in understanding the communicational failures in depression and bipolar disorder. Since the effect of an observer's mood in attending to the details of the face is considered, the results may have an application in forensic psychology and eyewitness testimonies because police line-ups are affective situations for eyewitnesses.

This report is divided into four parts. Part one focuses on the related theoretical background and experimental approaches that examine each theory. The gaps in the previous research are noted as well as the aims of the current study. Part two reports the procedure of the research design and pilot studies. Part three discusses the experimental phase of the research, including the explanation of six experiments. The final section includes a discussion of the findings and their limitations as well as an evaluation on how successful the research has been in fulfilling its aims.

Critical Summary and Analysis of the Literature

Human Face as a Specific Stimulus

The human face is a unique type of stimulus as it provides information about a person's age, gender, race, identity, attractiveness, direction of attention, level of motivation and also emotional states. Hence, the human face is a key element in social communication. Such information has functional significance in forming human interactions (Arundale, 2009; Lundqvist, Esteves, & Ohman, 1999). For example, direction of attention and level of the motivation extracted from someone's face determine if the speaker should continue talking or not. Moreover, some of the signals exhibited by facial expressions contain life affecting information for the observer. Since immediate processing of the situation is necessary for the best decision and the most adaptive response, extracting fast and efficient information from the face has adaptive values for the observer. For example prompt avoidance or defensive behaviour may be crucial in response to an angry face. It is important to note that not only emotional faces but also neutral faces provide a great source of useful information for social interactions (Palermo & Rhodes, 2007).

In this context, many research findings (e.g., Vuilleumier, 2000) have highlighted the attention grabbing ability of faces; which means, in competing with other stimuli, faces are more successful in capturing attention. This specific ability is essential because we are surrounded by many items in our visual environment that all are not necessarily worthy of our attention. So, selection is the gist of attention.[1]

It seems that our attentional mechanism inherently allocates attention to face and correspondingly, face-like stimuli. In other words, there is a cognitive mechanism

[1] Different theories were developed to explain how this selection takes place. For example Broadbent's selective filter model (1958), Treisman's attenuation model (1964) and Deutsch and Deutsch's late filter model (1963) have proposed how specific inputs are attended and the rest are disregarded.

specialized for face perception. For example, cognitive developmental studies showed that we are born with the ability to attend and prefer face-like stimuli (e.g., Johnson, Dziurawiec, Ellis, & Morton, 1991, Experiments 1 and 2; Mondloch et al., 1999; Umilta, Simon, & Valenza, 1996; Valenza, Simon, Cassia, & Umilta, 1996; for a review, see Quinn & Slater, 2003). In such studies, typically, face-like shapes and non-face-like shapes are shown to newborn babies. The shape that was selected or held in attention by the newborn is assumed to be the preferred shape (Mondloch et al., 1999; Valenza et al., 1996). Showing schematic face-like stimuli to infants in the first hours of their life, while registering their eye gaze and duration of attention, revealed that face and face-like structures are capable of attracting the attention of newborn human babies (Mondloch et al., 1999). Infants kept this preference for up-right face-like pattern even when the alternative shape was more visible (Umilta et al., 1996, Experiment 3; Valenza et al., 1996). Developmental and cognitive researchers have not been able to explain the mechanism beneath this preference. It is unclear whether the human infant is equipped with an exclusive system to recognize face pattern or if the infant is able to learn about faces more efficiently. However, there is no doubt that the human face is a special visual stimulus for our attentional mechanism from birth. These findings inspired researchers to explore the brain activation pattern during face perception.

Kanwisher, McDermott and Chun (1997) used the functional magnetic resonance imaging (fMRI) of normal participants while they were passively looking at photographs of faces and non faces (e.g., hand, spoon, telephone, unfamiliar houses, and scrambled faces). fMRI is a neuroimaging technique for measuring brain activity as it detects the blood flow and oxygen changes in neurons. A stronger signal indicates higher neural activity of that particular region of the brain (Clare, 1997; Ogawa et al., 1992). It was reported that the activation in fusiform gyrus located in the occipitotemporal region (Figure 1) was significantly stronger while viewing face compared to non-face stimuli. Moreover, this activation is greater in the right fusiform than the left fusiform. This region that is assumed to be particularly involved in face perception is called the fusiform face area (FFA) (Kanwisher et al., 1997; for a review, see Haxby, Hoffman, & Gobbini, 2000; Posamentier & Abdi, 2003). Activation of FFA is not related to the familiarity of our cognitive system with human faces, since other familiar objects were not able to activate FFA as strongly as faces (McCarthy, Puce, Gore, & Allison, 1997). Participants were passively watching continuous changing pictures while their brain activation was traced using fMRI. The pictures included the human face or flowers embedded on a series of objects or non objects. The results showed that the right fusiform gyrus was activated during passive processing of the face, but observing the familiar object like a flower did not activate this area. They concluded that right FFA is more engaged in processing the face, so, it might be the specialised part of the brain for face processing (McCarthy et al., 1997).

While most of the mentioned research proposed that just the face (or face like stimuli) is capable of activating the FFA part of the brain, another set of research interpreted that this activation is due to our considerable experience with faces. Namely, humans are experts in face processing due to their considerable experience with observing different faces since childhood. Therefore, the fusiform gyrus is activated by observing any object that we have expertise with (Gauthier, Tarr, Anderson, Skudlarski, & Gore, 1999; Gauthier, Skudlarski, Gore, & Anderson, 2000; for a review, see Posamentier & Abdi, 2003). For example, when bird or car experts (a person who has considerable experiences on identifying different species of birds or different models of cars), viewed bird or car pictures, the right FFA showed activation while this activation was not seen while watching other familiar objects (Gauthier et al., 2000). The expertise phenomenon has been demonstrated even when the research participant was familiarized with unfamiliar stimuli. With long time training of recognising different types of computer generated shapes the same activation was observed on the right FFA region of the brain (Gauthier et al., 1999). These results suggested that there is not a specific face processing system, but that the specialization of the fusiform gyrus to face processing was due to expertise.

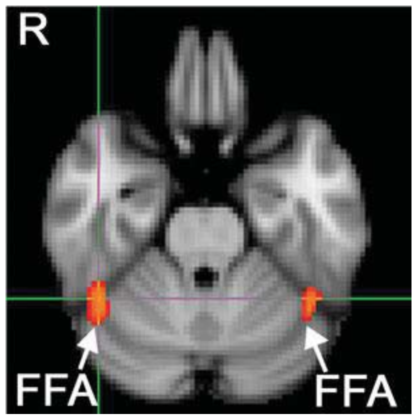


Figure 1. The FFA is located on the ventral surface of temporal lobe on the fusiform gyrus. From "Internal and external features of the face are represented holistically in face- selective regions of visual cortex", by T. J. Andrews et al., 2010, The Journal of Neuroscience, 30, p. 3546

Recent fMRI study showed that activation in FFA occurs even when a prosopagnosic patient encounters with face stimuli (Steeves et al., 2006). Prosopagnosia is a neurological problem in which the person is not able to recognize face despite having the intact visual ability (Hecaen & Angelergues, 1962). This deficit is usually caused by damages in the medial occipitotemporal cortex (Meadows, 1974; Takamura, 1996). Activation of the FFA in prosopagnosia suggested that other areas of the brain might collaborate with FFA for intact face processing (Steeves et al., 2006).

Extensive studies on the effect of face perception on the specific areas of the brain inspired researchers to study patients with focal brain damage. Another set of evidence in favour of the unique ability of the human face in capturing attention was provided by studies of patients with a single focal lesion in the right hemisphere. It provided more support for the specificity of face stimulus in directing visual perception. For example, three patients with single focal damage in the right hemisphere (fractions in right middle cerebral artery or right middle and anterior cerebral arteries[2]) were studied by Vuilleumier (2000). They were presented with faces, objects or scrambled faces in either left or right or both visual fields. In general when two visual stimuli in both sides of the visual field were presented to these patients, the stimulus in the left side of the visual field was neglected (called extinction - left spatial neglect). It is assumed that two stimuli compete to get attention but the stimulus presented in the right side of the visual field extinguishes the stimulus shown in the left side of the visual field (contra lesional) (Compton, 2003; for a review, see Brozzoli, Dematte, Pavani, Frassinetti, & Farne, 2006). Surprisingly, the results of this experiment showed that when the face was located on the left side of their visual field, it was less likely to be missed (Vuilleumier, 2000). Ability of the face stimulus in overcoming the neglect effect in brain injured patients proposed that the face is a meaningful stimulus for our attentional system and capable of biasing attention.

Abundant findings of previous studies have emphasized that two notions are important in face perception: automaticity and holisticity.

The meaning of automaticity in face perception

The term automaticity, based on research carried out on attention, is mostly used in situations when a performance such as driving a car or riding a bicycle becomes fast and effortless by practicing. However, in the context of face perception,

[2] These arteries provide blood for the cerebrum, if blocked by any reason sufficient blood will not receive to the brain tissue and may cause permanent damage which called bran infarction.

automaticity demonstrates an innate capability of our cognitive system and is not related to practice (Yiend, 2010).

Faces are assumed to be processed automatically in terms of different attributes. Speeded processing, mandatory processing, out of conscious awareness processing, and minimal attentional resources required for processing, were assumed as evidence for automatic face perception (e.g., Bentin, Allison, Puce, Perez, & McCarthy, 1996; Dimberg et al., 2000; Heshler & Hochstein, 2005; Suzuki & Cavanagh, 1995; Vuilleumier, 2000; for a review, see Palermo & Rhodes, 2006; Yiend, 2010). Evidence obtained by using different methodologies: the most used methods were behavioural research on healthy participants or participants with brain damages as well as brain imaging studies. These studies are discussed here in detail.

Event-Related Potential (ERP) studies of healthy participants showed a different pattern for detecting face stimuli compared to other categories of stimuli (Bentin et al., 1996). EPRs show neural responses of a brain to a specific cognitive, sensory or motor event (Luck, 2005). Participants' ERPs were recorded using scalp electrodes while they were counting the occurrence of different stimuli including faces, scrambled faces, cars, scrambled cars and butterflies (Experiment 1). The results showed that while negative ERPs for face stimuli were elicited in the lateral posterior scalp at approximately 172 milliseconds, other stimuli did not provoke such early response. Replication of this study for animal face showed that they were not able to elicit N170.[3] Moreover, other stimuli as familiar as a human face (e.g., human hand) were not able to elicit the N170 too (Experiment 2). These results showed that the perception of the human face occurs faster in the brain compared to other categories of objects (Bentin et al., 1996). Bentin et al.'s (1996) stimuli selection was subsequently

[3] N170 refers to the negative ERP which is provoked at posterior temporal region almost 172 milliseconds after presenting a face stimulus.

challenged by the claim that these stimuli belong to different categories, and that observed differences might relate to the stimuli's visual properties. To solve this problem, Pegna, Khateb, Michel, and Landis (2004) manipulated the visual stimuli representation with the use of a computer programme. This manipulation included turning the images to black and white and disguising them with patches and bubbles. Finally, by adding a meaningless background, the objects were not recognizable by observers. In the next stage, participants were informed about the hidden stimulus inside the manipulated images. It assumed that after revealing that there is a hidden stimulus in the picture, its processing was inescapable. This method could control the physical difference between various objects and provide a valid stimulus design for comparing objects from different categories. Results revealed that visual processing of the face happens faster than objects or words even when they were disguised in images (Pegna et al., 2004). These empirical studies provided evidence that faces are processed faster than other stimuli.

Another characteristic of automatic face perception is that it is assumed to be mandatory or obligatory (Suzuki & Cavanagh, 1995; Vuilleumier, 2000) which means that even if the observer has no intention of processing the face, it will unavoidably be processed. Vuilleumier (2000) observed that patients, who suffered from neglect and visual extinction, are able to perceive human faces, but not other stimuli (e.g., shapes, names or scrambled faces). This finding suggested that processing of human face is mandatory. The obligation for face processing was even observed when it was irrelevant to the task demand. For example, when the observers were asked to look for a specific element embedded in schematic shapes; the search time was slower when the target was a feature of a schematic face than when it was an element of a meaningless shape (Mermelstein, Banks, & Prinzmetal, 1979; Suzuki & Cavanagh, 1995). This means that even if face processing is irrelevant to the task requirements, it takes place unavoidably.

In addition, studies with healthy participants suggest that face processing is automatic because it does not reach the threshold of conscious awareness (Dimberg et al., 2000; Morris, Ohman, & Dolan, 1998; Murphy & Zajonc, 1993). In such studies, the face stimulus was presented very briefly to avoid conscious processing. The briefly presented face stimulus usually conveyed an emotion and was followed by a neutral stimulus (called a *mask*[4]). Results showed that the emotional valence of the briefly presented face affected the psychophysiological or behavioural response to the neutral mask. It assumed that the content and emotion of the face was processed unconsciously. For example, Murphy and Zajonc (1993) in their first experiment presented participants with happy or angry faces for 4 milliseconds and immediately replaced the faces with a Chinese symbol. These Chinese symbols were novel, neutral and bland for the observers, nevertheless, participants were asked to assess whether they liked or disliked each symbol. Results showed that even though the participants were not aware of the faces (because of their brief presentations), their assessment of the symbols was affected by the emotions of the faces. When the symbol was presented after a happy face, it was assessed more likable than when it was followed by an angry face (Murphy & Zajonc, 1993). These findings support the notion that observers are able to perceive the face even if it does not reach the threshold of conscious awareness. Unconscious perception of the emotional faces was also able to influence the physiological responses. A brief presentation of happy or angry faces is enough to evoke physiological changes. In human faces, specific muscles are activated in expressing happiness while others are more engaged in conveying anger (Dimberg et

[4] Masking is an important method in visual cognition studies. Generally, the masking stimulus is presented in certain temporal or spatial closeness to the target stimulus. This procedure weakened the perception of the target stimulus. (for a review, see Ansorge, Francis, Herzog, & Ogmen, 2007).

al., 2000). Dimberg and associates (2000) presented happy or angry faces for 30 milliseconds and immediately masked these using neutral faces. Recording the facial muscle activations showed that these briefly presented emotional faces activated the congruent emotion in observers' facial muscles (Dimberg et al., 2000). It was concluded that the briefly presented positive and negative faces were unconsciously perceived by the observers and resulted in facial mimicry.

Finally, another group of studies indicated that face processing is automatic because it is capacity free and does not need any attentional resources (e.g., Hershler & Hochstein, 2005).

The visual search paradigm was the most applicable method in studying the attentional allocation to the face stimulus. Visual search paradigm (Treisman & Gelade, 1980) was adopted from one of the common cognitive performances in everyday routine: search for a particular item in the crowd of other items. It is assumed that attention is involved in search performance for detecting visual targets; this has made visual search an eligible candidate to study allocation of attention to different visual objects. In the experimental settings, typically, participants are asked to detect a specific target (a face) in the crowd of different distracters (Treisman & Gelade, 1980; Wolfe, 1994; 1998; 2001). Reaction time and accuracy of the responses are registered as indicators of speed and accuracy of the attentional bias to the target. If detection of the target stimulus takes place regardless of the number of distracters, the processing is assumed to be automatic (Chun & Wolfe, 2001; for review, see Becker, Anderson, Mortensen, Neufeld, & Neel, 2011; Frischen, Eastwood, & Smilek, 2008; Yiend, 2010). Automatic search is capacity free and called pop-out (parallel search) (Treisman & Gelade, 1980).

Hershler and Hochstein (2005) showed that if the target is a photograph of the real faces among different non-face object distracters, it was considered pop-out, while, the animal faces or scrambled faces or facial features were not pop-out (serial search). These results were assumed as evidence to show that the holistic structure of the face is processed with minimal attentional resources (Hershler & Hochstein, 2005).

The hypothesis of capacity free face perception has encountered some challenges. For example, further research suggested that processing of the face is not automatic and attentional resources are required to detect a face stimulus (Pessoa et al., 2002). Pessoa and associates (2002) proposed that task requirements influence the allocation of the attentional resources. Namely, if the main task is difficult enough to load all the attentional resources, processing of the irrelevant faces would become less likely. In their experiment, participants were requested to assess whether the orientation of two bars was the same or not, while in the centre of the screen at a fixation point, a male or a female face was presented conveying fearful, happy, or neutral emotions. The participants' fMRI data revealed that the face related brain activity was observed only when enough attentional resources were available. However, when the comparison task was difficult, no attentional resources were available and no brain activation in terms of face processing was observed (Pessoa et al., 2002). Overall, it looks as if the evidence for automatic face processing is mixed and face processing is highly dependant on the task demands and context of doing the task (Pessoa, 2005). Moreover, particular facial emotions (e.g., negative expression) were assumed to be able to capture attention more readily and interfere with the ongoing task (Eastwood, Smilek, & Merikle, 2003; Vuilleumier, Armony, Driver, & Dolan, 2001; White, 1996). The specific effect of different facial emotions on attention and perception will be discussed later.

The meaning of holistic face perception

The human face, according to the *hierarchical network theory* (Palmer, 1977), is organized in a hierarchical pattern. This means that the entire face consists of features that are internally linked. These small parts may consist of smaller elements (Palmer, 1977). In other words, the "overall structure [of the face] contains many embedded levels of details" (Palmer, 1977, p.442).

Reviewing the history of face perception studies shows various theories and debates in support of holistic or featural face processing. Holistic processing is one of the fundamental concepts in face studies. It views the face as a whole structure with interrelated features. Holistic processing claims that a human perceptual system tends to process the face as a whole and its parts are not processed independently (e.g., Farah, Tanaka, & Drain, 1995; Tanaka & Farah, 1993; for a review, see Maurer, Le Grand, & Mondloch, 2002). Facial features are assumed to be integrated together simultaneously to form a "single perceptual representation" (Rossion, 2008, p. 275). From this point of view, the representation of the face structure is not just the summation of the features.

In contrast, featural or analytical face perception is a part-based processing where each of the features is processed individually to make the representation of a face (e.g., Macho & Leder, 1998).

Different strategies have been developed to study face perception. Using inverted faces is one of the most applied methods in studying face processing. In a classic study, Yin (1969) utilized upside down stimuli in a memory task. Stimuli included human faces or other familiar objects like houses or airplanes. Results revealed that participants' ability to recognize inverted faces was more impaired than other inverted objects like houses or airplanes (Yin, 1969). This phenomenon called the face inversion effect which has been widely used in many face perception studies (e.g., Farah et al., 1995; Goldstein, 1965; 1975; Haxby, Ungerleider, Clark, Schouten, Hoffman, & Martin, 1999; Leder & Bruce, 2000; Scapinello & Yarmey, 1970; for a review, see Valentine, 1988). The above mentioned effect showed that processing of the face is more vulnerable and sensitive to the orientation compared to other visual objects.

The face inversion effect was used as an evidence of holistic face processing: it was assumed that inversion disturbs the spatial relationship between features, and consequently breaks down the face gestalt. Since the face is processed more holistically than other objects, its perception is more impaired due to inversion (Farah, Tanaka, & Drain, 1995). Farah et al. (1995) suggested that the processing of all visual objects apart from the face, includes some level of part based processing, whereas, faces are processed as a unified whole and its elemental parts are not clearly embodied in processing. This characteristic of face processing compared to processing of the other objects makes the face perception to be sensitive to orientation changes (Farah et al., 1995). Farah and colleagues (1995) predicted that if an observer is forced to process each of the facial features relatively in isolation, the inversion effect would not be observed (Experiment 2). In order to examine this hypothesis, facial features were presented to participants in two different ways: either organizing them into an upright face or presenting isolated in different boxes next to each other. Results showed that recognizing the embedded parts in a face was impaired when the face was inverted, whereas, recognition of the same features was not impaired due to inversion when located in separate boxes. It was concluded that when the observer is forced to process the facial features as separate parts; it is less likely to be impaired by changing the orientation. Nevertheless, when the face is presented as a whole, it is processed holistically and no part-based information is provided. In this case, the face processing is vulnerable to the orientation change and recognition will be impaired by 180º rotation (Farah et al., 1995).

In another study, observers' visual field was restricted to perceive one feature of a face at a time. In this method, observers were able to see the face through a small central window. The size of the window allowed the observer to see only one facial feature at a time, so simultaneous processing of the whole face was not possible. The location of the window was changed due to observer's gaze. The results showed that when the observer is not able to perceive the entire face at the same time, face recognition is not affected by the inversion (Van Belle, De Graef, Verfaillie, Rossion, & Lefevre, 2010). Van Belle et al. (2010) suggested that if observers are prevented from gaining information about features' relationship, the holistic perception will be blocked. When the upright face is not processed holistically, it will not be affected by inversion since inverted faces are processed in a part-based manner.

Another study revealed new information about upright face perception: Leder and Bruce (2000) suggested that, while inversion impairs the perception of metric distances between facial features, it does not affect the processing of the features. In their study, participants were familiarized with two sets of faces. In the first set, six faces were only different by the colour of hair, lips or eyes. In the second set, all the facial features were similar but the metric characteristics (e.g., distance between features) were different. The results showed that recognition of the first set of faces remained intact due to inversion, while participants showed failure in recognition of faces with metric differences (Leder & Bruce, 2000, Experiment 1). The results emphasized that efficient face perception includes processing of the entire face at the same time and extracting information about the features interrelations. However, part-based information contributes to holistic perception (Leder & Bruce, 2000)

Another applied method of studying face perception is using composite faces as stimuli (e.g., Carey & Diamond, 1994; Hole, 1994; Hole, George, & Dunsmore, 1999; Young, Hellawell, & Hay, 1987). In this typical technique, faces are split into two top and bottom parts. Then half top and half bottom parts of two different faces are adjusted and aligned together to make an appropriate new face. The original faces may be selected from familiar (e.g., celebrities) or unfamiliar faces.

Young et al. (1987) made composite faces by matching top parts of familiar faces with bottom parts of unfamiliar faces. Participants were asked to perform a quick recognition task based on the top half of the composite faces. They observed that participants were unable to process the halves in isolation, because a novel face is created by aligning and adjusting two halves of different faces. This means that, even if one half of the face was irrelevant to the task requirements, it was impossible for observers to ignore it. This result provided convincing evidence that the face is perceived as an integrated whole. Surprisingly, when the composite faces were presented in an upside down orientation, participants were able to ignore the bottom half of the face and process only the top half of the composite faces. These results suggested that in the upright orientation, faces are processed holistically. In contrast, when interrelation between facial features is disturbed by changing the orientation, the observer is able to process the face analytically (Hole et al., 1999).

Later, Hole (1994) used only unfamiliar faces to create new composite faces. Participants were presented with two composite faces for two seconds and they were asked to decide if the top halves were the same or different (Hole, 1994). Hole's (1994) idea was to investigate if the holistic processing which was seen for familiar faces would replicate for unfamiliar ones. Results showed that comparison between two composite faces, in a matching task, took longer when the faces were upright than inverted. This suggests that the entire gestalt of the new composite faces is processed holistically even when the original faces were unfamiliar. In addition, holistic processing might suppress isolated perception of the individual features; In this case, the comparison between the parts of different faces is impaired (Hole, 1994). Recent studies, using the composite face technique, showed that not all facial emotions are extracted holistically. For example, in a recent study, Tanaka, Kaiser, Butler, and Le Grand (2012) showed that identification of facial expressions can be made either holistically or part-based. In their third experiment happy or angry composite faces were shown to the participants in two different versions: in one version, the top and bottom halves were matched appropriately to create a new face. In the other version the top and bottom halves were joined and then this new composite face was split horizontally and the bottom part was moved to the right side. Participants were asked to label the facial emotion just by focusing on the top half. The reaction time showed no difference between emotional recognition of whole faces and their split versions. These results showed that, inconsistent with previous studies, composite faces are not necessarily processed holistically. Different processing strategies might be adopted depending on the task requirements (Tanaka et al., 2012). Putting these findings together, recent composite face studies provided significant evidence that either or both perceptual strategies can be activated based on the situation. Therefore, face perception is not exclusively holistic or part-based.

Additional evidence for holistic face processing was provided by Tanaka and Farah (1993). In their research, participants were first familiarized with a set of faces and later were requested to recognize a feature of the faces (for example, “which nose belongs to Bob?”). Data showed that recognition of the facial feature was more difficult when it was presented as an isolated part than when it was embedded in a whole face

(Tanaka & Farah, 1993; Tanaka & Sengco, 1997, Experiment 1). But, the recognition of the face feature was not enhanced when it was presented as a part of scrambled or inverted faces. The authors concluded that upright faces are processed more holistically, but since holistic representation is disrupted in scrambled and inverted faces, the feature embedded inside scrambled and inverted faces is processed the same as presented in isolation (Tanaka & Farah, 1993).

The idea of holistic face perception is well documented in many studies, but it seems that both strategies (holistic/ part-based) are involved in precise and efficient face perception.

Facial emotion and attention

As mentioned before, the attentional system selects only some of the visual information for further processing and the rest of the stimuli will be ignored. Hence, the most important materials have an advantage in capturing attention. Stimuli are evaluated as important when they are relevant to the current goals, expectations, and behaviours (Chun & Wolfe, 2001). From an evolutionary perspective, one of the basic goals of the live organism is to survive; so, any stimulus with the potential capability of affecting an organism's survival has priority to be attended and to be processed by the perceiver (LeDoux, 1998; Ohman, Flykt, & Esteves, 2001). Though, Ohman, Flykt and colleagues (2001) suggested that negative potential stimuli (snakes, spiders, and angry faces) have an advantage to capture attention, but in general "if only some of the information in the world can be attended, it is adaptive to prioritize those stimuli and events that affect goals in either a positive or negative way" (Compton, 2003, p.116).

Faces owing to their biological and social importance capture attention effectively, but different facial emotions carry different information and therefore bias attention in different ways. For example, a happy facial expression may encourage the observer to approach the person expressing it as well as provide the information about probable availability of reinforcement in the environment; in contrast, sad facial expressions may signal something unpleasant. In such a context, research on the effect of different facial expressions on recruiting attentional resources seems valuable.

Different neuropsychological and behavioural methods have been used to study the effect of different facial emotions on attention and perception. Studies of patients with focal brain damage suggested that different neuro-cognitive routes are in charge of processing different facial expressions. For instance, patients with bilateral amygdala damage showed impaired performance in rating the valence of sadness in faces, while ratings of happy face expressions was intact (Adolphs & Tranel, 2004).

Data from visual search studies revealed the difference between negative and positive facial expressions (Eastwood, Smilek, & Merikle, 2001; Fox, Lester, Russo, Bowles, Pichler, & Dutton, 2000; Hansen and Hansen, 1988; Ohman, Lundqvist, & Esteves, 2001). Hansen and Hansen (1988) showed that an angry face in a crowd of happy faces was detected more efficiently than detecting a happy face among angry faces (Experiment 1). However, the characteristics of their stimuli created some doubts about their results: Hansen and Hansen (1988) used the photographs of nine different individuals showing angry or happy expressions. So, it was possible that the inconsistency in facial expression of different individuals affected the results. To address this problem they used photographs of the same person expressing happy or angry emotions in Experiment 2. Results from the second experiment replicated the first experiment findings, and the superiority of an angry face to capture attention in a crowd of happy faces was observed. The stimuli design of the second experiment of Hansen and Hansen (1988) was encountered with another criticism: using the photographs of the same person for the target and distracters created more consistency, but has no ecological validity, as in everyday life visual search should be executed among inconsistent distracters (Ohman, Lundqvist et al., 2001). Therefore, it was concluded that the advantage of negative facial expression observed by Hansen and Hansen (1988) in their study was more likely due to the stimuli attributes (Purcell, Stewart, & Skov, 1996). To avoid this existing problem and assess whether this effect was reliable, Ohman, Lundqvist, and colleagues (2001) replicated the Hansen experiment by using schematic faces (Experiment 1). Ohman, Lundqvist and associates (2001) postulated that biased processing of negative facial expressions (especially threatening emotion) has evolutionary benefits. Threatening faces potentially signal “aversive consequences”, and it should be able to capture and direct attention more efficiently (Ohman, Lundqvist et al., 2001, p.381). In their experiment, participants were required to find the threatening or happy (friendly) target faces among opposite emotion face distracters. Reaction time and accuracy of the responses analysis showed that observers were faster and more accurate when they searched for the threatening face among happy face crowd (distracters) than vice versa (Ohman, Lundqvist et al., 2001). The design and conclusions of the above mentioned experiments were challenged considerably: faster detection of negative face among happy distracters could be the result of exclusive capability of negative faces to capture attention; but, at the same time it might be caused by an efficient and smooth processing of the crowd of happy faces. In the case of the first interpretation, it was assumed that the angry face had superiority to attract attention to its location. But the second interpretation indicates disengagement of attention from the happy face distracters took place faster, so, a happy crowd is processed efficiently and the angry target was detected faster. The fluent processing of the happy faces was supported in other experiments (e.g., Fox et al., 2000). For instance, Fox and colleagues (2000) showed when a display contains only happy faces, its search happened faster than a display of sad faces. In such a context, it is not clear whether the observed search differences were created by the emotional valence of the distracters or the target's facial emotion.

To resolve this issue, researchers used neutral distracters in their research designs (e.g., Eastwood et al., 2001; William & Mattingley, 2006). For example, Eastwood and colleagues (2001) demonstrated that detecting negative schematic faces in the crowd of neutral expression distracters was more efficient than detecting schematic happy expression in a neutral crowd (Eastwood et al., 2001). Fox and associates (2000) also showed that schematic negative faces (angry/sad) were detected more efficiently than positive faces among neutral distracters. They conclude that the visual system is fast in detecting negative facial emotions (Experiments 1, 2, and 4). They also observed slower reaction time in searching for a potential difference in displays that contain similar negative faces than searching displays with similar positive faces (Experiments 1 and 5). Fox et al. (2000) concluded that negative expressions are detected faster than positive expressions; however, negative expressions hold visual attention for longer time for more processing. Fox and colleagues (2000) showed that visual search for the negative expression is fast and efficient but not completely independent of the number of distracters; meaning negative faces are not processed automatically.

The priority of processing negative facial emotions was observed even when face perception was not directly relevant to the task demands (Eastwood et al., 2003; Vuilleumier et al., 2001). For example, in Eastwood et al. (2003) experiment (Experiment 1), three curves (upward or downward) were placed in an order to represent a schematic face. The orientation of the mouth curvature indicated whether this face was happy or sad. Four of these faces with the same emotional valence were randomly placed in a display; so, each potential display could be happy or sad. Participants were presented a target shape (isolated curve) and were asked to count how many of that target was embedded inside each display. The task required an attentional switch from the overall shape (global level) to its elements (local level). Data revealed that counting the local elements of the sad faces took more time than counting the local elements of the happy faces. The authors concluded that the negative facial expressions capture attention more effectively than happy faces even if it is not relevant to the task situation (Eastwood et al., 2003). The processing advantage of negative faces over positive faces was also examined and discussed in other studies (Ohman, Lundqvist et al., 2001, Experiment 2; Fox et al., 2000, Experiments 1, 2, and 4). In sum, it appears facial expressions are able to involuntarily capture attention even when they are not directly related to the task demand. This does not mean that faces are able to capture attention automatically; since, faces capture attention when "their presence has been noticed" (Horstmann & Becker, 2008, p. 1432).

However, most of the experiments emphasized the superiority of angry face expressions in capturing attention, but, recent investigations have found that this is not always the case (Juth, Lundqvist, Karlsson, & Ohman, 2005; for a review, see Frischen et al., 2008). For example, it was shown that an emotional face was detected more efficiently when embedded among neutral faces or located within faces with different emotional expressions (White, 1995). White's (1995) results revealed no difference for searching happy or sad target faces among inconsistent emotional distracters. These findings proposed that emotional faces are more capable of biasing attention than neutral faces. This result was replicated in another study with unilateral neglect patients (Vuilleumier & Schwartz, 2001), showing superiority of the emotional face in capturing attention over the neutral faces. For these patients, when two objects are presented simultaneously on both sides of their visual field, the object on the right side will be ignored or extinguished. However, extinction was less likely when the presented object on the right side of the visual field was a face (Vuilleumier, 2000). More importantly, the possibility of extinction of faces with positive or negative expressions was less than faces with neutral expression (Vuilleumier & Schwartz, 2001). These findings suggested that not only face stimuli are unique in directing attention, but different emotional valences compared to neutral value bias attention more effectively.

The inconsistency in experimental results is not restricted to emotional versus neutral expressions: Juth et al. (2005) showed that when the stimuli were photographs of real individuals, detecting a happy target face was faster and more accurate than detecting an angry target face among the neutral distracters. In contrast, when authors replaced the real face stimuli with schematic faces, the angry target face was detected more efficiently than the happy target face (Experiment 4B). Juth and associates (2005) proposed that using schematic faces as distracters in visual search studies has no ecological validity because they share a uniform shape. Namely, the uniform shape of distracters increases the possibility of the search being based on the physical difference of the features. In other words when there is no variability among distracters, the likelihood of detecting a single different feature arises; in this case the detection is no longer related to the different emotions conveyed by the target face (Becker, Anderson, Mortensen, Neufeld, & Neel, 2011). The superiority of happy faces in the crowd of neutral faces has been replicated in other experiments using computer-generated faces (e.g., Becker et al., 2011).

The results of the above mentioned experiments were not in agreement with the evolutionary aspect, but the effect of familiarity could be a probable interpretation: since, most people experience positive mood more frequently (Diener & Diener, 1999), so, in normal life, familiarity with happy face expressions is higher than with negative facial expressions and this may facilitate fluent processing of happy faces. Moreover, it is assumed that angry faces and neutral faces have more visual similarities (Hansen & Hansen, 1988); therefore, faster detection of a happy face among neutral distracters might occur because the target was clearly distinguishable among the distracters.

Taken together, results of different experiments have provided inconsistent results. This means that variable results were obtained by applying different methodologies. The reason might be concealed due to the fact, that allocation of attention is a highly context dependent process and the characteristics of the target, task requirements, context of task, as well as the observer's characteristics affect this process. It seems that the effect of the contextual factors in guiding attention is one of the most considerable research objectives.

Study human face in research - using schematic faces

As mentioned previously, the human face is a rich source of information, so a valid stimulus for experimental settings should have the same ability as the real human face in transmitting information.

Schematic faces are advantageous for studying face perception because their simple structures allow researchers to alter the facial features and overall expression easily (Lundqvist et al., 1999). Nevertheless, the important question is whether schematic faces provide valid results about face perception or not? In other words, are the schematic faces perceived in the same way as real faces? Neurocognitive studies and behavioural studies showed that schematic faces are trustworthy stimuli in face perception research and the results have the ability to be generalized to the real environment (Chang, 2006; Sagiv & Bentin, 2001). Processing of the basic facial expressions (happy, neutral and sad) took place in the same way when the face stimuli were real faces, photographic faces and schematic faces (Chang, 2006). These results suggested that schematic faces are processed in the same way as real faces. Comparison between N170 event-related potential (ERP) evoked by watching a real photographic face and a schematic face showed that there is the same magnitude of this component for the photographic faces, portraits and schematic faces. N170 refers to the brain's face-specific response provoked in the lateral posterior and have a negative potential with a latency of 172 milliseconds after presenting participants with a human face (Eimer, 2000). It was found that N170 is not affected by familiarity of a face, therefore, it is assumed that this negative potential is associated with early stage of face processing when the face structure is encoded (Eimer, 2000). The ERPs of the participants were recorded with scalp electrodes while they were presented with a photograph of a real human face, painting of a human face, schematic face, scrambled face and a photograph of flowers. The task was irrelevant to the stimulus processing and participants were asked to count target images belonging to one of the five categories (Sagiv & Bentin, 2001). The results showed a similar pattern of ERPs for different face types (photograph, painting and schematic). In fact, in spite of doubts regarding the ecological validity of schematic faces, the above mentioned experiments suggested that initial processing of schematic faces is similar to real faces.

In designing the most adequate schematic faces, it is important to consider which of the features are more responsible for conveying specific emotions. McKelviet (1973) compared 128 schematic faces that consisted of different mouths, eyebrows, noses, eyes, and eye height. He found a significant interaction between the mouth and eyebrow shape in terms of facial emotional recognition. That is, an straight line for the mouth did not convey any specific emotion, while a downward curve for the mouth were easily labelled as showing a sad expression (McKelviet, 1973). The author concluded that recognition of the basic emotions in the face is the function of the moving features (McKelviet, 1973). These results later were supported by Lundqvist and associates (1999) showing that eyebrows are the most powerful elements in the faces and they interact significantly with the direction of the mouth curvature to show facial expressions (Lundqvist et al., 1999). It is concluded that in any design of the schematic faces the eyebrows and the mouth should be treated as crucial features in conveying emotions.

Moreover, it is important to have an idea about the potential of each geometric form to convey affect-related meanings. For example, round shapes have higher potential to convey the meaning of happiness, friendliness, warmth and pleasantness (Aronoff, Woike, & Hyman, 1992). Or, straight lines (using for mouth and eyebrows) were assumed as ambiguous feature which apparently carry no specific emotion (Hale, 1998).

In designing schematic faces usually two issues are considered: first, using geometric forms that resemble any of the face features and second, placing suitable distances between these parts (Bradshaw, 1969; Lundqvist, Esteves, & Ohman, 1999; McKelviet, 1973). Therefore changing the dimensions and distances of the features affects the way that emotions, gender and age are attributed to the faces (Bradshaw, 1969). In summation, using schematic faces in cognitive studies is a controllable and safe way to study cognitive function of face stimuli in the laboratory and the results of schematic faces studies can be generalized to the real environment. Moreover, in creating the most appropriate schematic faces, two moving parts of the face (mouth and eyebrows) should be considered as key elements.

Summary

The human face is the most important stimulus from the biological aspect as well as the social aspect, thus it has received considerable attention from cognitive psychologists, developmental psychologists, vision scientists as well as neurophysiology researchers.

Automaticity and holisticity are the most noticeable themes in studying face perception. Based on the recent research, it seems that face perception is not completely automatic and that minimal attentional resources are still needed for face processing.

A considerable body of research applying different methods supports the hypothesis that face processing occurs holistically. However, recent research suggested that some level of part-based (feature-based) information is also needed for efficient face perception.

Neuropsychological studies as well as behavioural studies found that different facial emotions convey different information; so, it is possible that allocation of attention and processing of faces with different emotions occurs in a variety of ways. Research focused on comparing processing of different facial emotions, has provided inconsistent results. This highlights the importance of contextual factors in face perception.

Structure of Our Visual Environment

We live in a composite world. In our visual environment every scene consists of structures or entities which are also made up of distinct components. Studying human visual perception has always been accompanied by questions about the processing sequence of compound materials. Disputes with this issue were seen in the fundamental assumptions of *structuralism* and *gestalt* theories, where the former believed in early processing of the independent elements but the latter emphasis was on the advanced processing of the whole visual concept (Kimchi & Plamer, 1982). Later, the basics of these two viewpoints were reformulated in new models of compound material perception. Following the basics of structuralism, in *feature integration theory*, Treisman suggested a model in which elements of a specific visual stimulus are processed first; at the later level all these representations combined together to form the stimulus (Treisman & Gelade, 1980). This means that the visual concept of a scene is derived by integrating separate and independent information about the elements of the scene. Focused attention is the essential integrative factor that binds all features together to form a single united object (Treisman & Gelade, 1980). However, the *global precedence effect (GPE),* following the basic concepts of Gestalt theory, suggested processing progresses from the overall shape to its elements (Navon, 1977). Both theories are supported by empirical evidence, but the scope of this research review is to discuss the global precedence effect assumptions and examine the paradigm in a specific perceptual context.

Any visual scene or complex stimulus is likened to a hierarchy in which the overall shape consists of structural elements. In each level of the hierarchy the overall shape which is called the *structural unit* consists of many embedded elements. Each of these elemental details can be another structural unit made up smaller details. However, the existence of the elemental parts is not sufficient to form a structural unit. In the hierarchical stimulus the elemental parts should be spatially related and create a good form. For example, a face as a hierarchical stimulus not only consists of elemental features (e.g., nose, eyes, etc) but the features' spatial locations are also defined (e.g., eyes over a nose). Moreover, the features' sizes are counter-balanced to create a good form (e.g., the eyes are very small in relation to the head) (Palmer, 1977).

In simple words, compound or hierarchical stimulus refers to a big stimulus made up of a suitable organization of small stimuli that are interrelated with each other. Small elements are individually meaningful and their visual identity does not depend on the big stimulus but they are spatially interrelated to constitute the overall shape. In such a structure, the big stimulus is called the global level of the shape and the small stimuli are the local level of the shape. The local level may also have some component parts, and in this case, the local element will be the global level of the form and the component parts are the local level of the stimulus. Compared to the global level, the local level holds more details (Kimchi, 1992; Kimchi & Palmer, 1982; Navon, 1977; 2003; Palmer, 1977).

Global precedence and interference effect in processing visual materials

How we process complex visual materials has always been a fundamental issue in cognitive science. In one of the attempts to explain the visual perception of compound materials, Navon (1977) used Kinchla's (1974) compound letters (Figure 2), in which H was assumed as global and S was assumed as the local level of the shape. In his global-local processing experiments, compound letters were presented and participants were requested to identify either the small (local) or the large (global) letter (Experiment 3). The compound letter was presented on the screen in one of four random locations for 40 milliseconds and was replaced (masked) by a display of dots. Brief presentation of the compound letter was assumed to prevent further processing; thus, this method is able to illustrate which level is processed first. Reaction time (RT) data (and sometimes accuracy data to explore possible speed/accuracy trade-offs) were analyzed to identify the speed of processing of these two levels of the compound target stimulus. Faster reaction time was assumed as the priority in processing. Navon's (1977) results revealed that identifying the global level (bigger shape) was faster than identifying the local level (small elemental parts). This means the global information is registered first and the processing of local elements takes place afterwards. The global advantage hypothesis was also tested in a same - different comparison task (Experiment 4). Participants were asked to decide if two presented shapes were the same or different. This means that they needed to attend to both levels of the compound shapes. The compound shapes were triangles made of different spatial arrangement of small squares. Two target shapes could be the same or different in either global level or local level. The results showed that observers were more successful in detecting global level differences. So, it was concluded that the global level of a compound shape has priority in perception even if both levels were equally accessible. This phenomenon is called the global precedence effect. Moreover, if processing of the local elements is required, information from the global level (irrelevant level[5]) is not ignored but interfered with the procedure, while local details do not interfere with processing of the global level *(global interference effect - GIF*). In short, processing of the local features appears to be impossible without prior perception of the whole (Navon, 1977).

Navon (1977; 1981) concluded that visual perception takes place in an inevitable sequence: it starts with the global level and expands to the local level. Therefore, it is

[5] In global local processing experiment the level of the stimulus that is attended and related to the task demand is called relevant level and the non attended level is called irrelevant level.

expected that the materials which are processed slower and optionally cannot have any effect on the materials which have already been processed (Navon, 1981).

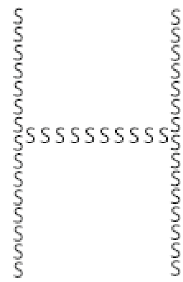


Figure 2. A typical compound letter. Here, the H is the global level of the form and Ss are local level of the form. From "Primacy of wholistic processing and global/local paradigm: A critical review" by R. Kimchi, Psychological Bulletin, 112, p. 26.

Progress of processing from the global level to the local level is advantageous for our cognitive system. Since, we encounter many stimuli in our visual environment; selection is the key of the attentional mechanism because not all of the materials have the same importance to get processed. In such a context, the perceptual mechanism is equipped with the ability to register rough information about the whole visual material and more detailed processing is guided by this prior rough information that was already registered (Navon, 1977).

The global advantage and global interference hypotheses motivated many researchers to study the factors that might affect the global precedence and interference effects. It seems that the GPE and GIF are not a preset phenomenon and primacy of global pattern perception is influenced by stimulus attributes. Research has revealed that the size of the stimuli (Kinchla & Wolfe, 1979), sparsity of the local details (Martin, 1979), quality of the information (Hoffman, 1980), and meaning of the compound stimuli (Boucart & Humphreys, 1992; Poirel, Pineau, & Mellet, 2006; 2008) influence the GPE and GIE.

The effect of the stimulus size on GPE and GIE

Kinchla and Wolfe (1979) explored whether the stimulus angular size affects the level of processing priority. Their experimental stimuli were compound letters composed of H, S or E either in global or local level, presented in five different visual angle sizes (from 4.8º to 22.1º). Participants first heard the name of a letter and then had to decide whether the heard letter was presented in the visual compound letter. The results revealed that the global level was detected slower than the local level when the compound stimulus size exceeded 6º to 9º. Thus, there is a specific range in the size of the visual stimuli which facilitates speed of processing; visual materials larger or smaller than that fixed visual angle are processed later. Therefore, the visual angle of the compound stimuli is assumed as a mediator item that affects the level of processing. The authors critiqued the stimuli design of Navon's (1977) experiments, since they were restricted to 5.5º of visual angle. Whereas, if the size of the stimuli increased to over 9º, the local elements became more salient and the order of processing would be reversed (Kinchla & Wolfe, 1979).

The effect of visual angle in level of processing was revisited by Navon and Norman (1983). Their compound stimuli consisted of Cs or Os in either global or local or both levels. The stimuli were presented in 2º or 17.25º of visual angle and the task was to detect the C's orientation in either global or local level. Their data showed that the processing advantage of global level information was independent of the stimuli sizes (Navon & Norman, 1983). Navon (1981) illustrated that Kinchla and Wolfe's (1979) results were affected by the nature of their stimuli: since, by enlarging the size of the stimuli, the retinal position of the global level was located off the centre, while the local feature was located in the centre of the fovea. Navon and Norman (1983) noted that the eccentricity of both levels in Kinchla and Wolfe's (1979) experiments was not equal. Navon (1981) explained if the eccentricity affects the global and local levels differently, the results will be biased by the difference of foveal and peripheral location.

The effect of sparsity on GPE and GIE

One characteristic of compound stimuli that has received considerable investigation is the effect of sparsity or number of local elements on GPE and GIE. It was shown that when the number of the elemental parts was reduced (the spacing between the local details was increased), the global advantage effect was reversed (Martin, 1979). The research stimuli were compound letters that were presented on the screen for 100 milliseconds. The compound letters were different from the density of their elemental items. Participants were requested to identify (call the name of) either the global level letter or the local level letter (Experiment 1). Results showed that when the local level consisted of many items, processing of the global level of the shape had priority, but, processing of local element took place faster when the compound letter consisted of fewer items (Martin, 1979). Martin’s (1979) results were later challenged in terms of his failure to create good compound letters (Kimchi, 1992). As mentioned previously, goodness of a form is a crucial factor in designing hierarchical stimuli. This means that in the process of creating a good compound shape, a suitable arrangement of elemental parts is inevitable. Consequently, Martin’s low density stimuli did not create a good shape: extra spacing between the elemental parts damaged the overall shape which biased the observer, to recognize the local elements faster (Kimchi, 1992).

The effect of the quality of information on GPE and GIE

The effect of the quality of the information on global precedence effect was explored by Hoffman (1980). Hoffman (1980) suggested that information from global and local levels is encoded in a parallel fashion and the determinant item for speed of encoding is the quality of the material. To examine this hypothesis he designed compound letter stimuli in which local and global levels (either, both, or neither) were distorted by changing one element to an inappropriate spatial location (Figure 3).

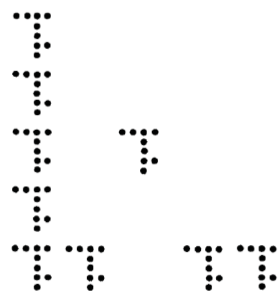


Figure 3. One of the Hoffman's compound letters; the global pattern is a big L consisted of small Ts; and Ts are consisted of small dots. Both L and Ts are distorted by moving one part to an inappropriate spatial location. From "Interaction between global and local levels of a form" by J. E. Hoffman, Journal of Experimental Psychology: Human Perception and Performance, 6, p. 228.

Participants were first presented with two random letters to memorize. The memory set was replaced by a compound visual letter for 90 milliseconds. The task was to search whether the memorized letters are available in the compound letter. Results showed that when the local level of the form was distorted, the global precedence effect was observed, but if the global level was distorted, the reverse pattern, which he named the *local precedence effect*, was observed. In the case of searching both levels, the advantage in processing was affected by the interaction of the level of distortion and the availability of the target in each of the levels. That is, the likelihood of fast processing was higher in the presence of the target compared to the absence of the target. Distorted letters compared to non-distorted letters took more time to be processed. Hofmann (1980) discussed that because the information from both levels is processed in parallel, based on the quality of the information conveyed, the interference effect may be seen for both levels. Hoffman's way of creating the distorted letters was challenged by Navon (1981) over whether the goodness of the form was affected by the physical manipulation he adopted for designing the letters, as in compound stimuli, both levels should be equally recognizable.

The effect of the meaning of the stimuli on GPE and GIE

The effect of the meaning in hierarchical stimuli is an interesting area in global-local processing and has been tested with different stimulus design and task requirements (e.g., Boucart & Humphreys, 1992; Poirel et al., 2006; 2008). In almost all of the early studies the typical Navon stimuli (letters made up of letters) were used and in order to create meaningless (unfamiliar/non-nameable) compound shapes, the spatial position of the letters was changed (e.g., Hoffman, 1980, Figure 3) or pseudo letters were created (Peressotti, Rumiati, Nicoletti, & job, 1991). In more recent studies, familiar or unfamiliar objects were used to create compound shapes (Boucart & Humphreys, 1992; Poirel et al., 2006; 2008). These studies suggested that, there is an interaction between the level of processing and the semantic network. Therefore, the meaning of the observed materials in each level of the stimulus can facilitate or impair the speed of processing. For example Boucart and Humphreys (1992) hypothesized that observers are not able to attend to objects without identifying them. To evaluate this hypothesis, they designed two sets of nameable and non-nameable fragmented stimuli. The nameable objects were drawings of animals or vehicles broken into pieces. The non-nameable compound shapes were made of the same fragments as nameable ones, but each piece was rotated. The rotation of the pieces was made in a way to retain the overall shape geometrically similar to the nameable version, though the shape was not semantically meaningful. In a target matching task, participants were presented with a nameable target followed by two alternative shapes and were requested to decide which of the alternative shapes was similar to the global level of the reference target (Experiment 1). Results revealed that if the target and the match were similar in the overall shape (global level) and also semantically related, the decision would be fast and efficient. However, if the target and match was only physically similar and the alternative shape was only semantically related to the target, the speed of processing would be slowed down. The semantic connection of the irrelevant shape and reference target resulted in longer decision time (Boucart & Humphreys, 1992). However, the reaction time was not affected when the reference target was a non-nameable shape (Experiment 3). Boucart and Humphreys (1992) concluded that in global processing, it is impossible to ignore the meaning of the shape. This effect is not a function of the physical attributes of the shape, since, the effect was not seen when the shapes were inverted (Experiment 4). These findings give rise to the idea that semantic information is processed automatically during visual processing even if the observer does not intend to do so.

Further investigations were carried out on processing of object identification in compound shapes. Most of the studies revealed new aspects of GPE and GIE, while they were mainly focused on object identification. Poirel and associates (2006) investigated the effect of meaning on level of processing. Their stimuli were hierarchical forms made out of objects or meaningless shapes in either or both levels. The familiar objects were adapted from the pre-school educational books or standardized bank of Snodgrass pictures suggested by Snodgrass and Vanderwart (1980). Although, the meaningless forms were organized in a way to be perceived as a unit, the authors did not illustrate the procedure for creating them. In their experiment participants were requested to do a same/different comparison task between two compound stimuli by attending to both levels of the forms. Thus, four comparison situations were possible: same in both levels, different in both levels, same in global level but different in local level and finally, same in local level but different in global level. A combination of these options (same/different x object/non-object) offered 16 potential different conditions (p. 328). Data revealed that when two forms were similar, only the nature of the global level affected the reaction time. On the contrary, when two forms were different in one level, it was the nature of the material of the identical level that had an impact on reaction time. That is, detecting the difference in the local level was faster when the global level consisted of similar objects. However, detecting the difference in the global level was faster when the local level consisted of the same meaningless shapes. This means that, an object (meaningful material) is capable of creating interference when it was presented in the local level. Poirel and colleagues (2006) concluded that when familiar (meaningful) material is presented in a compound shape, inevitable semantic processing is accompanied by visual processing which affects the overall processing duration (Poirel et al., 2006).

Since, the pattern of the findings in the Poirel et al. (2006) experiment was complex the authors studied this effect in another experiment with fewer potential conditions (Poirel et al., 2008). They designed three different types of hierarchical stimuli: big letters made of small letters, big objects made of small objects and big meaningless shapes made up of other meaningless shapes. Participants were requested to detect a target in either the global or the local level of the mentioned shapes

(Experiment 1). For each trial three conditions were possible: (a) target was presented on the attended level, (b) target was presented in an irrelevant level, and (c) target was not presented in any of the levels. Data showed that in all of the compound stimuli (letters, objects, and meaningless forms) the global level has priority in processing; while, the global interference effect was just seen for meaningful materials. This means that the meaning of the compound stimuli affects the global advantage and global interference in different ways. This difference proposed that the global advantage and global interference are operated by two different mechanisms; in any compound form regardless of meaning, the sensory information from the big form (global level) is registered and processed with an advantage over its elements. So, the processing priority of the global level of a form is not affected by the meaning of that form. Therefore, the sensory mechanism is responsible for the global level processing advantage. However, when observers have to attend to just one level of the stimulus and ignore the other level, only familiar and recognisable materials are able to interfere with processing the attended level of the form. So, this suggests that in the global interference effect, the cognitive mechanism and the sensory mechanism are both in charge. In this case, the cognitive mechanism related to the semantic identification of the stimuli accompanies the sensory mechanism (Poirel et al., 2008).

In conclusion, the level of processing is highly affected by the meaning of the stimuli. Having significant social and biological meaning, the human face is crucial to our cognitive system and can be a useful target to study the effect of meaning on GPE and GIE.

Summary

The processing of complex objects or scenes is an important issue in visual cognition. A tremendous amount of research has attempted to explain whether the overall shape or the elemental parts leads to an advantage in processing. The global precedence effect was an attempt to explain the level of processing in complex objects via creating novel stimuli.

GPE suggested not only that the global (overall) level of the shape is processed first, but that it also interferes with the direct processing of the local (elemental) level. The global advantage and global interference effects were challenged by other research, which showed that these effects are not universal and different attributes of the visual scenery might influence them. These results emphasized that visual perception is highly context dependent.

However, it is important to explore whether information from other sources (e.g., observers' characteristics) is able to affect the global precedence and interference effects.

The Effect of Mood on Visual Information Processing

We are surrounded by objects and events. Some of them are pleasant and some are unpleasant; some arouse us and others do not. The impact of the environment creates a global psychological state (pleasant or unpleasant) in the perceiver which is called *affect*. Affective state is an internal (subjective) state that can be explained with two psychological attributes: (a) valence (the level of pleasantness) and (b) the level of physiological activation (Weierich, Wright, Negreira, Dickerson, & Barrett, 2010). It seems that affective experiences are an inevitable part of our mental life. More importantly, affective states as a contextual factor influence the way we process our complex environment.

A tremendous amount of research has been done to study the influence of affective states on cognitive mechanisms. In earlier studies, participants were mostly selected from clinical populations (e.g., individuals with depression). It was assumed that studying the cognitive performance of people with affective disorders would provide an opportunity to explore how cognition would be affected by mood (for a review, see Storbeck & Clore, 2007; Chepenik, Cornew, & Farah, 2007). It seems that cognitive performance of people with affective disorders invigorated the idea of the interrelation between cognition and mood in cognitive psychology. For example, it was shown that depressed people's ability to process facial emotions and judge facial expression is impaired (Hale, Jensen, Bouhuys, & van den Hoofdakker, 1998; Mandal & Bhattacharya, 1985; for a review, see Bourke, Douglas, & Porter, 2010; Venn, Watson, Gallagher, & Young, 2005). In one clinical study, when depressed patients were requested to put different faces in six categories based on their expressions, happy faces labelling was made with higher errors while recognition of sad faces was most successful (Hale et al., 1998; Mandal & Bhattacharya, 1985). Moreover, compared with healthy participants, people who were diagnosed with depression showed a tendency to label ambiguous faces as negative (Hale et al., 1998).

Studies of participants with affective disorders provided valuable knowledge about the possible relationship between mood and cognition, but the results could not be generalized to the healthy population. This inspired cognitive researchers to develop laboratory methods to induce particular affective states in normal participants and study the effect of manipulated mood on cognition. Available mood induction procedures and their effectiveness were discussed later in detail; but, here, the priority was given to the available research findings with healthy samples.

The Effect of Mood on Cognitive Performance

Investigations of cognitive processes in healthy participants with manipulated mood suggest that most mechanisms like attention (e.g., Gilboa-Schechtman, Revelle, & Gotlib, 2000), perception (e.g., Basso, Schefft, Ris, & Dember, 1996; Riener, Stefanucci, Proffitt, & Clore, 2011), memory (e.g., Storbeck & Clore, 2005; for a review, see Kensinger, 2009) and judgment (e.g., Riener et al., 2011) are influenced by a person's affective state. In short, mood influences how we deal with different aspects of our environment. For instance, Riener and associates (2011) showed that a person's mood has impact on the verbal judgment and visual estimation of a geographical slant. Happy or sad mood was induced in participants by playing related pieces of music for 10 minutes. Then participants were asked to estimate the incline of hills. Results showed that the hills' slant were estimated significantly steeper in sad mood.

Gilboa-Schechtman et al. (2000) found that sad mood was accompanied by attentional bias to negative words in a Stroop test.

In another study, the effect of happy and sad mood was studied on memory. Storbeck and Clore (2005) studied the effect of happy and sad mood on recalling semantically related materials. They found that people in a happy mood are more likely to recall items which were not presented but were semantically related to the presented materials. Thus, they concluded that in happy mood the possibility of forming a false memory is high. Based on these results Storbeck and Clore (2005) proposed that different mechanisms are in charge for registering (encoding) materials in happy and sad moods. In happy mood, encoding of materials takes place through a concept based strategy while in sad mood encoding inputs are more based on the physical features (Storbeck & Clore, 2005).

Affective states were shown to have significant effects on face perception (Bouhuys, Bloem, & Groothuis, 1995; Lee, Ng, Tang, & Chan, 2008). Participants listening to a sad piece of music while they engaged in labelling 12 schematic faces showed a higher tendency to process neutral schematic faces as sad. The neutral faces were composed of straight horizontal lines instead of brows and mouths. Analysis of labelling results showed that sad participants mostly rated the neutral faces as sad and unpleasant. Their performance was also impaired in recognition of happy expressions (Bouhuys et al., 1995). This experiment was revisited by utilizing real face photographs to increase the ecological validity of the results (Lee et al., 2008). Data replicated the hypothesis that sad mood creates a negative perceptual bias toward ambiguous faces.

Results of distinct studies support the notion that even in healthy participants, affective states have influence on cognitive mechanisms. In such a context, researchers were motivated to formulate theories in which the internal interaction of mood and cognitive mechanisms were explained. Prominent proposals about the effect of mood on cognition were originally formulated to define the interrelation between mood and a particular area of cognitive performance (e.g., judgment), however, later these proposals were applied to interpret findings of different aspects of cognition. In the following section, I will focus on the theories which were mostly developed to explain the effect of mood on visual processing of complex scenes.

Mood and Visual Perception Proposals

Affect as information hypothesis is one of the proposals that was first developed to explain the relationship between mood and judgment, nevertheless it has also been accepted in the visual information processing field. This hypothesis states that in dealing with any new situation, there are accessible mental contents to be used. Mental contents include beliefs, expectations, strategies, responses, desires, stereotypes, and so on, and are usually provided by previous experiences (Clore, Gasper, & Garvin, 2001; Clore, Wyer, et al., 2001). When a sad or a happy person confronts a new situation, their mood determines if the accessible mental resources are helpful to solve the problem or not. This means that, “affective feeling may be experienced as feedback about one’s performance and about the value of accessible information” (Clore, Wyer et al., 2001, p.43). Happy mood and sad mood influence the evaluation process differently; happy mood signals that the available internal knowledge is trustworthy and the person can rely on the signals to deal with the new situation. Therefore, the positive mood assumes a “go” signal assuring the person the situation is harmless and favourable and previous mental knowledge is useful. In this context, happy people register new sensory information from new situations, integrate it with the internal accessible information and finally take an action. In a reverse way, negative mood warns the person that the situation is problematic and the available mental resources are not helpful. Negative mood behaves like a “stop” signal and inhibits the person from using available resources for processing information. Hence, to deal with a new situation in sad mood, only external sensory information would be attended to details (Clore, Gasper et al., 2001; Clore, Wyer et al., 2001). It is important to note, that the effect of mood on directing perception happens when mood is experienced as relevant to the new situation (Gasper & Clore, 2002). In other words, if the experienced mood was assumed as irrelevant to the task, it is not able to validate or invalidate the available mental resources (for a review, see Clore & Schnall, 2005).

The *level of focus paradigm* was later extracted from the affect as information theory to explain the attentional allocation and processing of hierarchical stimuli. The level of focus paradigm indicates that different attentional strategies are activated in positive or negative mood (Clore, Gasper et al., 2001 & Clore, Wyer et al., 2001; Gasper, 2004; Gasper & Clore, 2002). Level of focus paradigm suggests that happy mood promotes global processing; while, sad mood fosters adopting an analytical strategy. Namely, happy mood signals that the available strategy is trustworthy; since global level perception is assumed as the prior strategy in processing of the hierarchical shapes (Kimchi, 1992; Navon, 1977); so, happy mood is related with promoting global processing. On the contrary, sad mood warns an observer that the available strategy of visual perception is not adequate, so the global perception is inhibited and the observer has to focus on the details of the sensory information from the stimuli. Thus, the probability of attending to the local details is higher in sad mood (Gasper, 2004; Gasper & Clore, 2002).

Level of focus hypothesis was studied using different hierarchical stimuli in different task designs. In one experiment participants after mood induction (writing about a sad or happy memory), were asked to match the target compound shape with two alternative shapes. Both alternatives matched with the target on either global or local level (Figure 4). Such stimuli design and task demands minimized the effect of internal knowledge (Kimchi & Palmer, 1982).

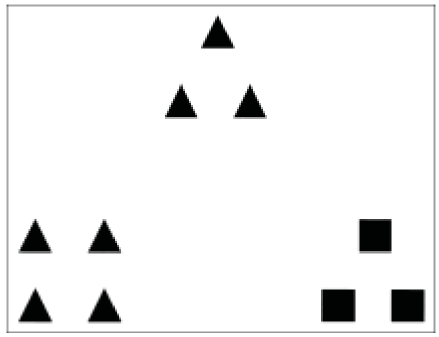


Figure 4. The target is a triangle made up small triangles. Both of the alternatives could be a potential match based on the global or local level, so the task is ambiguous. From "Attending to the big picture: Mood and global versus local processing of visual information" by C. Gasper and G. L. Clore, 2002, Psychological Science, 13, p. 38.

The research question was to investigate if participants' mood alters the level of attention to the global aspect or local details (Gasper & Clore, 2002). Along the same line with the level of focus hypothesis, happy mood facilitated participants to match the target and alternatives based on their global level, whereas in sad mood attention was directed significantly toward local details (Experiment 2). Gasper and Clore's (2002) research was challenged in some aspects: first, their task only contained ambiguous trials, namely, there was no distinct answer for each trial and each of the alternatives could be a potential match for the target shape on either level. In this context, the observer's selection only shows the preferred level. Second, the valid measurements for evaluating cognitive performance were not applied in their research method. To compare the preferred level of attendance, Gasper and Clore (2002) calculated how many times each participant had adopted global or local level and utilized that as the measure. While to gain a valid comparison, measurement tools like reaction times or accuracy of the responses should be taken into account.

Gasper (2004) addressed these two failures in her research design, which studied the reaction time of the participants in a non ambiguous matching task. The stimuli were one target shape and two alternatives, all compounded from geometric forms. The task consisted of ambiguous and non-ambiguous trials. Ambiguous trials were the same as given by Gasper and Clore (2002). In non-ambiguous trials, one of the alternatives was identical to the target, so, matching the target and the appropriate alternative was straight forward. Participants were engaged in doing the task after nine minutes of writing about an emotional event in their life. Results revealed that the mood was able to manipulate the level of focus when there is some degree of ambiguity in the situation. This means that in non ambiguous trials, mood did not show any effect on observer's level of processing (Gasper, 2004). Gasper's (2004) results proposed the importance of the task and stimuli design in studying the effect of mood, however a concern about her methodology still remains. Non-ambiguous trials were easy and the appropriate match for the target could be selected quickly. This means that the task was not challenging enough compared to the ambiguous trials. Therefore, it is possible that the observed difference between the ambiguous and the non-ambiguous trial was caused by ceiling effects (Gasper, 2004).

Taken together, it appears that the level of focus hypothesis has been well formulated and was supported by new empirical evidence (e.g., using an eye tracking strategy by Bianchi & Laurent, 2010). However, the theory is not able to explain how sad mood and local level processing are connected. It is not clear whether sad mood facilitates local processing strategy or just restrains global processing strategies (Gasper, 2004).

The level of focus hypothesis has been recently revisited and some of the assumptions have been replaced by new alternatives (Huntsinger, 2012; Hunsinger, Isbell, & Clore, 2012; Huntsinger, Clore, & Bar-Anan, 2010). The new paradigm assumes that particular mood states are not necessarily connected with certain attentional strategies; instead, happy mood promotes the available attentional strategy and sad mood inhibits that. Since, global processing is assumed as the natural and dominant perceptual strategy (Kimchi, 1992; Navon, 1977), happy mood boosts global processing. However, if local processing was already adopted, happy mood promotes it. In short, in *malleable mood effects hypothesis*, happy mood is an approval sign for any available attentional and perceptual strategy (Hunsinger et al., 2012). It seems that malleable mood effects hypothesis has tried to create a sensible method to change participants' current level of focus in experimental settings. One of their suggestions was asking the participants to write about an event in detail (Experiments 1 and 2). It was assumed that focusing on the details of an event alters the attentional focus to the local level. Another suggestion was to treat the questionnaire paper with odour. Hunsinger et al. (2012) assumed that the odour boosts the attention to the details of the environment and decreases the global attention. The main task was to read about an introvert or extrovert person and label some trait to the person's personality. The results showed when local focus strategy was adopted, happiness promoted judging based on the available information. This means that happiness is not always related to using stereotypes (global thinking); it can facilitate detailed focusing too. The malleable mood effects hypothesis suggested that different mood states do not necessarily associate with different attentional strategies.

It is important to note that this hypothesis is not studied in any other conditions and needs to be investigated in the visual perception domain.

Whereas the level of focus hypothesis shares some elements in common with the *broaden and build* model, there are also some different points. The broaden and build theory has two fundamental proposals: first, it suggested that happy and sad mood affect the cognitive mechanisms and a person's action in different ways (Fredrickson, 1998; 2004). With positive affect the scope of attention and thinking is expanded over the environment and the overall structure of the situation is considered. Fredrickson (1998; 2004) explained that this ability has evolutionary functions and increases the level of adaptability. That is, in happy mood the environment is perceived as harmless and safe. This encourages the beholder to focus on a wide variety of available resources (Derryberry & Tucker, 1994).

The second assumption suggests that positive emotion prompts the observer to explore and discover the environment and also enhances learning. In this context, the new experiences help the person to build new mental resources for upcoming situations (Fredrickson, 1998; 2004). So, based on the broaden and build theory, positive mood does not just increase the reliability of the internal available resources, it facilitates building new resources by expanding the attention over the visual scene. The basic assumption of the broaden and build theory shares some elements in common with the level of focus hypothesis. However, with its' emphasis on creativity and flexibility of attention in positive mood, the broaden and build theory is also similar to the *flexibility paradigm.*

The flexibility paradigm is an alternative proposal formulated to explain the influence of the affective states on perception of our composite visual environment. The flexibility paradigm suggested by Baumann and Kuhl (2005) explains that our semantic network stores great numbers of alternative actions to respond to any new situation, but generally not all the alternatives are available in time; so, our perceptual system mostly follows the dominant strategies (e.g., dominant global processing) to deal with new situations. Happy mood equipped the observer with the flexibility to overcome the dominant strategies and choose the most satisfactory option among all alternatives (Baumann & Kuhl, 2005). So, based on the flexibility paradigm, 'happy mood' is not associated with any specific processing strategy, instead it provides flexibility for the cognitive mechanism to switch from one strategy to another for a better function. Other studies also suggested that, when a task requires creativity and flexibility, happy mood facilitates cognitive performance (e.g., Dreisbach & Goschke, 2004; Isen, Daubman, & Nowicki, 1987; Isen, 1999).

Baumann and Kuhl (2005) criticized the research methodologies applied in level of focus studies. They discussed that the nature of visual matching tasks that were highly utilized in the level of focus paradigm studies, directed the researcher to conclude that global level processing is more likely in happy mood while the matching task does not provide any evidence to show that observers are unable to attend to the local level. They proposed that if a task situation provides the opportunity for the observer to be able to switch attention between global and local levels freely, the results will be different. To follow this proposal, participants were asked to recall happy or sad life events from their personal life and produce words which reminded them of that event. The words were presented to prime and activate the participants before each trial to create a happy or sad mood. Then, a single geometric shape was given as a target which was replaced by a compound geometric shape. The task was to detect if the target shape was present on the consequent compound geometric form or not. The target shape might be available on the global level or the local level. The reaction time analysis showed that when the target was available on the local level, positive mood facilitates flexibility to switch attention from the dominant level (global) to the non-dominant level (local) of the form. While in 'sad mood' the reaction time was slower due to lack of flexibility in diverting attention from the global to the local level. This means that positive mood provided the observer the ability to overcome the attentional biases. The results supported the flexibility paradigm assumption that is, if overcoming the global advantage processing and accessing to the local elements is requested by the task situation, then happy mood facilitates this procedure better.

The mood induction strategy used by Baumann and Kuhl‘s (2005) was enhanced by other research (Tan, Jones, & Watson, 2009). In Baumann and Kuhl's (2005) experiment some keywords from participants' happy or sad memories were chosen and before each trial the keywords were used as a prime for each participant to induce happy or sad memories. Namely, the mood induction method they applied was a short term manipulation and also was not uniform for all the participants. Thus, Tan and associates (2009) used pictorial primes from the International Affective Picture System (IAPS) prior to each trial to induce a happy, neutral or sad mood (Experiment 2). The stimuli and the task were the same as used by Baumann and Kuhl (2005) but the compound shapes consisted of fewer local elements. Consistent with the flexibility paradigm the results revealed that in a global or local detection task, positive affect facilitates switching from the prominent strategy. The performance in sad mood showed no significant difference with the performance in neutral mood in Tan et al.'s (2009) experiment, which was not consistent with Baumann and Kuhl (2005) findings. This means that the sad mood does not necessarily impair the performance. Tan and colleagues (2009) suggested that positive mood facilitates overcoming the default strategy and attends to the requested level of stimulus. For instance, if the default strategy is local perception, happy mood facilitates disengagement from the local level and attends to the global level (Tan et al., 2009).

Mood induction in laboratory settings

In order to study the interrelation between mood and cognition different mood induction procedures (MIPs) were invented. An overall look through different MIPs used in previous studies show that manipulation could be done by using a single procedure or combination of two or more strategies together. Mood manipulation procedures could be applied using instructions or without using instructions (Westermann, Spies, Stahl, & Hesse, 1996). Imagination MIP and music MIP are among the most common MIPs. Imagination MIP's assumption is that remembering some emotional event is able to induce a particular mood. Imagination MIP can be conducted in two ways: ask each participant to imagine a personal memory with specific mood valence (e.g., Hunsinger, Isbell, & Clore, 2012), or ask all participants to imagine a certain event (e.g., Colibazzi et al., 2010). It is also possible to ask the participants to write about the imaginations (e.g., De Dreu, Baas, & Nijstad, 2008); it is assumed that writing intensifies the induced mood. Robins (1988) developed the imagination technique in which participants listened to a narrator on an audiotape describing a situation of success or failure. Participants were requested to imagine themselves in the mentioned situations. The results showed high success in creating a sad or happy mood in participants. This procedure has been applied in different research studies, and is a good candidate for combining with another strategy (Chepenik et al., 2007).

In the music mood induction procedure, pieces of classical or modern music, that have been selected based on special criteria, is played for the participants. Participants can be instructed to try to get the feeling of the music (with instructions) or only be involved in listening to the music without any emphasis on the emotional character of the music piece (without instructions). In the first application of music as a mood induction technique, the range of music pieces were offered and participants were free to select music pieces (Sutherland, Newman, & Rachman, 1982) while later the same music pieces were utilized for all the participants (Clark & Teasdale, 1985). The idea of using united music pieces for mood manipulation in different groups of participants was supported by research showing that there is an agreement between different groups of people in labelling music emotions. It seems that there is universality in the perceptual understanding of the melodies and melody expectations, so, judgment studies did not show any significant variation between different cultures (Krumhansl, 2002). The music pieces are usually selected by the professional musicologists based on the structural characteristics of the music piece: sad music is supposed to have slow tempo and minor harmonies, while, happy music has fast and cheerful tempos and major harmonies (Krumhansl, 2002; Sousou, 1997) and usually in pilot studies the effectiveness of the selected pieces are evaluated by participants (Albersnagel, 1988). Therefore, based on the previous success of particular music pieces in inducing intended moods, they are applied in the later research. For example, Mozart's "Eine Kleine Nachtmusik" was used before in research that induced happy mood or "Adagio for strings" composed by Barber was used in research that induced sad mood (e.g., Chepenik et al., 2007; Niedenthal & Setterlund, 1994; Nguyen & Scharff, 2003; Poon, 2007; Sousou, 1997; Storbeck & Clore, 2005). Another critical issue in music mood induction procedures is finding the appropriate exposure duration for listening to the music; Albersnagel (1988) observed that participants in long term music listening (20 minutes) showed the sign of distraction or feeling bored in the participants, so he chose 7 minutes exposure with music. Exposure time to music was decreased to almost 5 minutes in Sousou's (1997) experiment. Nguyen and Scharff (2003) selected the 5 minutes and 10 minutes exposure time for their research. It seems that less than 10 minutes administration time for the selected pieces of music is the optimum mood manipulation duration (Martin, 1990).

Analysis showed that the success of the music mood induction procedure is over 75% (Martin, 1990). Trainor and Schmidt (2003) also suggested that music is a powerful tool in provoking happy or sad mood in experimental settings. However, Westermann et al. (1996) considered music mood induction as moderately effective. In sum, the possibility of using music in the background and the capability of being matched with other techniques (e.g., autobiographical imagination), make the music MIP one of the most used strategies.

As mentioned previously, even though research has shown that mood induction techniques are quite successful in inducing particular moods in research participants, the effectiveness and the validity of different procedures was always a major concern of the researchers. The items which affect the effectiveness of different mood induction techniques are varied. For instance, it was shown that gender related differences influence the effectiveness of the different procedures (Albersnagel, 1988), so, it may be risky to declare if a specific technique was able to induce specific moods in all people. On the other hand the meta-analysis by Westermann and associates (1996) showed that there is no significant effect of gender in mood induction success.

Another issue pertains to the difficulty of inducing a purely specific mood. Usually participants report a blend of various moods after particular mood manipulations; this means that some of the negative moods or positive moods are connected together, so the non-intentional provoking of unwanted moods is possible. For example, while inducing sad mood by reading some negative phrases, participants reported significant anger and anxiety feelings as well (Polivy, 1981; Westermann, et al., 1996). The possible reason for this effect is the inability of the participants to discriminate between their own moods. For some of the close feelings (e.g. sadness and anger), discriminating them and putting a label to them is difficult. This bias may have been created by an inefficient self-reporting questionnaire too. Usually the self-rate scales provide the name of the particular mood and ask the participants to rate how strongly they feel that mood. It is possible that the scale makes some bias in the participants to feel what the researcher wants them to feel. It is also possible that any particular mood has the ability to trigger the related moods and it is the real nature of the sad mood to be accompanied with anger and anxiety (Polivy, 1981).

Chepenik and colleagues (2007) pointed out the fact that sometimes uncontrolled mood induction techniques mislead researchers in interpreting their data. This means that, the inconsistent results may simply be caused by different mood induction techniques, while the researcher explains the inconsistency in terms of the stimuli or task differences. Moreover, the results of the sad mood induction in the laboratory may have differences as it happens in real life, first because induced mood in laboratory settings are always temporary (up to 15 minutes) (Carr, 2004) and we have no idea if longer exposure with particular mood may produce differences in cognitive performance, Moreover, the effect of mood intensity is not appropriately studied in the experimental setting; so, we are not sure if the strength of a particular mood is able to conduct the cognition in different ways or not.

Even if the induced mood is successful and valid, there is still another concern that remains: effect of engagement in the task. In studying the effect of mood on any intended cognitive performance, typically participants are engaged in doing a task after mood manipulation. But what if engagement in the task distracts participants from induced mood? Van Dillen and Koole (2007; 2011) suggested that for successful completion of any task, some cognitive materials need to be activated; through this, mood related thoughts are replaced by task related mental materials. The authors utilized the working memory model to explain their proposal: as the capacity of working memory is limited, so different types of information compete over this limited capacity. When the task needed to occupy more capacity of working memory, then there will be not enough room for mood related materials. In this case, working memory facilitates attention to task-relevant information at the expense of distraction from task-irrelevant materials (Knudsen, 2007; Lavie & De Fockert, 2005). Sad participants showed less sad mood after doing a maths task compared to sad participants whom did not do the maths task (Van Dillen & Koole, 2007). Therefore, in mood study research it is important to be aware of the effect of the distraction created by engaging in doing the task.

There are still some doubts about the induced mood in the laboratory and its similarity with real mood. However, it looks as if the clarification of the results can be accomplished with due care and the support of control studies, thus they can be trustworthy tools for cognitive research.

Summary

Different theories were developed to explain the effect of observer's mood on processing of the compound stimuli. To sum up, level of focus paradigm is associated with adopting different types of attentional strategies in different mood states, while flexibility paradigm looks at the ability to overcome biased attentional strategies in different moods. It looks like there is still a lot to examine in both theories, for example, none of them provide details about whether different levels of intensity or experiencing duration of a particular mood is able to change the pattern of attention allocation and consequent perception.

Level of Visual Perception, Facial Emotion and Contextual Factors

In previous sections of this review, the human face was discussed as a unique compound stimulus capable of conveying different emotions. Attentional allocation to and processing of the different levels (global / local) of compound stimuli (e.g., face) were discussed.

It looks as though visual attention and visual perception are context dependent processes and factors like stimulus properties, task requirements as well as observer's characteristics influence mentioned mechanisms. Therefore, research objectives have been directed to study different conditions and circumstances that can affect the attentional allocation to and perceptual procedures of compound stimuli.

One study by Eastwood et al. (2008) addressed the interaction of the emotional meaning and the perceptual attributes of faces. They showed results that if the constitutional parts of an expressive face were made salient by changing the colour, the priority of processing global level of the form over the local level was attenuated. In their experiments three upward or downward curves were placed in order to look like a face. The orientation of the mouth curvature was indicated whether the face is happy or sad. Experimental trials included displays of four happy or sad faces in gray colour presented on a black background. The participants' task was to count the number of either downward or upward curves in each display. Data revealed that counting the local elements of the sad faces took more time than counting the local elements of the happy faces. But, when downward or upward curves were turned to red colour (change the colour of elemental parts), this pattern of results was not observed any more (Eastwood et al., 2008). It was concluded that the global level of the sad face compared to happy faces has an advantage in capturing attention and preventing fast access to the local details (Eastwood et al., 2003).

The interaction of the perceptually and emotionally significant stimuli was considered in another experiment (Huang & Yeh, 2011). Their stimuli were animal or human pictures expressing neutral or negative conditions and human made objects. The human with negative emotion or animal in negative condition were assumed as emotionally salient stimuli while the rest of the stimuli were assumed as being neutral. In a 3x3 matrix, two, four or eight of the mentioned pictures were randomly presented in white frames. All of the frames were complete rectangles, only one of them was not completed and there was a gap in it. The target photo was always located in the incomplete frame. In the first experiment, the targets were presented in three different ways: (1) coloured photo of human or animal with emotional content among gray photos; (2) coloured photo of neutral human or animal with neutral content embedded among gray photos; and (3) gray photo of objects among gray photos. Results revealed that the perceptual property of the target was able to guide attention more readily than the emotional meaning of the pictures. That is, participants' reaction time to detect the incomplete frame was faster when the photo was presented in colour, but there was no difference in reaction time with respect to the emotional or neutral content of the photo. The results of the first experiment proposed that in competition between perceptual and emotional salience of the stimulus, emotional content is inferior when it is not directly related to the task requirements (Huang & Yeh, 2011). In the second experiment, the target was human or animal photos showing either neutral or negative conditions. Photos were either coloured or gray. The distracters were always gray objects. Participants were told that the target is always a human or animal photo. This instruction forced the observers to consider the content of the targets as well as the perceptual characteristics. The finding showed that reaction time was influenced by both perceptual characteristics and emotional characteristics of the photos. That is, colour photos were perceptually more recognizable than gray photos. This difference made their detection more efficient, while the emotional content compared to neutral content had the effect of slowing down the detection of the target. Huang and Yen (2011) suggested that perceptual and emotional attributes affect the visual search in different ways depending entirely on the experimental context. In the mentioned experiment a perceptually significant stimulus guided attention to its location and this facilitated the decision time even when the number of distracters increased. Whereas, when processing of the emotional content was imposed, it interfered with the target search but was not affected by the number of distracters. One interpretation for these results assumed that the emotional materials keep the attention for a longer time and delay the target detection. It is also possible that it took longer because emotional information is processed from different pathways than perceptual information (Huang & Yen, 2011).

The mentioned research initiated a productive question for face perception studies: "Under what conditions do emotionally expressive materials (e.g., face) capture attention?" (Eastwood et al., 2008, p.259).

In addition to the stimulus properties and task demands, the observer's characteristics are assumed as a contextual factor. For example, the affective state of the observer is able to influence the cognitive mechanisms such as attention and perception. As mentioned previously, the observer's mood influences the priority of perception of different levels of compound shapes.

Previous studies investigated the effect of the observer's mood on face perception. For example, the influence of the affective state of the observers on the speed of face emotion recognition was assessed. Results showed that happy facial expressions were recognized faster when the observer is in positive mood than in negative mood (Leppanen & Hietanen, 2003). In addition to that, different theories discussed the influence of the observer's mood valence on level of processing of the schematic faces and whether global or local level processing has the advantage in different affective states (e.g., Gasper & Clore, 2002; Baumann & Kuhl, 2005). Recent investigations considered the effect of observer's mood strength as well as different mood valence to direct attention to different levels of compound shapes (Gasper, 2004).

However, the effect of mood valence on processing and attending to our hierarchical visual environment was thoroughly investigated from different aspects, but two issues did not receive enough consideration in previous research studies. The first issue is the effect of mood on allocation of attention to the emotional stimuli. The available knowledge about the effect of mood on level of processing was mostly provided from studies on neutral stimuli (compound letters or compound geometric forms); while we are surrounded by many stimuli which convey emotional meaning. It is not surprising that emotional stimuli owing to their intensive social and biological importance are able to bias the attentional resources. Yet, the available body of research does not provide any evidence regarding which (emotional content or affective states) has the priority to rule the perceptual strategy and attentional allocation; or if they interact together and tune visual perception processes.

Second, in previous models and paradigms only the mood valence and its effect on perception of the compound stimuli were focused on, while other properties of the experienced mood remained unattended. In a recent study, Gable and Harmon-Jones (2010) suggested that the effect of mood on level of processing is not related to the mood valence, but that motivational intensity of happy or sad mood is the contributing factor. They explained that each of the positive and negative moods can narrow the scope of attention and promote attending to the local level when it is experienced in high motivational intensity. For example, the effect of disgust (unpleasant mood with high motivational intensity) on the attentional scope is similar to desire (pleasant mood with low motivational intensity); while it differs from sadness (unpleasant mood with low motivational intensity). These findings reminded that the connection between mood and our cognitive system is complex and many other mediators might be involved. Thus, for better understanding about the relationship between mood and level of processing not only the mood valence but also other characteristics of the experienced mood should be taken to account. To the best of my knowledge none of the previous research considers the effects of mood strength and mood involvement duration on visual perception and attentional allocation.

In seeking to fill these gaps, my research has two aims:

First, level of processing, emotional valence of the face and the affective state of the observer were studied. In particular, my research study has observed how local processing in faces with different emotional meaning would be affected by the positive or negative affective states of the observer.

If the emotional meaning of the stimuli effectively directs attention, in line with previous studies, I expected a slower reaction time for attending to the local level of emotional faces than neutral faces. Moreover, I hypothesized that sad facial expression compared to happy facial expression interferes with fast access to the local level and delays the reaction time.

However, if affective states efficiently guide attentional resources, I expected that experiencing happy and sad mood influences local processing in different ways: if the level of focus paradigm is the case, local processing is facilitated in sad mood while happy mood interferes with that.

However, if the flexibility paradigm is a valid prediction, happy mood provides higher flexibility in attentional mechanism to overcome the dominant global processing and adopt the local processing strategy than sad mood. Therefore, based upon the flexibility paradigm, I predicted a faster reaction time to the local level in happy mood compared to sad mood.

There is also an expectation that mutual interaction of the emotional stimuli and affective states of the observer influence attentional allocation to the local details. Since the interaction of the emotional content and affective context was not studied by previous research and theories, no specific directional prediction was made.

Second, different mood induction techniques, varying in involvement and length, were assessed in regard to their effects on the level of processing of schematic emotional faces. It would be the first time that the influence of affective states, varying in intensity and persistency, is studied on attentional scope.

Important Note

In cognitive psychology studies, sometimes different technical terms are used interchangeably to express similar meanings; for example, *global processing*, *holistic processing* and *configural processing* were used interchangeably. (Kimchi, 1992; Rossion, 2008). In the remaining parts of this thesis, global processing refers to the initial stage of visual information processing in which the overall whole shape rather than its component parts is being processed. Holistic processing has also been used to express the primacy of processing the whole shape before its parts. To avoid any confusion, I did not use the technical term "configural processing".

The previous studies showed that emotion, mood and affective states were also utilized interchangeably. Emotion is an affective state related to something good or bad. Mood refers to a pleasant or an unpleasant feeling (Clore et al., 2001). It was suggested that emotion is object-based; this means that an emotion state is linked to something specific. So, the relationships between subjects and objects are evident in emotions (Frijda, 1994). In the remaining parts of this research, I have used the word "emotion" to address the happiness or sadness of visual stimuli. The words "mood" and "affective states" have only been used to express participants (observers/ people) happy or sad feelings. To avoid confusion, mentioned words have never been used interchangeably in this research.

Chapter 2

Pilot Studies

Pilot Studies

The aim of my research was to study the effect of an observer's mood on the level of processing of emotional faces. In order to achieve the research aim it was necessary to find the best possible study design, therefore a few pilot studies were undertaken. These pilot studies are explained in the following section.

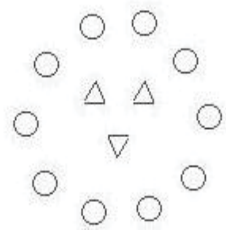
Stimuli design

For this research, schematic versions of emotional faces were chosen, since detecting the effect of facial features on the participant's performances is easier using schematic faces than photographs of real faces (Lundqvist et al., 1999). Moreover, schematic faces convey the intended emotions clearly. For example, the upward curve, in the place of a mouth, is always perceived as a smile (McKelviet, 1973).

In order to create schematic faces with happy, neutral and sad expressions, different combinations of schematic facial features (geometric forms) were selected and put together to find the best possible faces. The selection of these geometric forms was made based on previous studies (e.g., Eastwood et al., 2003; Lipp, Price, & Tellegen, 2009; Lundqvist et al., 1999; Mermelstein et al., 1979; Suzuki & Cavanagh, 1995).

The first set of stimuli was compound faces made of circles and triangles designed using *Microsoft Paint*, however, these faces did not convey emotional expressions clearly (Figure 5, left). In the next attempt, designed faces consisted of upward or downward curves (Figure 5, right). To emphasize the emotion of the faces, I designed the mouth curvature proportionately bigger than other parts. Volunteers, who were asked to evaluate the level of happiness and sadness, rated the faces as expected.

However, Aronoff, Woike, and Hyman (1992) suggested that the size of each feature has an effect on the power of that feature. This means that, the mouth might bias attention to its location due to its bigger size; this would disrupt the research aim which was to study the effect of facial emotion on attention.



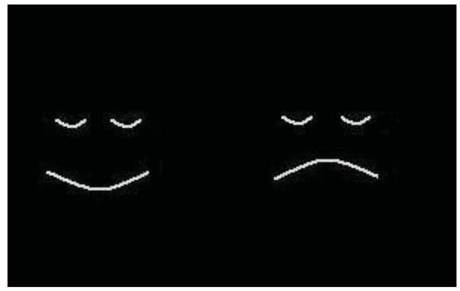


Figure 5. Samples of the first (left) and second (right) attempts in designing compound face stimuli. Stimuli were designed using Microsoft Paint.

The final face stimuli were adapted from Eastwood and colleagues research (2003) in which upward and downward curves of the same size were used as mouth and eyes. Since straight lines were used to design neutral expression in previous research (e.g., Lipp et al., 2009), straight lines, the same size as curves, were used to create a neutral expression. One triangle acting as a nose was located under the eyes and over the mouth in order to make each schematic figure more similar to a real face. Lundqvist and associates (1999) found that schematic faces with noses are perceived as being more energetic, excitable and active compared to the same forms without a nose. At the last stage, volunteers were asked to add labels of happy, neutral, and sad to the designed faces. The results showed that intended emotions were successfully conveyed by the faces (Figure 6).

In order to investigate whether the results are caused by the facial emotions or simply created by the effect of elemental parts, control experiments are necessary. In most of the previous research, inverted versions of the faces were utilized for the purpose of breaking down the facial features' spatial relations thereby reducing the emotional meaning of the face (e.g., Eastwood, 2003). However, Lipp and associates (2009) observed inverted angry faces were detected faster than inverted happy or neutral faces; thus, they proposed that perception of emotional facial expressions did not become impaired due to inversion. McKelvie (1995) also showed that recognition of happiness remains intact in inverted faces. In this context, I decided to use the scrambled version of the faces to ensure that the new forms did not convey any meaning of emotion. In order to create the scrambled version of the faces, Suzuki and Cavanagh (1995) applied successive rotation to the features and the whole structure of faces. I have applied the same strategy with minor changes: Each face is entirely rotated 90 degrees anti-clockwise; then the eye parts rotated 90 degrees anti-clockwise and the mouth part rotated 90 degrees clockwise. These rotations have been made to scramble the face form as much as possible, but with regard to the proximity rule of Gestalt, parts were placed close enough to one another to make one unit (Figure 7).

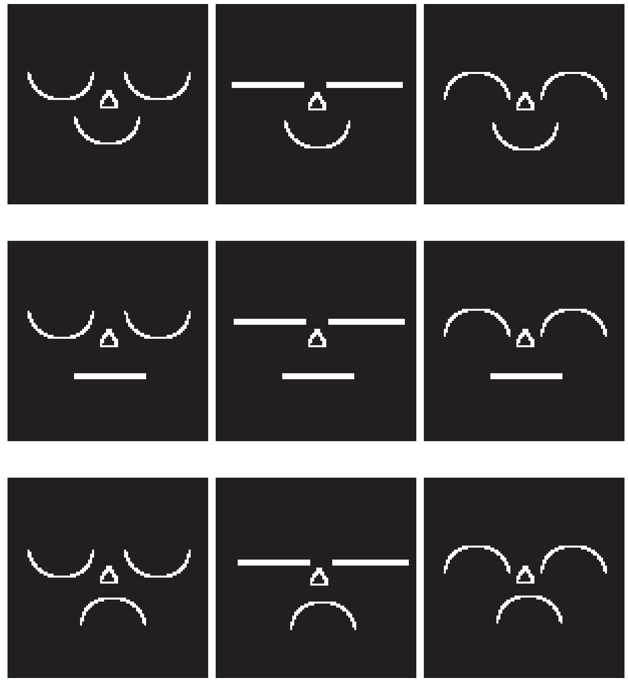


Figure 6. The happy, neutral and sad schematic faces used in this research (Figures are not drawn to scale)

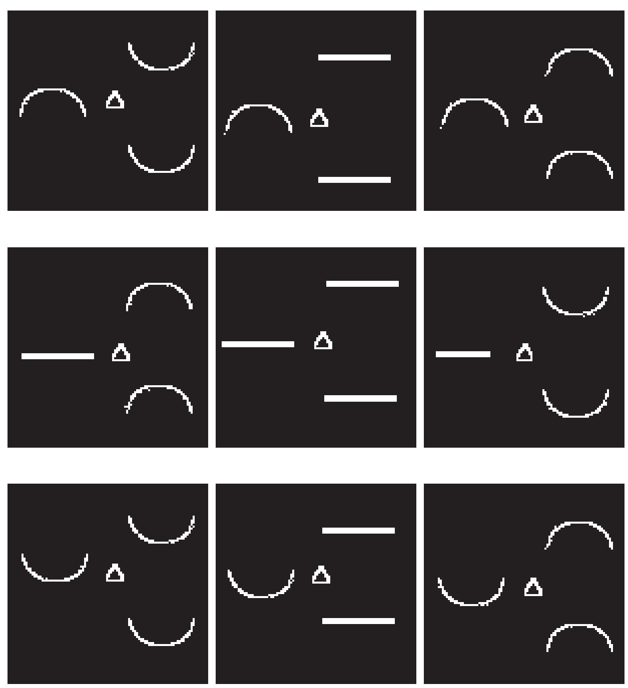


Figure 7. The scrambled version of happy, neutral and sad faces used in control studies of this research (Figures are not drawn to scale)

Mood manipulation check scale

One important part of the research design was to find an appropriate scoring scale to control the success of the mood manipulation. In the first attempt, I decided to use the Positive and Negative Affect Schedule (PANAS) developed by Watson, Clark, and Tellegen (1988), which consists of 20 items. Each item consists of a word that describes different feelings and emotions. Participants are required to score to what extent they feel that emotion (Watson et al., 1988).

The first application of PANAS in my research showed that, participants struggled with putting the right labels on their own mood (e.g., interested, inspired or excited). Moreover, answering the questionnaire sometimes took 10 minutes which could distract the participants from the induced mood. Therefore, I replaced the PANAS with a 1-7 rating scale. Similar scales were used by many studies before (e.g., Gasper & Clore, 2002) and were found to be successful in rating the participants' mood before and after mood induction.

Data Analysis Handling

Previous research has found that the distribution of the simple reaction time is positively skewed (e.g., Jaskowski, 1983; McCormack & Wright, 1964; Ratcliff, 1993). This means that, in such a distribution, detecting outliers will be challenging. Outliers are extremely fast or slow reaction times that are mostly generated by guessing, lack of attention, confusion with task instruction, and so on. In order to avoid contaminated and biased results, this extreme data should be detected and eliminated from the genuine data. To deal with outliers in reaction time data, different strategies have been proposed and used by different studies. However, each of the techniques has been faced with critics.

(1) Median reaction time procedure:

Using the sample's median is assumed as an appropriate strategy to deal with outliers in a positively skewed distribution (e.g., Eastwood et al., 2008). The median is a measure of central tendency which is not affected by extreme scores (Hays, 1994). Therefore, in a positively skewed distribution, the median is less contaminated by the few very high scores (Hays, 1994). However, Miller (1988) discussed that the median is affected by the sample size and not a reliable measure in comparing different samples with an unequal number of trials. Miller (1988) illustrates that in small samples the calculated median will be bigger than the real median (overestimation bias). Thus, comparing two samples of reaction time data with a different number of trials can lead to the researcher making erroneous conclusions. In such cases using the mean reaction time is more trustworthy; since it will not generate statistical artifacts (Miller, 1988). This median procedure was used by Eastwood et al. (2008) to handle the reaction time data in their experiments. However, they used a modified recursive procedure (described below) in their previous study which had a similar design.

(2) Restricted mean procedure:

Restricted mean is one of the most common strategies utilized in data analysis (e.g., Leppanen & Hietanen, 2003). In this procedure, the mean and standard error of the scores are calculated. Data that fall outside a certain number of standard deviations from the mean will be treated as outliers. Typically, scores ± 2, ±3 or even sometimes ±4 SD away from the mean are assumed as outliers. Miller (1991) discussed that it is more likely for slow reaction times to be detected as outliers than fast reaction times in a positively skewed distribution. In small samples it is more probable that the large outliers were assumed as genuine scores and were included in analysis. Miller (1991) suggested that the restricted mean technique should not be used when comparing two samples with an unequal number of trials. However, when the samples have equal observations or more than 20 observations, excluding trials outside of ±2 SD from the mean is a safe procedure (Miller, 1991).

(3) Modified recursive procedure:

This strategy is assumed to be more sensitive in detecting outliers (Van Selst & Jolicoeur, 1994) and was selected for use in recent studies (e.g., Eastwood et al., 2003). In this strategy, the highest and lowest scores are eliminated. The mean and standard deviation for the remaining data will be calculated and the cutoff points (± certain number of SD from the mean) are determined. If the highest and lowest scores (which were removed) are located outside of the cutoff points, they are recognized as real outliers and removed permanently; otherwise, they are assumed to be real scores and returned to the rest of the data. This procedure is continued until the higher and lower scores are located inside the cutoff points. This strategy was considered for the results of this research, although, using the modified recursive procedure, the same way that was used by Eastwood and associates (2003), did not detect any of the reaction times as outliers, beyond what the restricted mean procedure did.

It seems that different techniques were created by the researchers in order to find the most appropriate method for detection of outliers. For the purpose of data analysis in this research, all three techniques were considered and since the number of trials was equal in the samples, the restricted means method was selected as being most appropriate.

Chapter 3

Level of Processing in Meaningful and Meaningless Visual Compound Stimuli

Navon (1977) indicated that the global level of a compound shape has a processing advantage. This priority also interferes with fast processing of the local level even when the task demands attending to local details. Various studies have investigated different aspects of the Global precedence and Global interference effect hypothesis.

In this current chapter, the interference of the global level on processing of the local details was studied in two experiments. In the first experiment, the global interference effect was studied in happy, neutral and sad schematic faces to investigate if various facial expressions alter the global interference effect. In the second experiment the scrambled version (meaningless) of the same faces was used to control for the results of the first experiment. The second experiment also provided an opportunity to see if the meaning of the observed materials alters the global interference effect.

These experiments are used as baselines for other experiments in which the effect of observer's mood was also considered in relation to the global interference effect.

Experiment 1

The effect of emotional valence of stimuli on global interference effect was studied in recent studies. In a visual search task, Eastwood and associates (2003) showed that attending to the local level of happy faces was faster than sad faces. They proposed that the sad facial emotion (conveyed by the global level) captures attention more effectively interfering with fast access to the local level. Experiment 1 of this research was a replication of Eastwood and colleagues (2003) study, in which, participants were asked to count the particular elemental parts of the happy, neutral, or sad faces. Counting the elemental parts is a visual search task that requires attending to the local level of the compound faces. If the global aspect of the sad facial expression biases attention, counting the target shape, embedded in the sad faces, is expected to take longer than counting the parts of happy or neutral faces.

Method

Participants

Nineteen participants (8 female, 11 male), ranging in age from 18 to 40 years, fluent in English, with normal or corrected-to-normal vision, volunteered to participate in the experiment in exchange for NZ$15. They were all informed about the task procedure and their rights prior to the experiment. The written consent was obtained from the participants. The research design and procedure was approved by Massey University Human Ethical Committee: Northern (MUHEC: N) no.08/066R.

Apparatus

The task was run on a PC with a 17 inch monitor. The reaction time and accuracy of the response of the participants were registered by the computer. The research task was programmed in C++ at the School of Psychology, Massey University.

Research stimuli

The schematic faces stimuli showed in Figure 7 were used for this research. The upward  and downward  curves and straight lines  with .86º width and .38º heights angular size were used to form the face stimuli. These shapes were used as eyes and mouth. One triangle with .286º height was presented in all faces as a nose. The combination of three potential eyes and three potential mouths plus one nose resulted in nine potential faces to show three different emotions (Figure 6). Each face subtended a visual angle of approximately 2.1º x 1.2°. The elemental parts were presented in light grey colour on a black background. . For each visual display four faces with the same emotional valence randomly occupied four potential 2.5 x 2.5 cm cells in an imaginary 4 x 4 matrix (Figure 8).

A total of 243 trials were presented in random order to each participant. The number of trials for happy, neutral and sad face displays was counterbalanced (81 trials each). In each of the happy, neutral and sad trials, participants counted upward curves on 27 trials, downward curves in 27 trials and straight lines in 27 trials.

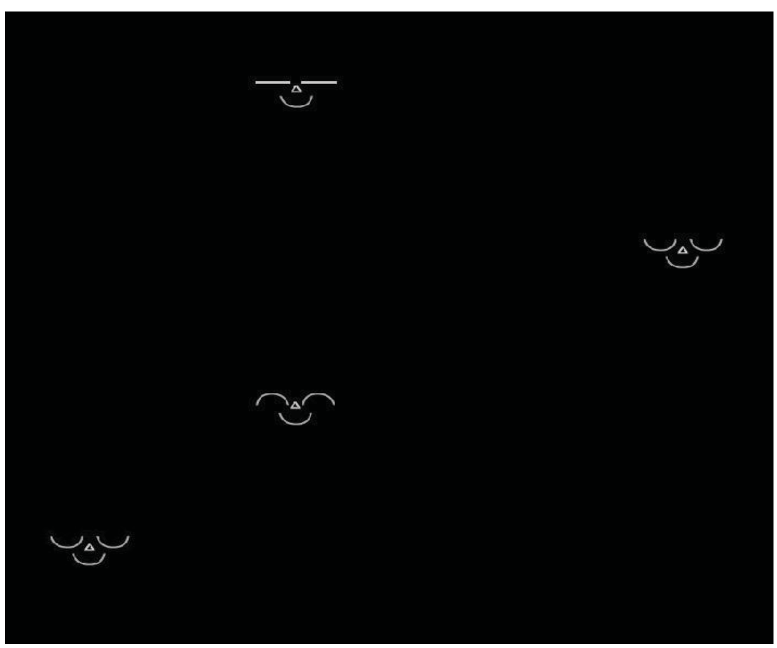


Figure 8. A sample of a happy face display presented in an imaginary 4 x 4 matrix (Figures are not drawn to scale).

Procedure

The research information was presented to each participant and a signed consent form was obtained. Participants sat facing the computer screen with a viewing distance of 60 cm. The research procedure was displayed on the screen, but participants were allowed to ask questions if they encountered any difficulties. A target (downward or upward curve or straight line) flashed on the screen for 1000 milliseconds before being replaced with one of the potential displays (discussed before). Participants were asked to count how many of the targets had been on the screen as fast and accurately as possible. After they finished counting, participants pressed the spacebar as fast as possible and then recorded the number of targets by using the number pad. Ten practice trials were completed at the beginning of the counting task. Trials were self-terminated and written feedback for half a second was given after registering the number of targets. Each trial had to be performed as fast and accurately as possible. The entire experiment lasted 45 minutes.

Results

Data from one participant were excluded owing to high error rates (77.78%). If incorrect responses were higher than 50%, the participant was considered as having a high error rate.

Reaction time analysis

Trials with incorrect responses were excluded from further analysis. In total 8.5% of the trials were eliminated. In order to control outliers, mean reaction times greater than two standard deviations were removed from the data for each of the happy, neutral, and sad face displays.

In this research a *restricted means* procedure was used to deal with the outliers. Generally, in this method, data that fall out of ±2 or ±3 SD from the mean are eliminated from further analysis. It is assumed that the middle 85% to 95% scores in the reaction time distribution are real data and are not the outliers (e.g., Whelan, 2008). Since, in a normal distribution 95% of the observations lie within two standard deviations from the mean, I treated the data falling out of the middle 95% of the distribution as outliers and excluded them from analysis[6].

The mean reaction times of happy, neutral, and sad face displays were analyzed using SPSS (19), using analysis of variance (ANOVA) to compare the effect of different facial expressions on response speed to different displays. In this ANOVA, the display was the within-subject variable with three levels (i.e., happy face, neutral face, sad face). Data showed that there was a significant main effect of display, F (2, 34) = 39.92, $p < .001$, $\eta^2 = .70$. Post hoc comparison using Least Significant Difference (LSD[7]) indicates that responses were significantly faster to neutral face displays (M = 2245 ms, SD = 638.30) than happy (M = 2617 ms, SD = 667.82) or sad (M = 2641 ms, SD = 583.76) face displays, $p < .001$. The difference in reaction time data was not significant in happy and sad face displays, $p = .66$ (see Figure 9).

[6] It was assumed that reaction time distribution is not normal and other statistical analysis to deal with the RTs were suggested. All of the suggested methods were considered and were already discussed in chapter 2.

[7] LSD procedure has some limitations when it compares more than three groups. For three groups comparison LSD has been considered as an adequate procedure for multiple comparison (Curran-Everett, 2000; Keselman, 1998)

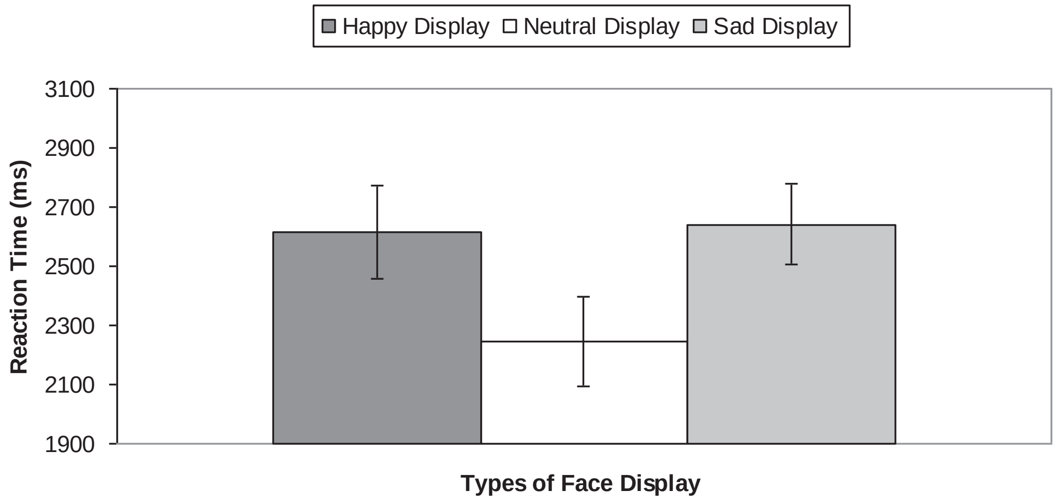


Figure 9. Reaction time (ms) representing detection and counting speed of the target shape in happy, neutral, and sad face displays in Experiment 1. Significant differences between RTs to happy/sad face displays and neutral face display were found. No difference was found in RTs to happy and sad face displays. Error bars represent ±1 standard error.

Response accuracy analysis

The mean of the accurate response to happy, neutral, and sad face displays were analyzed using SPSS (19), using an ANOVA to compare the effect of different facial expressions on percentage of accurate responses to different displays. Data showed that there was a significant main effect of display, $F(2, 34) = 13.11$, $p < .001$, $\eta^2 = .44$. Post hoc comparison using Least Significant Difference (LSD) indicates that responses were significantly more accurate to neutral face displays (M = 94.4%, SD = 3.82) than happy (M = 90.7%, SD = 5.41) or sad (M = 89.4%, SD = 6.25) face displays, $p = .001$. The difference in accuracy data was not significant for happy and sad face displays, $p = .15$ (see Figure 10).

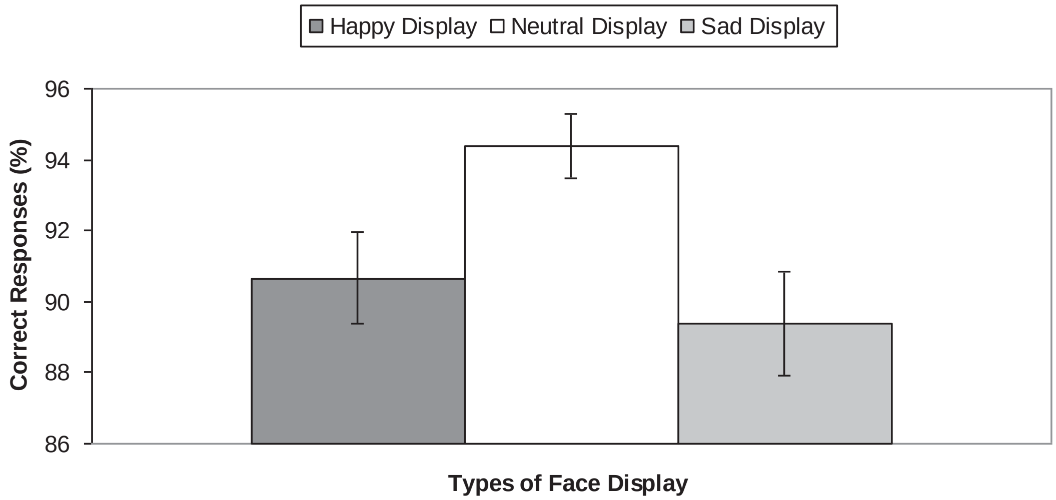


Figure 10. Correct responses (%) representing accurate detection and counting of the target shape in happy, neutral, and sad face displays in Experiment 1. Significant differences between correct responses to happy/sad face displays and neutral face display were found. No difference was found in correct response rates to happy and sad face displays. Error bars represent ±1 standard error.

Discussion

The present study investigated whether processing of elemental parts of faces is influenced by their expressions (i.e., positive, neutral, and negative) which is conveyed by the global level.

The results showed a significant difference between neutral faces and emotional faces, while, no significant difference between local processing of happy and sad faces was observed. Therefore, the results were not completely in agreement with the hypothesis. In contrast to the current results, Eastwood and colleagues (2003) found that negative facial expression was more efficient in capturing attention and blocked fast access to the local details than happy and neutral faces. They discussed that even if the perception of the facial expression is irrelevant to the task negative expression is more effective than positive expression in biasing attention.

However, the results of Experiment 1 did not show any significant difference between happy and sad faces, though observation of the results of Experiment 1 revealed a pattern of slower reaction time and less accurate responses to the negative face displays. Namely, the pattern of the reaction times was in the same direction as found by Eastwood et al. (2003). In this research, the restricted means were used to deal with reaction times and ± 2SD was selected as the cutoff points, while, Eastwood and associates (2003) utilized the modified recursive procedure in which cutoff points were located on ± 4SD from the mean. In the modified recursive procedure (Van Selst & Jolicoeur, 1994) the mean and standard deviation of the remaining data are calculated, after removal of the highest and lowest data. If the removed scores are higher or lower than ±4 SD from the mean, they were assumed as real outliers and permanently removed from the rest of the analysis; but if they are located in ±4SD from the mean they are returned to the analysis and assumed as real data. This procedure was repeated until no outlier remained. The modified recursive procedure was considered to deal with the outliers of this research; however, it did not appear to be an efficient procedure to detect outliers. By using the modified recursive procedure for this research data, none of the reaction time scores were detected as outlier beyond those the ±2SD restricted mean procedure eliminated. By selecting two different cutoff points, data that were assumed as outliers in the current experiment, were treated as genuine data and included in the Eastwood et al. (2003) analysis.

Analysis of the reaction time data of Experiment 1 showed that attending to the local level was significantly faster in neutral faces compared to both emotionally expressive faces (happy and sad). Moreover, the number of correct responses was significantly higher for neutral displays than happy or sad displays. According to the patterns of reaction time and accuracy of the responses, detecting elemental parts of the neutral faces was the fastest and most accurate suggesting emotional faces (either positive or negative) disrupt, attending to the local level in terms of both speed and accuracy. One reason might be the advantage of emotionally expressive faces in capturing attention. Numerous studies claim the advantage of the emotional faces in capturing attention (e.g., Eastwood et al., 2001; Ohman, Lundqvist, et al., 2001; Vuilleumier & Schwartz, 2001).

The results of the current experiment suggest that shifting attention from the global level of a face to its local level is easier with neutral than with emotional faces, resulting in faster reaction times in counting features of neutral displays. Inconsistent with this experiment's results, Eastwood and associates (2003) did not find any difference between local processing of the happy and neutral faces. This inconsistency might be caused by the difference of the task difficulty. Eastwood et al. (2003) visual displays consisted of happy and neutral faces with circular or oval nose and eyes. If the face was happy an upward curve was used as a mouth, while in neutral face the mouth was a straight line. The target was always a circle or and an oval; thus, counting the number of the target shape in happy and neutral displays was equally difficult. However, critical observation of my experimental stimuli provided an alternative interpretation: in three potential faces conveying sad or happy emotion just two out of nine constitutional parts are straight lines whereas in three faces conveying neutral expression five out of nine parts are straight lines. Thus, the faster reaction time toward neutral displays may simply be because of the ease of screening the lines than arcs. This means that, even if a target was an upward or downward curve, the observer may be able to reject lines faster and then decide among remaining parts. In visual search the efficiency of finding the target among different numbers of distracters depends on target properties, distracters quality and task requirements (Duncan & Humphreys, 1989; Wolfe, 1994). As the similarity between the target and surrounding distracters decreases, rejecting distracters and detecting targets was faster (Duncan & Humphreys, 1989). In any potential neutral display, straight lines might group and discriminate easier from the rest of the features and this eased the search performance when straight line was either target or distracter. On the contrary, potential happy or sad displays included more curves (downward or upward); therefore, the observer had to attend to a higher number of features which share similar characteristics. This might account for the slower reaction time to happy and sad displays as compared to neutral displays. To examine this alternative interpretation, a control experiment was designed in which the scrambled versions of the same faces were used. Scrambling the faces broke the faces' holistisity and impaired recognition of the emotional expression. If the differences between reaction time of the faces (neutral, happy and sad) were caused by the expressions, the reaction time differences would be eliminated. If the reaction time differences between faces remained, this might mean that the observed differences between sad, happy and neutral faces were caused by the elemental difference rather than the emotion they conveyed.

Experiment 2

The second experiment was originally designed to control for the results of the first experiment to examine if the observed differences among happy, neutral and sad face displays resulted from the emotions they conveyed or were simply caused by the physical structure of the elemental parts. In this experiment, the elemental parts of the faces were scrambled to create meaningless shapes; however, the proximity of the elements was maintained to keep the goodness of the form. Since emotional expressions were disrupted in the scrambled faces, this provided an opportunity to explore whether the difference between different facial expressions would replicate or not.

I predicted that no significant difference between different displays of the scrambled faces would be observed.

Method

This experiment's main characteristics were the same as explained in the Experiment 1 with the following differences:

Participants

19 participants (10 female, 9 male), ranging in age from 18 to 40 years, fluent in English, with normal or corrected-to-normal vision, volunteered to participate in the experiment in exchange for NZ$ 15.

Apparatus and stimuli

The apparatus and stimuli were explained in the Experiment1. For the meaningless set of stimuli, the same basic parts were scrambled to form meaningless patterns. The procedure of scrambling the parts was explained in Chapter 2. Each of the nine potential meaningless forms was equivalent to one of the nine potential faces (Figure 7).

Procedure

Participants were directed to do the counting task, in which they had to count how many of the target shape had been on the consequent display. Participants were asked to perform as fast and accurately as possible. The entire experiment took 45 minutes.

Result

The data of one participant were eliminated from further analysis due to high error rates (71.7%). Error rate higher than 50% was considered as high.

Reaction time analysis

Trials with incorrect responses were excluded from further analysis. In total 8.34% of the trials were eliminated. Mean reaction times greater than 2 standard deviations were removed for each of the displays to control for outliers (as per Experiment 1).

The mean of reaction time to scrambled version of happy, neutral, and sad face displays were analyzed using SPSS (19), using an ANOVA to compare the effect of different facial expressions on response speed to different scrambled displays. In this analysis, the display was the within-subject variable with three levels (i.e., scrambled happy face, scrambled neutral face, scrambled sad face).

Data showed that there was a significant main effect of display, $F(2, 34) = 27.68$, $p < .001$, $\eta^2 = .62$. Post hoc comparison using Least Significant Difference (LSD) indicates that responses were significantly faster to scrambled neutral face displays (M = 2117 ms, SD = 552.22) than scrambled happy (M = 2498 ms, SD = 717.12) or scrambled sad (M = 2467 ms, SD = 695.18) face displays, $p < .001$. The difference in reaction time data was not significant for scrambled happy and sad face displays, $p = .51$ (see Figure 11).

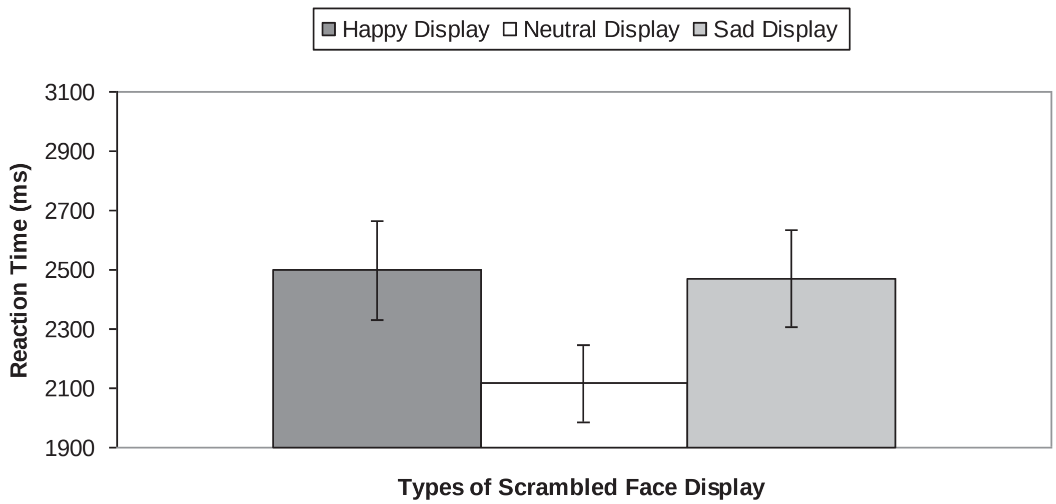


Figure 11. Reaction time (ms) representing detection and counting speed of the target shape in scrambled version of happy, neutral, and sad face displays in Experiment 2. Significant differences between RTs to scrambled happy/sad face displays and scrambled neutral face display were found. No difference was found in RTs to scrambled happy and scrambled sad face displays. Error bars represent ±1 standard error.

Response accuracy analysis

The mean of the accurate response to scrambled face displays (scrambled happy, scrambled neutral, and scrambled sad) were analyzed using SPSS (19), using an ANOVA. Data showed that there was a significant main effect of display, $F(2, 34) = 5.46$, $p = .009$, $\eta^2 = .243$. Post hoc comparison using Least Significant Difference (LSD) indicates that responses were significantly more accurate to scrambled neutral face displays ($M = 94\%$, $SD = 4.56$) than scrambled happy face displays ($M = 89.9\%$, $SD = 8.79$), $p = .02$. Accurate responses to scrambled neutral face displays was also significantly higher than scrambled sad face displays ($M = 91.1\%$, $SD = 5.81$) face displays, $p = .005$. The difference in accuracy data was not significant for happy and sad face displays, $p = .38$ (see Figure 12).

No other pattern for speed accuracy trade-offs was detected.

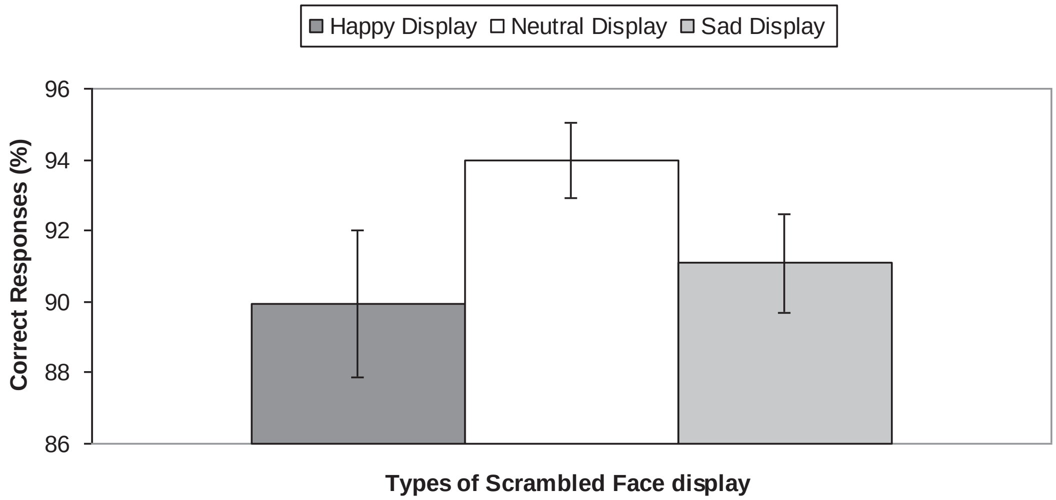


Figure 12. Correct responses (%) representing accurate detection and counting of the target shape in scrambled versions of happy, neutral, and sad face displays in Experiment 2. Significant differences between happy/sad scrambled face displays and neutral scrambled face display were found. No difference was found in correct response rates to happy and sad scrambled face displays. Error bars represent ±1 standard error.

Discussion

The main purpose of the aforementioned experiment was to examine if observed differences in counting the features of different faces in Experiment 1 were caused by their emotional expressions or resulted in the physical difference between features. The results showed significantly faster reaction time for counting the elemental parts of the scrambled neutral faces than for the scrambled emotional faces. The pattern of the accuracy of the responses revealed that, participants made fewer errors in responding to the neutral displays. Therefore, it is more likely that the physical attributes of the neutral faces enhanced detecting and counting the local parts of faces. So, the observed difference did not result from neutral expression per se, but from the use of the straight line. In this context, analysis of the neutral face displays was not considered in the following experiments, where neutral faces continued to lead to faster reaction times.

The analysis of the reaction time data of the scrambled happy compared to the scrambled sad faces did not show any significant differences. In order to better compare the meaningful and meaningless stimuli, the results of Experiments 1 and 2 were analyzed together for face displays and scrambled face displays.

Global Interference Effect in Meaningful and Meaningless Stimuli

Results

Reaction time analysis

The mean reaction time scores of the face and scrambled face (meaningless) stimuli were analyzed using SPSS (19), using an ANOVA to compare the effect of stimulus nature (meaningfulness) on reaction time in happy and sad displays. A 2 (Stimulus [meaningful, meaningless]) x 2 (Display [happy, sad]) factorial design was used. In this analysis the stimulus was a between-subject variable and the display type was a within-subject variable with two levels (i.e., happy and sad).

Analysis of reaction time data for different displays showed that there was no significant difference between happy and sad displays for faces or scrambled faces, $F(1, 34) = .007$, $p = .93$.

Data revealed that the main effect of stimulus nature (meaningful / meaningless) was not significant $F(1, 34) = .45$, $p = .51$ (see Figure 13).

No significant interaction between stimulus nature and different displays was detected, $F(1, 34) = .61$, $p = .44$.

Figure 13. Reaction time (ms) representing detection and counting speed of the target shape in happy and sad face displays and their scrambled versions in Experiments 1 and 2. No difference was found in RTs to face displays compared to scrambled face displays. No interaction between nature of stimuli (face, scrambled face) and display type was found. Error bars represent ±1 standard error in the figure.

Response accuracy analysis

An ANOVA was conducted to compare the effect of stimulus meaning on correct responses in happy and sad displays. Results showed that there was no significant difference between happy and sad displays, $F(1, 34) = .01$, $p = .93$ (see Figure 14).

The main effect of stimulus type on correct responses was not significant, $F(1, 34) = .05$, $p = .82$) and no significant interaction between the stimulus nature and different displays was seen $F(1, 34) = 2.48$, $p = .12$.

Figure 14. Correct responses (%) representing accurate detection and counting of the target shape in happy and sad face displays and their scrambled versions in Experiments 1 and 2. No difference was found in correct response rates to face and scrambled face displays. No interaction was seen between nature of stimuli (face, scrambled face) and display type. Error bars represent ±1 standard error.

Discussion

In two experiments participants attended to the local level of different face stimuli and to the scrambled version. Since the processing of the neutral faces was found to be affected by the perceptual characteristics of their elements, they were eliminated from the analysis. Attending to details of meaningful and meaningless shapes did not show significant difference for happy and sad face and not for scrambled happy and scrambled sad face displays either. The results did not align with Eastwood et al.'s (2003) predictions that suggested sad expression interferes with the processing of the local elements more than happy expression. Despite the non-significant results, reaction time to sad faces compared to happy faces was in the same direction as Eastwood et al. (2003) predicted, therefore, the faces continued to be used as the stimuli for the following experiments of this research.

Factors such as different data analysis procedures, cut-off points and task demands might affect the results. As mentioned previously, different outlier detection methods were used in this research and they were also studied. Restricted means method with cut-off point of ±2SD behaves more restricted in dealing with outliers than a modified recursive procedure with ±4SD cutoff point.

There was no difference in reaction time to attend to the local level of meaningful and meaningless shapes; hence, the global interference with the local level processing was not affected by the meaning of the overall shape. This does not appear to be the same as Poirel and associates (2008) predicted. They suggested that the global interference effect is connected with the object identification procedure, and as a result, meaningless shapes are not able to create interference with the processing of the local details (Poirel et al., 2008). This result was not in the same line with Mermelstein and associates (1979) findings. They found detection of a target was faster in scrambled faces than in coherent faces when the target was presented before each display (Mermelstein et al., 1979). They explained that the meaningfulness of a form interferes with detection of targets embedded within the global form. This issue is discussed in further detail in Chapter 8.

In Experiments 3, 4, 5, and 6 performances of happy or sad participants were studied when they attended to the local level of these stimuli.

Chapter 4

The Effect of Observers' Mood on Level of Processing of Schematic Faces

Experiment 3

The global interference effect proposed that even if direct processing of the local elements is the aim, prior processing of the overall configuration is mandatory. Compulsory perception of the overall shape delayed the fast processing of the local details (Navon, 1977). Previous research showed that emotional characteristics of the visual stimulus might alter the global interference effect (Eastwood et al., 2003). In the first experiment (Chapter 3), I studied the interference of the happy and sad expressions on the processing of the local features of the faces and even though the results did not show any significant difference, this is worth exploring further.

A growing body of research has shown that the stimulus attributes as well as the observer's characteristics influence the local level processing. For example, it has been shown that the observer's affective states influence the processing of compound visual stimuli (Baumann & Kuhl, 2005; Gasper & Clore, 2002; Hunsinger et al., 2012). The level of focus paradigm suggests that each of the happy or sad moods activates different attentional strategies; as a result, global level processing is more accessible in happy mood and local level processing is more adopted in sad mood (Gasper, 2004; Gasper & Clore, 2002). In another study, Hunsinger and associates (2012) showed the connection between mood and processing of the compound stimuli is not fixed. They proposed the malleable mood effects hypothesis in which positive affect always promotes the default processing style, while, sad mood inhibits it. Since, global processing is the common adopted strategy in visual processing, happy mood tends to promote global processing. However, if an observer's default processing strategy is primed to local processing, happy mood enhances the default processing strategy facilitating local processing (Hunsinger et al., 2012).

Whereas the flexibility paradigm suggests happy or sad moods trigger different levels of attentional flexibility; consequently, access to the non-dominant level is facilitated by happy mood (Baumann & Kuhl, 2005).

In this current experiment, the emotional valence of the stimuli and the affective states of the observer were studied together. The same set of compound schematic faces with three different emotional valences (happy, neutral, and sad) was used[8], while happy or sad mood was induced in two different groups of participants. The task was to attend to the local constructs of the faces and count particular features.

The aim of this experiment was to investigate how the emotional attributes of the stimulus interact with the observer's mood in visual processing. There was also an expectation that only one of the mentioned factors (either content or context) would influence the level of processing.

In Experiment 1 no significant difference between happy and sad faces was observed, however based on the results of the previous studies, slower reaction times were expected for attending to the local level of sad faces than happy faces.

Regarding the previous paradigms, processing of the local level of the shapes could be affected by the observers' mood. Based on the level of focus paradigm, I expected that counting the local elements of the faces would take longer in happy mood compared to sad mood; while, sad mood facilitated local level processing.

On the contrary, based on the flexibility paradigm, I expected that, participants in happy mood would shift their direction of attention to the local level (relevant level)

[8] The neutral displays were presented to the participants, but based on the results of the first and second experiments, the data of the neutral displays was not included in the analysis.

and count the elemental parts faster. Therefore, slower reaction time to the task in sad mood was expected based upon the flexibility paradigm.

Since, the task required attending to the local level, I proposed the default processing strategy would prime to local processing, and based on the malleable mood effects hypothesis, I expected faster reaction time in happy mood and slower reaction time in sad mood. Based on the different hypotheses, it was difficult to predict which would occur.

Method

The main characteristics of the current experiment were clarified in the Experiment 1. The following parts differed:

Participants

Twenty one participants (13 female, 8 male), ranging in age from 18 to 40 years, fluent in English, with normal or corrected-to-normal vision, volunteered to participate in the experiment in exchange for NZ$ 15.

Apparatus and stimuli

The apparatus and stimuli were explained in the Experiment1.

Procedure

Participants of both groups were asked to rate their current mood between 1 to 7 on a self rate scale, in which 1 showed sad mood and 7 represented happy mood. After mood rating the first group listened to happy music for 3 minutes and 41 seconds. “Eine Kleine Nachtmusik” by Mozart was chosen to induce happy mood. To induce sad mood, participants in the second group listened to “Adagio for Strings” by Barber for 3 minutes and 35 seconds (justification for music pieces selection was given in detail in the introduction chapter). The mood manipulation was followed by a mood rating based on the same scale. Afterwards, participants engaged in the counting task, in which they had to count how many of the target shape had been on the display. Each trial had to be performed as fast and accurately as possible (see Figure 15). Participants took between 45 minutes to 1 hour to complete the experiment. The overall procedure of the task was explained the Experiment 1 in details.

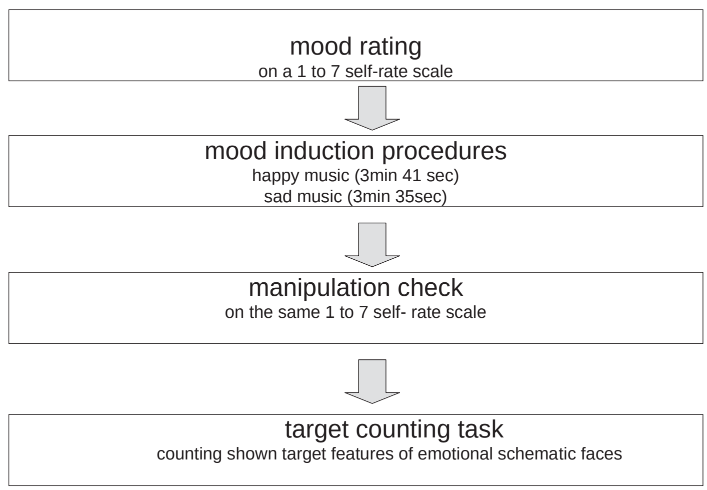


Figure 15. The experimental procedure for Experiment 3.

Result

Data from three participants were removed because of unsuccessful mood manipulation. The mood manipulation was considered unsuccessful if a participant's mood scores before and after listening to the music went in the non-expected direction. The final number of participants in each of the happy and sad mood groups was nine persons.

Mood manipulation check

Participants rated their mood two times, before listening to the music and after. The first rating provided a pre-test baseline. Increases in mood score after listening to happy music and decreases in mood scores after listening to sad music were expected. The mood manipulation was considered unsuccessful if a participant's mood scores before and after listening to the music went in the non-predicted direction.

Participants' mood before mood induction had a tendency toward a positive mood (M = 4.22, SD = .94). To confirm that music influenced participants' affective states as intended, scores of before and after mood manipulation were analyzed for each group using a paired sample t-test. Data revealed that there was a significant difference between mood scores before (M = 4.00, SD = .71) and after (M = 4.56, SD = 1.01) listening to happy music $t(8) = 2.29$, $p = .05$ (two tailed p-values were assumed); and also there was a difference between scores before (M = 4.44, SD = 1.13) and after (M = 3.56, SD = 1.24) listening to sad music, $t(8) = 3.41$, $p = .009$ (two tailed p-values were assumed). This means that the mood manipulation techniques were successful in inducing intended moods in both groups.

Reaction time analysis

Trials with incorrect responses were excluded from further analysis. In total 9.44% of the trials were eliminated. Mean reaction times greater than two standard deviations were removed for each of the happy and sad displays to control outliers (the reason discussed in chapter 3). The mean reaction times of remaining data were analyzed by SPSS (19), using an ANOVA to compare the effect of observers' mood on reaction time in happy and sad displays. A 2 (Mood [sad x happy]) x 2 (Display [happy, sad]) factorial design was used. In this analysis, the mood was a between-subject variable and the display was a within-subject variable with two levels (i.e., happy face and sad face).

Analysis of reaction time data on different displays showed that the main effect of the display was marginally significant $F(1, 16) = 3.65$, $p = .07$, $\eta^2 = .19$.

. The results showed that reaction time toward happy displays ($M = 2513$ ms, $SD = 502.09$) was slightly faster than reaction time to sad displays ($M = 2580$ ms, $SD = 594.71$) (see Figure 16).

Data revealed that the main effect of mood was marginally significant $F(1, 16) = 3.84$, $p = .07$, $\eta^2 = .19$. Data showed reaction time in happy mood ($M = 2313$ ms, SD = 367.08) was faster than in sad mood ($M = 2780$ ms, SD = 598.53).

No significant interaction between display types and mood was detected ($p = .65$).

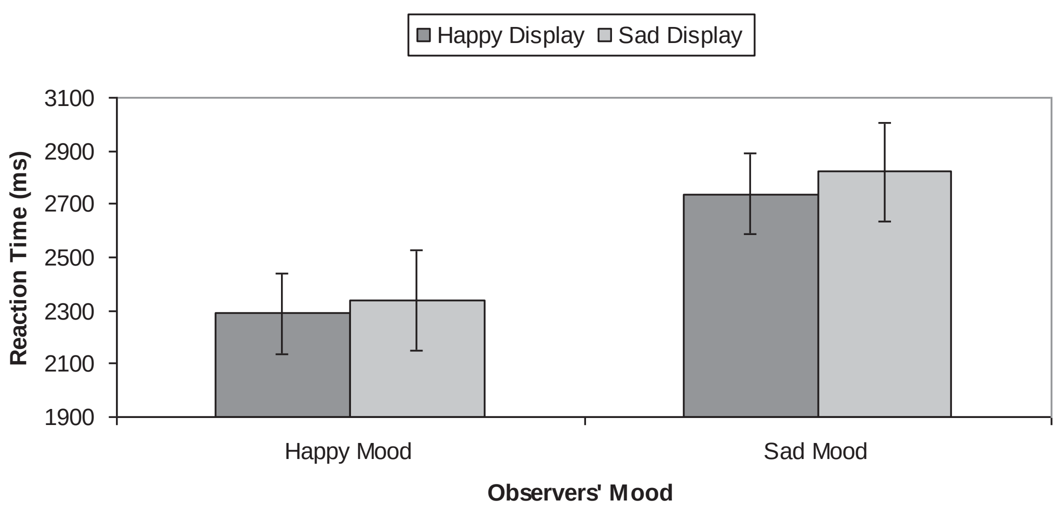


Figure 16. Reaction time values (ms) representing speed of detecting and counting a target shape in happy and sad face displays in low intensity happy or sad mood (Experiment 3). Counting targets in happy face displays was marginally faster than sad face displays. RT was marginally faster in happy mood compared to sad mood. Standard errors are represented in the figure by the error bars attached to each column.

Response accuracy analysis

An ANOVA was conducted to compare the effect of observer's mood on correct responses in happy and sad displays. Results showed that there was not a significant main effect of displays, $F(1, 16) = 1.23$, $p = .28$ (Happy Display: M = 90.3%, SD = 8.72; Sad Display: M = 89.1%, SD = 8.28) (see Figure 17).

The main effect of mood on correct responses was not significant, $F(1, 16) = .24$, p = .63 (Happy Mood: M = 90.7%, SD = 6.99; Sad Mood: M = 88.8%, SD = 9.73) and no significant interaction between observers' mood and different displays was seen, $F(1, 16) = 1.85$, $p = .19$.

Figure 17. Correct responses values (%) representing correct detection and counting a target shape in happy and sad face displays in happy or sad mood (Experiment 3). No correct response differences were found in happy and sad displays. No correct response differences were observed in happy and sad mood. No interaction between type of display and mood was found. Standard errors are represented in the figure by the error bars attached to each column.

According to the patterns of reaction time and accuracy of the responses, no speed accuracy trade-off was suggested.

Discussion

The aim of the experiment was to investigate how happy or sad mood directs observers to process local elements of different facial expressions. Participants were requested to attend to and count the particular face features. Faster counting performance (reaction time) was assumed as an ability to overcome the interference of the global level.

The results showed that the emotional valence of the faces influenced the speed of local processing. Observers were slower (marginally significant) in attending to the local level of the sad faces. This was in line with the hypothesis. The evolutionary perspective proposed that stimuli with threat potential are more effective in capturing attention (Ohman, Flykt et al., 2001). The superiority of negative expression in capturing attention was also observed in previous studies (e.g., Eastwood et al., 2001; Fox et al., 2000; Hansen & Hansen, 1988). The sad face may be processed as a negative signal, thus, it has a potential to grab attention efficiently. This may block fast switching of attention to the elemental details. Our results were in line with the findings of Eastwood and colleagues (2003) research study suggesting that sad facial expression interferes with fast access to the local elements. However, another alternative explanation can be given to interpret the faster attending to the elemental parts of positive faces: global representation of positive faces processes fluently and facilitates fast access to the component parts. For example Fox and associates (2000) found that when visual displays are uniform searching a happy face display took place faster than a sad face display.

The results also revealed that counting the elemental parts of faces was faster for happy observers than for sad observers. Fast and efficient counting of the elemental parts required overcoming the dominant effect of the overall configuration and switching of attention from the global level to the local details. Thus, faster reaction time in happy mood suggested that shifting of attention to the requested level is facilitated by happy mood. This is in line with the flexibility paradigm. The results of this experiment supported that happy mood makes the attentional and perceptual mechanism more flexible. As a result, when the task requests local processing, disengaging attention from global level and switching to local level were enhanced in happy mood (Kuhl, 2000; Baumann and Kuhl, 2005).

The results also supported the malleable mood effects hypothesis. Since, the task called for local processing, it is also possible that participants' default processing strategy was primed to local attention. Based on the malleable mood effects hypothesis, happy mood promotes the available processing strategy and speeds up the local processing performance (Hunsinger et al., 2012). These results were not consistent with the level of focus paradigm in which sad mood is expected to facilitate local level processing (Gasper & Clore, 2002; Gasper, 2004).

However, local processing was found to be influenced by emotional meaning of the stimuli as well as observed' affective state, but these effects were only significant marginally. It is possible that the happy or sad mood induced by the single mood manipulation strategy had low intensity, and engaging in doing the task might have distracted the participants from the induced mood (Van Dillen & Koole, 2007; 2011).

Taken together, the results of Experiment 3 showed that: i) the emotional meaning of the hierarchical stimulus can affect global interference effect, and ii) the different valence of observers' mood affects the local processing differently. However, it is not clear if different mood intensity influences the processing of the compound shapes. I was interested in studying whether the reaction time pattern found here would be the same in intensified happy or sad mood. I followed this idea in Experiment 4.

Chapter 5

The Effect of Observers' Intensified Mood on Level of Processing of Emotional Schematic Faces

Experiment 4

In Experiment 3, the effect of observers' different mood valences (happy vs. sad) were studied on attending to the local level of happy and sad faces. The results showed a tendency of faster reaction time in happy mood than in sad mood. This means that different mood valences direct the attentional level in different ways. Further, I observed that the attentional focus is manipulated in the way the flexibility paradigm and malleable mood effects hypothesis proposed. However, it was important to investigate how higher mood intensity influences the attentional resources.

Gasper (2004) proposed that mood strength has an impact on speed of processing; "…individuals processed information faster as their mood states intensified" (p.714). In support of the level of focus paradigm (Gasper & Clore, 2002), Gasper showed that with increasing the strength of sad mood, observers are able to recognize the local elements of a compound stimulus faster. She proposed that the local level of a compound stimulus becomes more recognizable and accessible in stronger sad mood (Gasper, 2004). The task used by Gasper (2004) was a matching task, in which a target shape and two alternatives were presented In half of the trials both alternatives could match with the target in either global or local level (ambiguous trials). In the rest of the trials just one of the alternatives could match with the target (unambiguous trials). She observed that mood (and also intensified mood) was able to change the level of focus only when the task situation was ambiguous (Gasper, 2004).

The effect of mood intensity on level of processing was only studied on the matching task in an earlier study (Gasper, 2004). Here, in Experiment 4, this effect was examined in a visual search task. The intention of this current experiment was to study how increasing moods strength impacts on overcoming the global interference effect.

In order to create happy or sad mood with higher strength, previous studies suggested using a combination of two mood induction techniques. A meta-analysis study suggested that combined techniques are more effective than single strategies in manipulating the mood (Westermann et al., 1996). One of the most employed procedures is to combine music and memory recall techniques (e.g., Jefferies, Smilek, Eich, & Enns, 2008). The music mood induction technique was evaluated as effective and was used in research extensively (Baumgartner, Esslen, & Jancke, 2006; Albersnagel, 1988; Bouhuys et al., 1995; Sousou, 1997; Nguyen & Scharff, 2003; Storbeck & Clore, 2005). Previous studies showed that recalling autobiographical memory has a significant effect on a person's current mood (Gillihan, Kessler, & Farah, 2007). This technique was also used in previous experiments and was reported as efficient (Jefferies et al., 2008; Gasper & Clore, 2002; Gillihan et al., 2007). In memory recall procedure, participants were asked to remember or write about one of their sad or happy memories. It seems that the combination of music and memory recall provided stronger mood manipulation than using each of them separately (Mayer, Allen, & Beauregard, 1995; Westermann et al., 1996).

In the current experiment, I used the same schematic faces and task procedure. A combination of music and memory recall was applied to induce stronger happy or sad mood. I hypothesized that combined mood induction procedure creates intensified mood compared to Experiment 3, where only a single procedure (music mood induction) was applied.

Moreover, following Gasper's (2004) proposal, it was expected that the time for counting the local parts of displays alters with mood strength. With regard to the flexibility paradigm, I hypothesized that intensified happy mood participants would show faster reaction time for counting features of the faces. It was also predicted that in a stronger sad mood the reaction time to the local level would be slowed down.On the contrary, concerning the level of focus paradigm, slower reaction time to the local level of faces was predicted in happy mood, and faster counting performance was predicted in sad mood. Since it was the first time that the effect of different mood intensity was studied on a visual search and counting task, predicting what would occur was difficult.

Method

The main characteristics of the current experiment were clarified in the Experiment 1. The following parts differed:

Participants

Twenty two volunteers (9 male, 12 female), ranging in age from 18 to 40 years participated for NZ$ 15 compensation. All reported normal or corrected-to-normal vision, all were fluent in English and all were tested individually.

Apparatus and stimuli

The apparatus and stimuli were explained in the Experiment 1.

Procedure

Participants were randomly assigned to two different groups. All participants were asked to give a score of their current mood on a 7-point scale from 1 to 7. In this self-rate scale 1 showed sad mood and 7 represented happy mood. After mood rating, the first group of participants listened to “Eine Kleine Nachtmusik” for 3 minutes and

41 seconds while they were requested to remember one of their happy memories. The second group listened to “Adagio for strings” for 3 minutes and 35 seconds and remembered one of their sad memories simultaneously. The selection of the music pieces was explained in the introduction chapter. Afterwards, mood scoring based on the same scale was requested a second time. This was followed by the counting task, in which they had to count how many of the target shapes had been on the presented displays. They were instructed to count as quickly and accurately as possible. The experiment lasted approximately 45 minutes to 1 hour. The task was explained in the Experiment 1 thoroughly (see Figure 18).

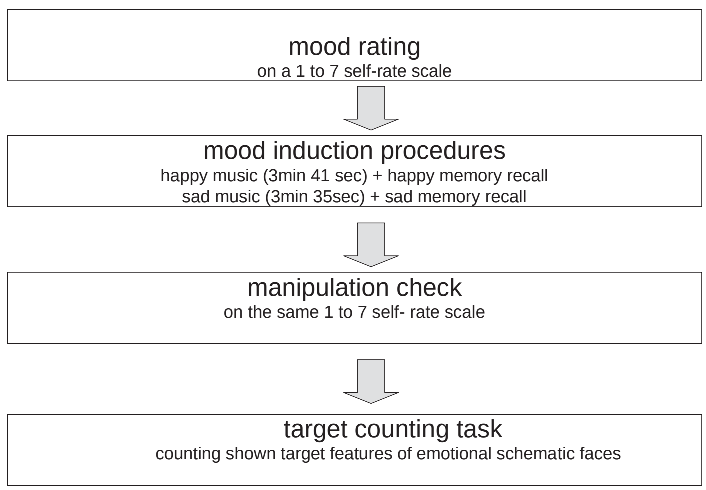


Figure 18. The experimental procedure for Experiment 4.

Results

Two participants with unsuccessful mood manipulation and 1 participant with high error rates (71.8%) were eliminated from the analysis. Error rate higher than 50% was considered as high. The final number of participants in each of the happy and sad mood groups was nine persons.

Mood manipulation check

Participants rated their current mood two times, once before and once after the mood manipulation. The first rating provided a pre-test baseline. Increases in mood score after listening to happy music and happy memory recall were expected. But if a participant's mood after happy mood manipulation went in the opposite direction (score decreased), it was considered unsuccessful and that data was excluded from further analysis. This procedure was the same for the sad mood induction group. Participants' mood before mood induction had a tendency toward a positive mood (M = 5.22, SD = .80). To confirm that combined strategy influenced participants' affective experiences as intended, scores of before and after mood manipulation were analyzed for each group using paired sample t-tests. Data revealed that there was a significant difference between mood scores before (M = 4.89 , SD = .78) and after (M = 5.56 , SD = .53) happy mood manipulation (happy music plus happy memory recall) $t(8) = 2.31$, $p = .05$ (two tailed p-values were assumed); and also difference between scores before (M = 5.56, SD = .73) and after (M = 3.77 , SD = .97) sad mood manipulation (sad music plus sad memory recall) was significant, $t(8) = 6.4$, $p < .001$ (two tailed p-values were assumed). Data analysis showed participants' mood changed significantly after mood induction in both groups.

Mood manipulation effectiveness comparison

The effectiveness of single mood induction (Experiment 3) was compared with combined mood induction (Experiment 4). Independent samples t-tests were conducted to compare the success of single and combined mood manipulation strategies in inducing happy and sad moods. For this purpose, the difference between scores of before and after mood induction was calculated for each person and was analyzed using

SPSS (19). Data did not show any significant difference between the scores of single strategy (*M* = .56, *SD* = .73) and combined strategy (*M* = .67, *SD* = .87) in happy mood, *t*(16) = .30, *p* = .77 (two tailed *p*-values were assumed). The difference in manipulation scores of single strategy (*M* = .89, *SD* = .78) and combined strategy (*M* = 1.78, *SD* = .83) was significant for sad mood induction, *t*(16) = 2.33, *p* = .03 (two tailed *p*-values were assumed). This means that combined mood induction strategy was able to induce sad mood with higher intensity but the strength of happy mood was not intensified by combined mood manipulation.

Reaction time analysis

Trials with incorrect responses were excluded from further analysis. In total 10.42% of the trials were eliminated. Mean reaction times greater than 2 standard deviations were removed for each of happy and sad face displays to control outliers (for the logic of this method, see Chapter 3). The mean reaction times of remaining data were analyzed using SPSS (19), using an ANOVA to compare the effect of observer's mood on reaction time in happy and sad face displays. The score differences were examined with a 2 x 2 factorial design (Mood [sad, happy] x Display [happy, sad]). In this analysis, the mood was a between-subject variable and the display was a within-subject variable with two levels (i.e., happy face and sad face).

Analysis of reaction time of different displays showed that there was a significant main effect of display, *F*(1, 16) = 8.86, *p* = .01, η^2 = .36. Results indicated that reaction time was significantly faster in responding to happy face displays (*M* = 2278 ms, *SD* = 322.47) than to sad faces (*M* = 2361 ms, *SD* = 304.99) (see Figure 19). Data revealed that the main effect of mood was not significant *F*(1, 16) = .43, *p* = .52. Interaction between face type and mood was marginally significant *F*(1, 16) = 3.49, *p* =

.08, η^2 = .18. In such, that observers in sad mood were significantly slower (*p* = .003) in response to sad face displays (*M* = 2435 ms, *SD* = 385.69) than to happy face displays (*M* = 23 ms, *SD* = 409.84). But, no significant difference between happy and sad faces was seen in happy mood (*p* = .44).

Figure 19. Reaction time values (ms) representing speed of detecting and counting a target shape in happy and sad face displays in intensified happy or sad mood (Experiment 4). Counting parts of happy face was faster than sad face in sad mood. No difference between counting time of happy and sad faces in happy mood. No difference was found between RTs in happy mood compared to sad mood. Error bars represent ±1 standard error.

Response accuracy analysis

The mean of the correct responses (%) was analyzed using SPSS (19), using an ANOVA to compare the effect of observers' mood on correct responses in happy and sad face displays. No significant main effect of the displays was detected *F*(1, 16) = .28, *p* = .60 (Happy Display: *M* = 88.7%, *SD* = 4.84, Sad Display: *M* = 88.1%, *SD* = 4.77). The main effect of mood was not significant too, *F*(1, 16) = .001, *p* = .97. Moreover, the interaction of mood and display was not significant, *F*(1, 16) = 1.25, *p* = .28.

Based on the accurate response analysis and pattern of the reaction times no speed accuracy trade-offs were detected (see Figure 20).

Figure 20. Correct responses values (%) representing correct detection and counting a target shape in happy and sad face displays in intensified happy or sad mood (Experiment 4). No correct response differences were found in happy and sad displays. No correct response differences were observed in happy and sad mood. No interaction between type of display and mood was found. Error bars represent ±1 standard error.

Discussion

The aim of Experiment 4 was to investigate the effect of the strength (intensity) of happy or sad mood on the processing of local elements of the happy and sad schematic faces. In order to induce stronger happy and sad mood in the laboratory, combination of two mood induction procedures was used in the aforementioned experiment. Data analysis showed that the combined mood manipulation technique was successful in inducing happy and sad moods however compared to the single mood manipulation technique, the combined strategy was only able to intensify the sad mood. This means that single and combined techniques induced happy mood with similar intensity. The complications of creating happy mood in the laboratory have been considered in previous studies (Nguyen & Scharff, 2003; Miller, 2009). One possible explanation may relate to the default affective state of participants. It was reported that, people are mostly thinking of positive subjects and remembering positive memories in their daily routine (Matlin & Stang, 1978, as cited in Diener and Diener, 1996). If remembering positive memories is the usual tendency of the cognitive system, it is more likely that happy memory recall has no effect on intensifying the happy mood. However, it is also possible that the mood rating scale was insensitive to distinguish between happy and happier mood.

The findings of Experiment 4 showed an attentional bias to negative stimuli in intensified sad mood. Observers with stronger (intensified) sad mood showed almost 135 milliseconds slower response to count the parts of sad faces than happy faces. This means that global interference effect in faces with sad expression becomes more prominent when the observer is experiencing sad mood with stronger intensity. Previous research showed that attentional resources were significantly engaged with negative materials in sad mood (Becker & Leinenger, 2011; Bradley, Mogg, & Lee, 1997). I proposed that attentional resources in observers with intensified sad mood were attracted by negative facial emotion for longer. As a result, disengagement from the sad emotion (global level) and counting the parts (local level) took more time.

Since the combined mood manipulation procedure was not able to inducehigh intensity happy mood, the results of this experiment could not provide any proposal for the effect of the stronger happy mood, beyond what occurred in Experiment 3.

The results of Experiment 4 also revealed that attending to the local elements of sad faces took longer than for happy faces. This is consistent with the results of Experiment 3 and also Eastwood et al.'s (2003) findings. This suggested that the global feature of a sad face is more informative for the observers, so, it captures the attention to itself and as a result, disengaging from the global level and attending to the local features takes more time. Consistent with the evolutionary perspective, negative expression contains a threatening signal, so it has advantage in capturing attention (Ohman & Mineka, 2001). When attentional resources are engaged with negative expression processing, the procedure of disengagement from the overall face and shifting attention toward the local parts delayed the response. However, it is possible that the processing of the positive information conveyed by the global level of the faces took place more efficiently than negative information processing therefore attentional resources were able to disengage from the global level more easily and switch to the requested local level.

Taken together, the results of this experiment suggested: first, sad facial expression has a tendency to capture and hold the attention for longer. This interferes with the fast access to the local details of the face. Second, the interference of the sad expression with local detail processing increases when the observer is experiencing stronger (intensified) sad mood. Third, available mood manipulation methods still need to be reviewed and developed. Despite the previous recommendations for using a combined strategy in order to create intensified mood, the combination of music and autobiographical recall did not intensify happy mood in this research.

Regarding the results of Experiment 4 two issues should be considered: first, induced mood in experimental settings may last for a short period of time (Chepenik et al., 2007). Chepenik and associates studied different mood induction procedures and concluded that induced mood in experimental settings remains efficient for 5 to 10 minutes. Therefore, if the cognitive task lasts longer, it is more likely that the observed results are not the direct effect of the induced mood. Secondly, engaging in a cognitive task might distract a person from the original mood (Van Dillen & Koole, 2007). It is possible that not only the degree of strength of certain mood but also the duration of exposure to the mood affects cognitive processing (Gilboa, Roberts, & Gotlib, 1997). Gilboa et al. (1997) proposed that the persistency of the happy or sad mood might be as important as its intensity.

Following these concerns, I was interested in applying a mood induction technique which persisted for the entire duration of the task. This idea has been examined in the next chapter.

Chapter 6

The Effect of Persistent Mood on Processing of Schematic Faces

Experiment 5

In Experiment 4 the effect of the intensified happy and sad mood on the global interference effect was studied on local processing of happy and sad compound faces. The results revealed that intensified sad mood biases attentional resources to be engaged with negative materials for longer. In Experiment 4, participants were engaged in doing the task after their mood had been manipulated. But, what if involvement in doing the task distracts participants from the experimentally induced mood? Van Dillen and Koole (2007) showed that doing a maths task distracts participants from their induced sad mood. They suggested that the task occupied the limited capacity of the working memory and therefore fewer resources remained for maintaining the person's current mood (Van Dillen & Koole, 2007). Moreover, it is possible that not only the strength of the induced mood, but also the duration of exposure with particular mood has an impact on cognitive performance (Gilboa et al., 1997). One potential solution is to use a mood manipulation technique during the course of the task. For example, in some research, background music was used as a mood manipulation technique, when the participants were engaged in doing a cognitive task (e.g., Jefferies et al., 2008).

While background music facilitates retaining the happy or sad mood throughout the task, using it has its own concerns. Previous research has not provided a clear interpretation about whether background music affects (either positively or negatively) the person's behaviours and performances. Different reasons may account for the lack of clear understanding about the effect of background music:

(1) Other known and unknown music attributes might affect the concurrent performance. This means that, it is not only the emotional valence of the background

music that matters, but other characteristics like music tempo can also make a difference (Hevner, 1937). For example, one detailed analysis by Kampfe, Sedlmeier, and Renkewitz (2010) demonstrated that fast tempo has a positive effect on sport performance (like running on a treadmill as shown by Edworthy & Waring, 2006); while, tempo did not affect cognitive performance. Thompson, Schellenberg, & Letnic (2011) showed that reading and comprehension performance were affected negatively by fast tempo music only if it was presented at a loud volume.

(2) Background music has diverse impacts on different persons. For example, in one study participants were requested to do an attentional task which was designed to assess Chinese participants' attention (the task was designed for application in occupational settings) (Shih, Huang, & Chiang, 2009). Results showed speed of performance increased in some participants due to listening to music, while, some other participants showed a decrease in speed. Shih et al. (2009) proposed that personal differences (e.g., personal history or appropriateness of the music) might account for different performances while listening to background music.

(3) Previous studies which used background music have different tasks and various dependent variables. The effect of background music was investigated in diverse fields: the effect of background music on advertising (Kellaris, Cox, & Cox, 1993), the effect of background music on sport performance (Edworthy & Waring, 2006), the effect of music on work place production (Mayfield & Moss, 1989), and also the effect of background music on cognitive abilities like memory, attention or decision making (Day, Lin, Huang, & Chuang, 2009; Salame & Baddeley, 1989; Shih et al., 2009). This diversity makes the comparison among different tasks and performances impossible. For example, the nature of a physical activity is not comparable with solving a math problem and as a result the effect of background music for each of these performances

should be studied separately. To solve this gap, Behne (1999) studied different types of research to find common predictors about the effect of background music on non-musical behaviours. Final results of his analysis showed that background music has no effect on non-musical behaviours (as cited in Kampfe, Sedlmeier, & Renkewitz, 2010). Although Behne's analysis was faced with a few methodological critics, a meta-analysis on the same selection of research also found no effect of background music on non-musical behaviours (Kampfe et al., 2010).

In this context, I applied background music to study the effect of happy or sad context when participants were engaged in doing the task, but, the potential unwanted effects of background music were also regarded.

The aim of Experiment 5 was to study attending to the local elements of happy and sad faces, when observers were exposed with happy or sad mood for the duration of the task. Based on the previous investigation (Eastwood et al., 2003) and the results of Experiments 3 and 4, I hypothesized that attending to the local elements takes longer when a global level conveys sad emotion.

To the best of my knowledge no experiment has examined the effect of continual induced mood on local processing of emotional stimuli, although, based on available paradigms (level of focus vs. flexibility) two different predictions were available: regarding the level of focus paradigm, I expected general slower reaction time to the local level of faces in happy mood and faster reaction time in sad mood. In contrast, I expected faster attendance to the local details in happy mood and slower reaction in sad mood based on the flexibility paradigm.

Method

The main characteristics of this experiment were the same as explained in the Experiment 1 with the application of the following differences:

Participants

Twenty three participants (10 male, 13 female), ranging in age from 18 to 40 years, fluent in English, reported normal or corrected-to-normal vision, volunteered to participate in the experiment in exchange for NZ$ 15. All participants were tested separately.

Apparatus and stimuli

The apparatus and stimuli were explained in the Experiment 1.

Procedure

Participants were randomly assigned into two groups. All of them were asked to rate their current mood between 1 to 7, on a self-rate scale, in which 1 showed *very sad* mood and 7 represented *very happy* mood. After the mood rating, the first group listened to “Eine Kleine Nachtmusik” by Mozart as happy music for 3 minutes and 41 seconds while they were asked to remember one of their happy memories. To induce sad mood, participants in the second group listened to “Adagio for Strings” by Barber for 3 minutes and 35 seconds while being requested to recall one of their sad memories. Mood manipulation was followed by mood rating based on the same scale. Afterwards, participants engaged in the counting task, in which they were requested to count quickly and accurately how many of the target shape had been on the consequential display. The same pieces of mentioned music were played in the lab as background in medium volume via computer speakers. Figure 20 represents the overview of this experiment.

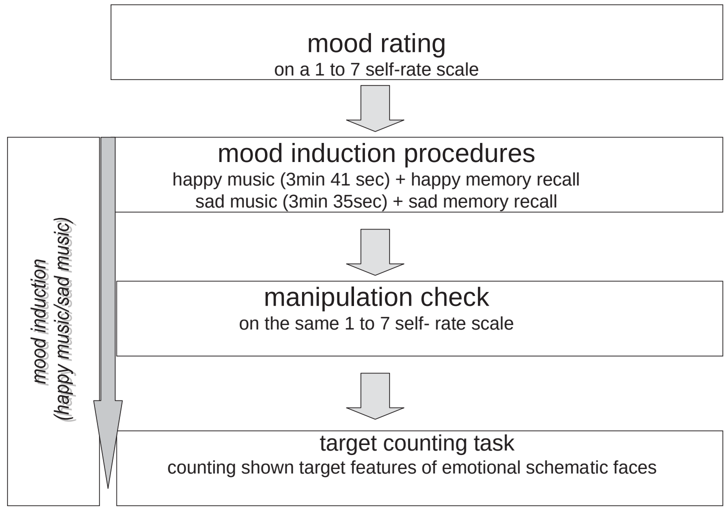


Figure 21. The experimental procedure for Experiment 5.

Result

Five participants' data were removed due to either unsuccessful mood manipulation (three participants) or high error rates (77.78% and 90.12%). As before an error rate of more than 50% of the trials was considered as high. The final number of participants in each of the happy and sad mood groups was nine persons.

Mood manipulation check

Participants rated their mood two times, before listening to the music and after. The first rating provided a pre-test baseline. Increases in mood score after listening to happy music and decreases in mood scores after listening to sad music were expected. The mood manipulation was considered unsuccessful if a participant's mood scores before and after listening to the music did not go to the predicted direction.

Participants' mood before mood induction had a tendency toward a positive mood (M = 5.17, SD = 1.04). To confirm that music pieces influence participants' affective states as intended, scores of before and after mood manipulation were analyzed for each group using paired sample t-tests. Data revealed that there was a significant difference between mood scores before (M = 5.00, SD = 1.12) and after (M = 5.55, SD = 1.13) listening to happy music and recalling happy memory $t(8) = 2.29$, $p = .05$ (two tailed p-values were assumed); and also a significant difference between scores before (M = 5.33, SD = 1.00) and after (M = 3.78, SD = 1.40) listening to sad music and sad memory recall, $t(8) = 5.29$, $p = .001$ (two tailed p-values were assumed). Data analysis showed after mood induction, participants' mood changed in the expected direction significantly in both groups.

Reaction time analysis

Trials with incorrect responses were excluded from further analysis. In total 6.99% of the trials were eliminated. Mean reaction times greater than two standard deviations were removed for each of happy, neutral and sad displays to control outliers (the reason discussed in chapter 3). The mean of the remaining reaction times was analyzed using SPSS (19), using a 2 x 2 (Mood [happy, sad] x Display [happy, sad]) ANOVA to compare the effect of observer's mood on reaction time in happy and sad displays. In this analysis, the mood was a between-subject variable and the display was a within-subject variable with two levels (i.e., happy face and sad face).

Analysis of reaction time data for different displays showed that there was a significant main effect of display, $F(1, 16) = 7.42$, $p = .02$, $\eta^2 = .32$. The results indicated that reaction time was significantly faster in responding happy face displays

(M = 2478 ms, SD = 467.21) than to sad faces (M = 2557 ms, SD = 511.97) (see Figure 22).

Figure 22. Reaction time values (ms) representing speed of detecting and counting a target shape in happy and sad face displays in persistent happy or sad mood (Experiment 5). Counting the elemental parts of the happy face displays was faster than sad face displays. Counting the elemental parts of the faces was faster in sad mood than happy mood. No interaction between types of face display and mood was found. Error bars represent ±1 standard error.

Data revealed that the main effect of mood was significant $F(1, 16) = 8.81$, $p = .01$, $\eta^2 = .36$. The results showed that reaction time in happy mood (M = 2799 ms, SD = 509.85) was slower than in sad mood (M = 2236 ms, SD = 236.62).

Moreover, interaction between display types and mood was not significant, $F(1, 16) = 1.69$, $p = .21$).

Response accuracy analysis

The correct responses were analyzed using SPSS (19), using an ANOVA to compare the effect of observer's mood on correct responses in happy and sad displays. Analysis of correct response data for happy and sad displays showed that there was a significant main effect of displays, $F(1, 16) = 4.79$, $p = .04$, $\eta^2 = .23$. Data showed that correct responses toward happy displays (*M* = 92.5%, *SD* = 3.24) were more than correct response to sad displays (*M* = 91%, *SD* = 4.34) (see Figure 23).

Figure 23. Correct responses values (%) representing correct detection and counting a target shape in happy and sad face displays in persistent happy or sad mood (Experiment 5). Correct responses to happy face displays were more than correct responses to sad face displays. No correct response differences were observed in happy and sad mood. No interaction between type of display and mood was found. Error bars represent ±1 standard error.

Data revealed that the main effect of mood was not significant, $F(1, 16) = 1.81$, $p = .20$). No significant interaction between display types and mood were detected, $F(1, 16) = 1.00$, $p = .33$.

Speed-accuracy comparison showed that reaction time to happy displays was faster and more accurate. Reaction time to sad displays, on the contrary, was slower and with more error.

Discussion

In the aforementioned experiment, I explored the effect of enduring happy and sad mood on processing the elemental parts of happy and sad faces. The aim was to see if the longer time exposure with happy or sad mood had an influence on the global interference effect with emotional stimuli.

The results supported this idea that sad facial expression has stronger ability to capture attention and interfere with attending to face elements. This result is consistent with Eastwood et al. (2003) and Experiments 3 and 4 showed that even if the task is irrelevant to the emotional valence of the faces the sad expression "involuntarily attracts" attention (Eastwood et al., 2003, p.358). It seems that negative meaning conveyed by the global face is capable of occupying attentional resources more than positive. It is probable that the unpleasant meaning of the sad expression has higher capability to affect the organism's survival. Therefore, the cognitive mechanisms allocated to sad face do not rapidly disengage and attend somewhere else.

However, another plausible interpretation can be given to interpret the faster attending to the elemental parts of positive faces: global representation of positive faces processes fluently and facilitates fast access to the component parts.

The results also showed slower reaction time in happy mood than sad mood. It is less likely that these results were due to the effect of the tempo of the music, since the meta-analysis on 16 studies showed that the fast tempo of the music had no overall effect on cognitive performance (Kampfe et al., 2010). Thompson and associates showed that fast paced music interferes with cognitive performance when it is presented at loud volume (72.5 dB); while, the music was presented in medium volume in this experiment (around 65 dB)[9] - as if a radio had been playing in the background. Day, Lin, Huang, & Chuang (2009) also showed that fast music tempo had no effect on the reaction time, although it promotes accurate responses. I suggest that slower

[9] The loudness of the music presented in the context of this task was not measured, however according to the "Comparative Examples of Noise Levels", the loudness of 72.5 dB is comparable with the noise of a freeway at 50ft from pavement edge in 10.pm or a vacuum cleaner noise, this level of loudness is assumed to be annoyingly loud for some people. The loudness of 65 dB is comparable with conversation in a restaurant or an office (Industrial Noise Control, 2010). The background music in Experiment 5 was roughly played as loud as normal daily conversations. Thus, I assumed that this level of loudness was medium volume. The information regarding noise levels can be retrieved from: http://www.industrialnoisecontrol.com/comparative-noise-examples.htm

reaction time to local details of faces most probably is not the effect of music tempo, but resulted in longer exposure time of happy mood. These results suggest that observers, who were experiencing happy mood for a longer time, were more likely to remain attended to the overall level of the visual stimuli. It seems that enduring happy mood had a stronger effect on the observers' performance than the task demand, since attending to the local level of the faces was delayed in prolonged happy mood. In the same line with level of focus paradigm assumptions, attending to the global level of the compound form is more probable when happy mood is in the context of the cognitive task. The results of this experiment proposed that visual processing can be affected by mood valence as well as the mood experiencing duration; but, they might guide attention in different ways.

To better understand the effect of mood valence, mood intensity and mood persistency, the results of Experiment 3, 4, and 5 were compared together in the next chapter.

Chapter 7

The Effect of Induced Mood on Processing Subsequent and Concurrent Emotional Materials (Summary of Experiments 4, 5, and 6)

In three separate experiments, the effect of observers' mood on processing local elements of face stimuli was studied. Stimuli consisted of arcs, lines and a triangle organized in a way to convey happy and sad facial expressions. Participants were asked to detect and count specific features in displays of schematic faces. Counting the elemental parts of a hierarchical stimulus required attending to the local level of the stimulus and overcoming the global level interference. Participants' mood was manipulated to happy and sad with different intensity (strength) and persistency (duration of experiencing mood). In this chapter isolated results were studied together.

Results

Mood manipulation procedures

Music mood manipulation strategy was used as a core procedure to induce happy and sad mood in participants. In Experiment 3 only music was used before the task to manipulate mood. In order to strengthen the induced mood, the autobiographical memory recall technique was added to the music, in Experiment 4. In Experiment 5, music was used in the context of the cognitive task to increase the mood experiencing duration. Participants rated their current mood before and after mood induction based on a 1 to 7 self rate scale which 1 showed very sad and 7 showed very happy mood. Participants' mood scores before mood manipulation showed overall tendency to happy mood (see Chapters 4, 5, and 6)

Analysis showed that each of the mood induction procedures was successful in changing the participants' mood in the predicted direction and inducing happy or sad mood (see Chapter 4, 5, and 6).

Reaction time analysis

Reaction time to attend to the local level of happy and sad faces in happy and sad moods was analyzed using SPSS (19) using an ANOVA in a 2 (Display [happy, sad]) x 2 (Mood [sad, happy]) x 3 (Strategy [low intensity, intensified, persistent]) factorial design. In this analysis the mood and the strategy were between-subject variables and the display type was the within-subject variable with two levels (i.e., happy face and sad face).

The results showed a main effect of the display, $F(1, 48) = 18.46$, $p < .001$, $\eta^2 = .28$. The results indicated that reaction time to happy face displays (M = 2422 ms, SD = 441.80) was significantly faster compared with sad face displays (M = 2499ms, SD = 487.06).

The main effect of mood was not significant, $F(1, 48) = .00$, $p = 1.00$. The main effect of strategy was not significant, $F(1, 48) = 1.61$, $p = .21$. The interaction between display and mood, $F(1, 48) = .32$, $p = .57$ was not significant. The interaction between display and strategy was not significant $F(2, 48) = .08$, $p = .92$. The interaction between display, mood and strategy was also not significant, $F(2, 48) = 2.17$, $p = .13$. The only significant difference was an interaction between mood and strategy, $F(2, 48) = 7.13$, $p = .002$, $\eta^2 = .23$.

The Post hoc comparison using LSD showed that reaction time in happy mood difference between low intensity and intensified happy mood was not significant (p =

.83). Reaction time in persistent happy mood was significantly slower than reaction time in low intensity (p = .02) and intensified (p = .01) happy mood (see Figure 24).

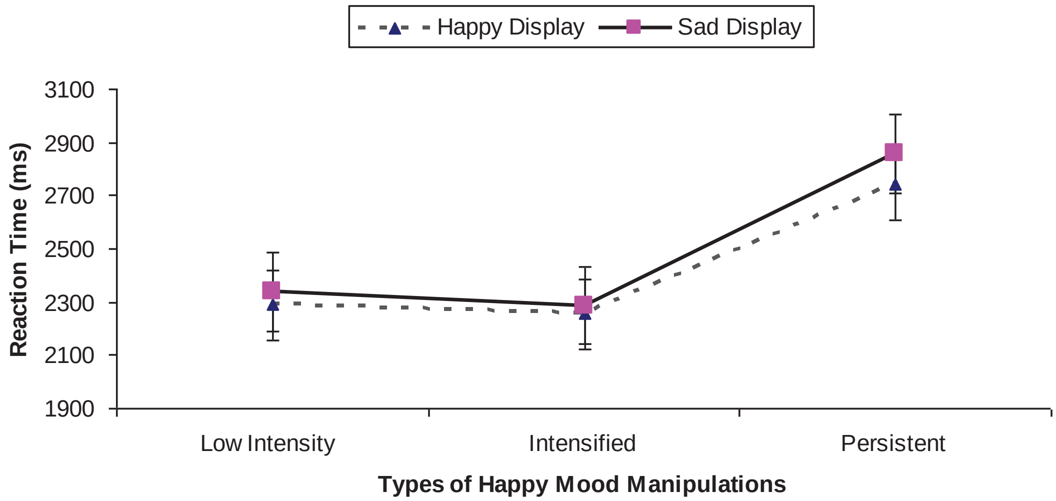


Figure 24. Reaction time values (ms) representing speed of detecting and counting a target shape in happy and sad face displays in low intensity (Experiment 3), intensified (Experiment 4) and persistent (Experiment 5) happy mood. Counting the elemental parts of the happy face displays was faster than sad face displays. No difference between RTs of low intensity and intensified happy mood was found. RT in persistent happy mood was slower than the intensified or low intensity happy mood. Error bars represent ±1 standard error.

In sad mood, reaction time in low intensity was significantly slower than intensified (p = .04) and persistent situations (p = .01). However, the reaction time difference between intensified and persistent sad mood was not significant (p = .50) (see Figure 25).

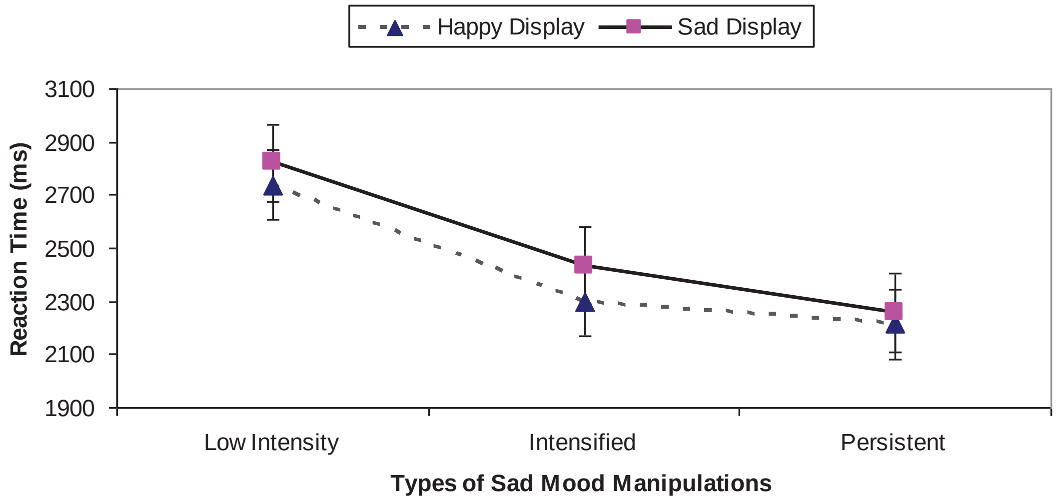


Figure 25. Reaction time values (ms) representing speed of detecting and counting a target shape in happy and sad face displays in low intensity (Experiment 3), intensified (Experiment 4) and persistent (Experiment 5) sad mood. Counting the elemental parts of the happy face displays was faster than sad face displays. RT in low intensity sad mood was slower than intensified and persistent sad mood. No difference between RTs of intensified and persistent sad mood was found. Error bars represent ±1 standard error.

Response accuracy analysis

To compare the effect of observers' mood on correct response in happy and sad facial displays, a 2 x 2 x 3 ANOVA was used (Display [happy, sad] x Mood [sad, happy] x Strategy [single, combined, background]). Data analysis showed a marginally significant main effect of the display, $F(1, 48) = 3.68$, $p = .06$, $\eta^2 = .07$. Data showed that the number of correct responses was higher to the happy face displays (M = 90.5%, SD = 6.16) than the sad face displays (M = 89.4%, SD = 6.07).

The main effects of mood, $F(1, 48) = .74$, $p = .39$ and strategy $F(2, 48) = 1.58$, $p = .22$ were not significant (see Figures 26 and 27).

None of the interactions was significant (interaction between mood and strategy: $F(2, 48) = .21$, $p = .81$; interaction between displays and mood: $F(1, 48) = .08$, $p = .78$;

interaction between display and strategy: $F(2, 48) = .20$, $p = .82$; interaction between display, mood, and strategy: $F(2, 48) = 2.14$, $p = .13$).

The pattern of reaction time and the accuracy of the responses showed that reaction time to the happy face displays was faster and more accurate.

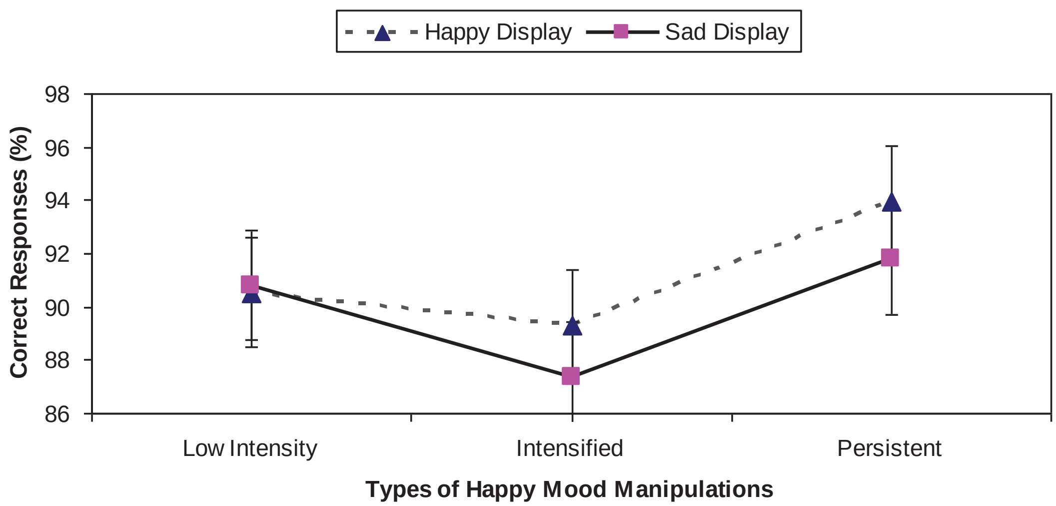


Figure 26. Correct response scores (%) representing correct detecting and counting a target shape in happy and sad face displays in low intensity (Experiment 3), intensified (Experiment 4) and persistent (Experiment 5) happy mood. More correct responses were given in counting the elemental parts of the happy face displays than sad face displays. No correct response differences were found in low intensity, intensified or persistent happy mood. No interaction was found. Error bars represent ±1 standard error.

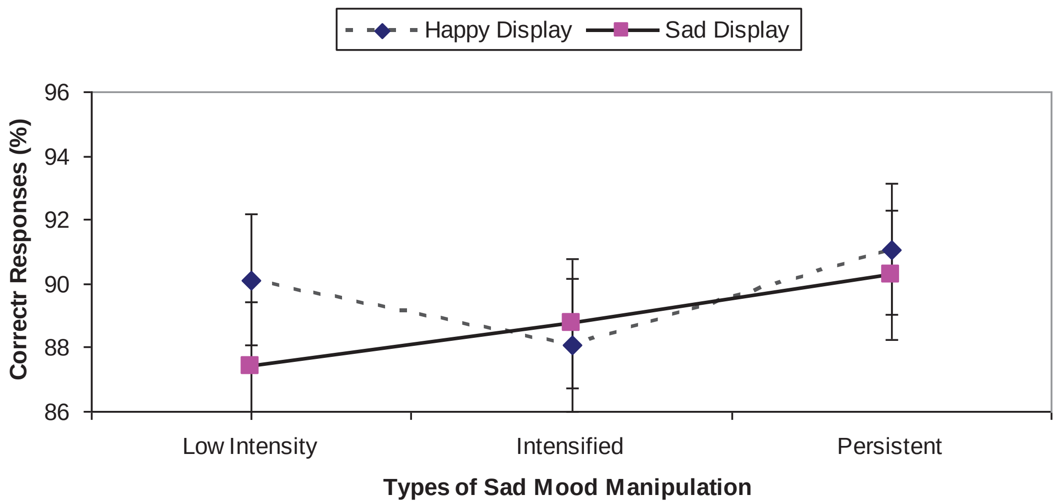


Figure 27. Correct response scores (%) representing correct detecting and counting a target shape in happy and sad face displays in low intensity (Experiment 3), intensified (Experiment 4) and persistent (Experiment 5) sad mood. More correct responses were given in counting the elemental parts of the happy face displays than sad face displays. No correct response differences were found in low intensity, intensified or persistent sad mood. No interaction was found. Error bars represent ±1 standard error.

Discussion

In this chapter, data from three different mood induction procedures were analyzed together to explore whether different mood characteristics (induced by different mood manipulation strategies) affect processing of the local level of emotional stimuli differently.

The task required allocation of attentional resources to the local detail. The results showed that emotional valence of the faces (conveyed by global level) influences the global interference effect even if it was irrelevant to the task demand. The results of Experiments 3, 4, and 5 showed that, attending to the local level of sad faces took place slower and with more error responses than happy faces. This means that sad facial expression interfered with fast and efficient attending to the local features of faces; while, attentional resources disengaged from global level of the happy faces and switched to their local level more efficiently. Therefore, the global structure of a face captures and holds attention more effectively when it conveyed sad expression than happy expression and this happens even when the task is irrelevant to the facial expressions. These findings support the idea that the global interference effect is not a fixed phenomenon and can be affected differently by the emotional meaning of the overall shape. This finding was consistent with Eastwood et al.'s (2003) results, which showed counting the elemental parts of the sad faces took more time than happy faces. The advantage of the negative faces in capturing attention was already observed in other studies (Eastwood et al., 2001; 2003; Fox et al., 2000; Hansen and Hansen, 1988; Ohman, Lundqvist et al., 2001). Eastwood et al. (2003) and Fox et al. (2000) showed that negative facial expression is able to capture attention to its location even if it was not intended. This fits with the evolutionary proposal that negative facial expressions could be a potential threatening signal about an unpleasant event in the environment; thus, engaging attention to the negative contents is advantageous (Ohman, Flykt, & Esteves, 2001). Moreover, it seems that more time is needed for the attentional resources to be disengaged from a negative stimulus and switched to something else (Fox et al., 2000).

However, another interpretation is plausible: faster reaction time to the happy face displays might result in efficient processing of positive meaning conveyed by global level of happy faces. This facilitates disengagement of attention from the overall face gestalt and allocation of attention to the elemental parts.

The analysis showed that reaction time was also influenced by intensity and persistency of happy mood or sad mood[10]. Since the combined strategy was not successful in inducing happy mood with higher intensity (Chapter 5), the results of this study were not able to compare low intensity and intensified happy mood. In this

[10] It is important to note, I was aware that happy or sad face displays could play the role of emotional primes and induce happy or sad mood. However, by presenting equal number of trials for each face expression and also random presentation of the trials, I tried to balance their effect on the participants' performance.

research, single and combined strategies induced happy mood with similar strength; so, the participants' reaction time did not show any difference. Previous studies found that inducing happy mood in the laboratory is difficult (Nguyen & Scharff, 2003; Miller, 2009).

The results showed that when happy mood was experienced for longer time (concurrent with doing the task) the reaction time was slower than when happy mood was experienced temporarily (before doing the task). This suggested that persistent happy mood influenced the searching and counting performance.

However, one might question whether the slower reaction time is related to the higher arousal level caused by the fast tempo of happy music. To the best of my knowledge, previous research did not provide any evidence about the ability of fast tempo music to interfere with cognitive performance in adults[11]. For example, Thompson et al. (2009) did not find any effect of fast music tempo on reaction time. In addition to that, the results cannot be the effect of different arousal level induced by music tempo, since Krumhansl (1997) showed that longer involvement with music, regardless of the music emotion, decreases the physiological activation. Thus, the observed difference in reaction time between persistent happy and sad mood in Experiment 5 is less likely to be the effect of different arousal level or different music tempo.

The reaction time comparison in sad mood showed that participants were significantly faster in intensified and enduring sad mood than low intensity sad mood. Namely, when the sad mood is experienced with higher strength and for longer duration, attending to the local details was facilitated. This finding suggested sad mood

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[11] A cognitive developmental study found that, listening to happy music in the background impaired local processing task (detecting an embedded target shape) in 10 to 11 year-old children (Schnall, Jaswel, & Rowe, 2008, Experiment 1). The researchers have clarified that the impairment in detail processing is the effect of happy mood and not the consequence of background music. The results of similar studies were not presented in this study, because of possible cognitive differences between adult and child participants.

is not necessary related to the slower reaction time (e.g., Isaac et al., 2012). But, as Gasper (2004) proposed, stronger sad mood makes the local details more salient.

The reaction time difference for sad mood in intensified condition and persistent condition was not significant. This proposed that longer time exposure with sad mood affects the local processing in the same way as intensified sad mood. However, another explanation is probable: in both intensified and persistent conditions, the combined strategy was used before doing the task. This suggests that persistent sad mood is not a contributing factor in affecting local processing and that the observed effect was caused by the intensified sad mood. In sum, the results showed that when happy or sad mood is experienced with higher strength and for longer duration, processing of local details is similar, which was predicted by the level of focus paradigm; while in weak and short-lived happy and sad mood, level of focus assumptions were not observed.

Chapter 8

The Effect of Observer's Mood on Level of Processing of Hierarchical Meaningless Shapes

Experiment 6

In three separate experiments, the effect of the observer's mood on the processing of the facial features was studied. However, it was necessary to study that this result was due to the facial expression and not because of perceptual characteristics of the features. For that purpose, Experiment 6 was designed to investigate the effect of the observer's mood on fast processing of scrambled faces' parts. Previous research showed that the spatial relationship between the parts will be broken in the scrambled version of faces (e.g., Pichler, Oruc, & Barton, 2010). As a consequence, the scrambled version of a face is not able to carry any meaning or convey any emotion.

In this experiment, participants were requested to attend to the local level of the meaningless forms (scrambled faces) when they were induced happy or sad mood. Based on the global interference effect, it was assumed that fast and efficient attending to the local level of the compound form is impaired by prior processing of the global level. However, new research showed that interference of the global level can be attenuated in special situations; for example, meaningfulness of the stimulus affects the processing information in the global and local level (Beaucousin et al., 2011; Poirel et al., 2006; 2008). It seems that less interference is seen when the global level of the form does not convey any meaning. Poirel et al. (2006; 2008) suggested that presenting a meaningful stimulus in the global level might activate the object identification procedure which delayed attending to the local level materials. The importance of meaningfulness of the information on processing, in global and local level was also supported by neuropsychological studies as well. Beaucousin and colleagues (2011) suggested that brain activity is different when observers are doing the task on global or local levels of compound letters or meaningful objects than when they process compound meaningless stimuli (Beaucousin et al., 2011). Since the global level of scrambled faces conveys no emotion, I did not expect any differences between counting the local elements of scrambled happy face and scrambled sad face. This experiment provided another opportunity to explore if the observed differences in reaction time between happy and sad face displays were caused by their expressions.

In the current experiment, the effect of observers' affective states on local processing of meaningless forms was also considered. Experiment 6 provided an opportunity to examine the validity of the flexibility paradigm and level of focus paradigm in processing the elemental parts of meaningless forms. The flexibility paradigm suggested that happy mood facilitates the flexibility of attentional mechanism to follow the task requirements and shift from prominent global level to local details (Baumann & Kuhl, 2005). In a different explanation, the level of focus paradigm proposed in happy mood attention is focused on global level of stimuli, but in sad mood attending on detailed local level is more facilitated. This means that based on the affect as information paradigm attending to the local level takes place faster in sad mood (Gasper, 2004; Gasper & Clore, 2002). To the best of my knowledge, none of the experiments before, study the effect of observer's mood on processing of compound meaningless forms.

In order to create the meaningless forms with the same characteristics of the face stimuli, I shuffled the facial features of the schematic faces. Shuffling made the global level meaningless, while the local level contained the same geometric forms (see Figure 7).

Method

This experiment's main characteristics were the same as explained previously in the Experiment 1, with the following differences.

Participants

Twenty participants (9 female, 11 male), ranging in age from 18 to 40 years, fluent in English, with normal and corrected-to-normal vision, volunteered to participate in the experiment in exchange for NZ$ 15.

Apparatus and stimuli

The apparatus and stimulus were explained in the Experiment 1. It is important to note that in the current experiment, the meaningless stimuli were used.

Procedure

The procedure was the same as per Experiment 4 explained in chapter 5, except that the face stimuli were replaced with the scrambled stimuli. See Figure 28 for an overview of the experiment.

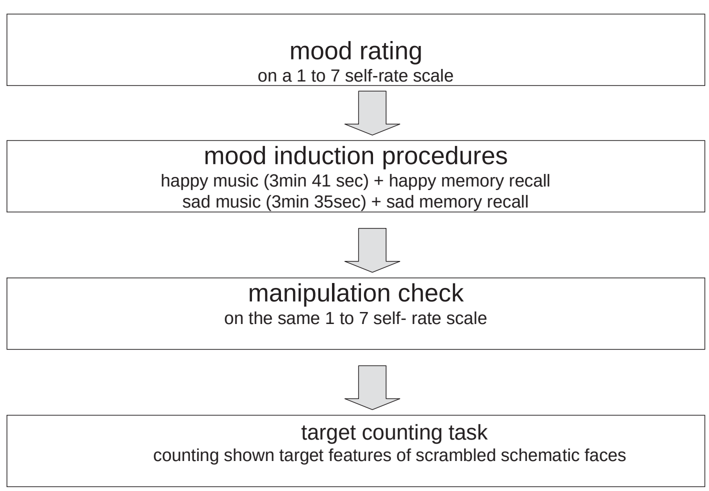

Figure 28. The experimental procedure for Experiment 6.

Result

Data from one participant were removed due to high error rates (67.9%). If the incorrect responses were more than 50%, the participant's data was considered as having a high error rate. Data from one participant were removed due to unsuccessful mood manipulation. The final number of participants in each of the happy and sad mood groups was nine persons.

Mood manipulation check

Participants rated their mood two times, before and after mood manipulation. The first rating provided a pre test baseline. Increases in mood score after happy mood manipulation (happy music + happy memory recall) and decreases in mood scores after sad mood manipulation (sad music + sad memory recall) were expected. The mood manipulation was considered as unsuccessful if a participant's mood scores after mood induction went in the opposite direction.

Participants' mood before mood induction had a tendency toward a positive mood (M = 5.00, SD = .84). To confirm that mood induction strategies influenced participants' affective states as intended, scores of before and after mood manipulation was analyzed for each group using paired sample t-tests. Data revealed that there was a significant difference between mood scores before (M = 4.55, SD = .73) and after (M = 5.11, SD = .60) listening to happy music and recalling happy memory $t(8) = 3.16$, p = .01 (two tailed p-values were assumed); and also difference between scores before (M = 5.44, SD = .73) and after (M = 3.89, SD = 1.36) listening to sad music and recalling sad memory was significant, $t(8) = 5.29$, p = .001 (two tailed p-values were assumed). Data analysis showed following the mood induction, participants' mood changed significantly in both groups.

Reaction time analysis

Trials with incorrect responses were excluded from further analysis. In total 7.52% of the trials were eliminated. Mean reaction times greater than 2 standard deviations were removed for each of the scrambled happy and scrambled sad displays to control outliers (the reason discussed in chapter 3). The mean reaction times of the remaining data were analyzed using SPSS (19), using an ANOVA to compare the effect of observer's mood on reaction time in scrambled happy and sad faces. A 2 (Mood [sad x happy]) x 2 (Display [scrambled happy, scrambled sad]) factorial design was used. In this analysis, the mood was a between-subject variable and the display type was a within-subject variable with two levels (scrambled happy face and scrambled sad face).

Analysis of reaction time data on different displays showed that the main effect of displays was not significant, $F(1, 16) = .46$, $p = .51$. Thus, there was no reaction time difference between local processing of scrambled happy (M = 2366 ms, SD = 505.15) and scrambled sad faces (M = 2352 ms, SD = 509.76).

Data revealed that the main effect of mood was not significant $F(1, 16) = .04$, $p = .85$. No significant interaction between display types and mood was detected $F(1, 16) = 1.39$, $p = .26$ (see Figure 29).

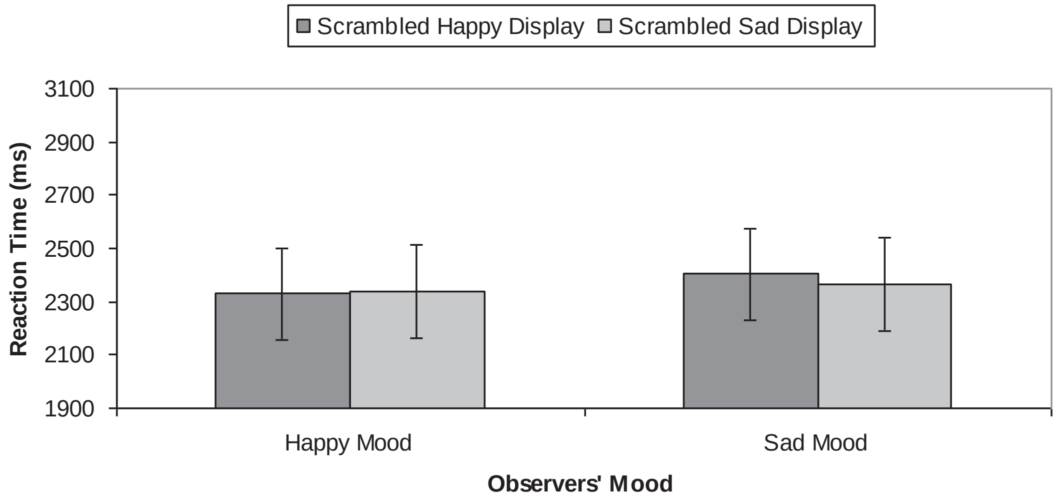

Figure 29. Reaction time values (ms) representing speed of detecting and counting a target shape in scrambled happy and sad face displays in happy or sad mood (Experiment 6). No difference was found in RTs of two different displays. No difference was found in RTs in happy and sad mood. No interaction between type of display and mood was observed. Error bars represent ±1 standard error.

Response accuracy analysis

To compare the effect of observer's mood on correct responses in scramble happy and sad faces an ANOVA was conducted. Results showed that there was no significant main effect of display, $F(1, 16) = .02$, $p = .90$. (Scrambled Happy Display: $M = 91.6\%$, $SD = 4.30$; Scrambled Sad Display: $M = 91.4\%$, $SD = 6.10$).

The main effect of mood on correct responses was not significant, $F(1, 16) = .62$, $p = .44$). No significant interaction between observers' mood and different displays was found $F(1, 16) = 1.04$, $p = .32$ (see Figure 30).

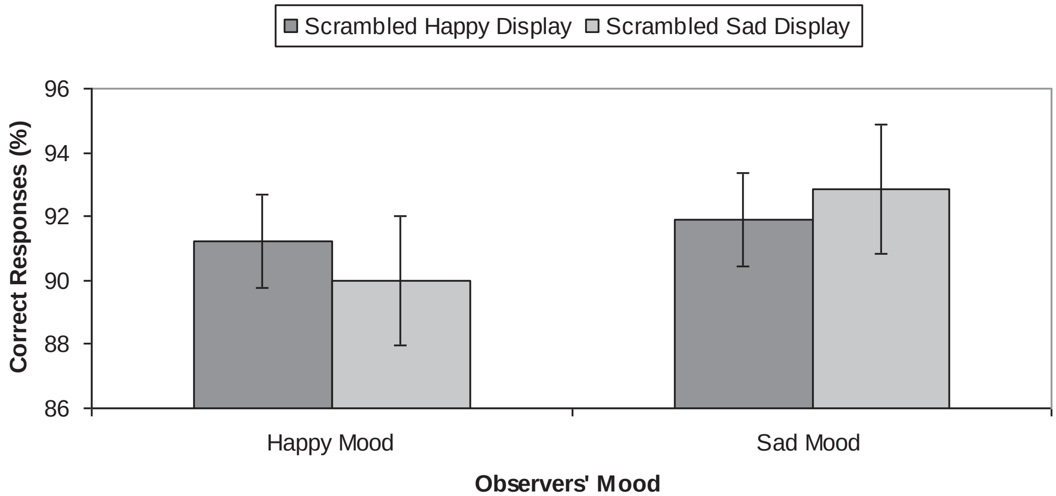

Figure 30. Correct response values (%) representing correct detecting and counting a target shape in scrambled happy and sad face displays in happy or sad mood (Experiment 6). No difference was found in correct responses of two different displays. No difference was found in correct responses in happy and sad mood. No interaction between type of display and mood was observed. Error bars represent ±1 standard error.

According to the patterns of reaction time and accuracy of the responses, no speed accuracy trade-off was suggested.

Discussion

The aim of the experiment 6 was to investigate the effect of the observers' mood on processing of the scrambled faces. This experiment explored whether happy or sad mood influence local processing in meaningless stimuli.

In Experiment 6, after mood manipulation, participants were asked to attend to the local level of the scrambled faces (meaningless forms) and count particular component parts. It was assumed that fast and efficient attending to the local level of the shapes required overcoming the interference of the global level. The results did not show any difference between processing speed of scrambled happy and scrambled sad faces. Scrambled faces were composed of the same elemental parts as the faces in

Experiments 3 to 5, but they did not convey any meaning. The results revealed that the global interference effect was related to the meaning of the stimuli in the global level. This control experiment supported that the significant difference between happy and sad faces in Experiments 4 most probably resulted from the emotional meaning of the observed materials.

Data did not show any effect of happy and sad moods on the local processing speed. This means that, time needed to attend to local details was similar in both affective states. In general, the findings did not support the flexibility paradigm (Baumann & Kuhl, 2005) or the level of focus paradigm (Gasper & Clore, 2002). The lack of difference between happy and sad mood to guide attention in meaningless shapes proposed that the impact of the observer's affective status shows up only if observed materials convey meaning for the observer.

Taken together, the results of this experiment suggest that, not only the structural relationship between parts and whole in compound shapes (Kimchi, 1992) affects perception, but also the semantic relationship between the whole and its parts influences the level of processing. This means that perception is an active interaction between top-down and bottom-up processing.

In order to better compare between the effect of mood on processing meaningful and meaningless stimuli, the results of Experiments 4 and 6 were analyzed together, as the same mood induction procedure was used in both of them.

The Effect of Mood on Global Interference Effect in Meaningful and Meaningless Stimuli

In chapter 3, the effect of the stimuli's meaningfulness on global interference effect was studied. The results showed that fast access to the local elements is similar in meaningful and meaningless forms. In Experiments 4 and 6, reaction time to the emotional faces and scrambled faces was compared; while, happy and sad mood were induced in participants. This comparison provided an opportunity to study the affect of stimuli's meaningfulness on the global interference effect in the context of happy and sad moods.

Results

Reaction time analysis

The mean reaction time scores of the face and meaningless stimuli were analyzed using SPSS (19), using an ANOVA to compare the effect of stimulus nature (meaning) and observers' happy or sad mood on reaction time in happy and sad displays. A 2 (Stimulus nature [meaningful, meaningless]) x 2 (Display [happy, sad]) x 2 (Mood [happy, sad]) factorial design was used. In this analysis the Stimulus nature and the mood were between-subject variables and the display type was the within-subject variable with two levels (i.e., happy and sad).

Analysis of reaction time data for different displays showed that the main effect of display was marginally significant, $F(1, 32) = 3.88$, $p = .06$, $\eta^2 = .11$. The interaction between displays and stimuli nature was significant, $F(1, 32) = 7.75$, $p = .01$, $\eta^2 = .2$. Analysis showed that the difference between displays were significant only when the display contained face stimuli ($p = .002$). In such that the reaction time to the happy face displays (M = 2278 ms, SD = 322.47) was faster than reaction time to the sad face displays (M = 2361 ms, SD = 304.99). However, when the display contained scrambled faces the reaction time difference was not significant ($p = .57$). The interaction of display, stimulus type and mood was significant ($p = .04$, $\eta^2 = .13$). Data showed reaction time to different displays was significant only when the stimulus type was face and the observer was in sad mood. That is, in sad mood attending to the local details of the sad faces (M = 2435ms, SD = 385.69) were significantly slower than attending to the local level of happy faces (M = 23ms, SD = 409.83). Data showed that the main effect of mood $F(1, 32) = .26$, $p = .62$, and the main effect of stimulus nature $F(1, 32) = .08$, $p = .78$ were not significant. The interaction between mood and stimulus nature was not significant, $F(1, 32) = .03$, $p = .87$. The interaction between display and mood was not significant too, $F(1, 32) = .61$, $p = .44$ (see Figure 31).

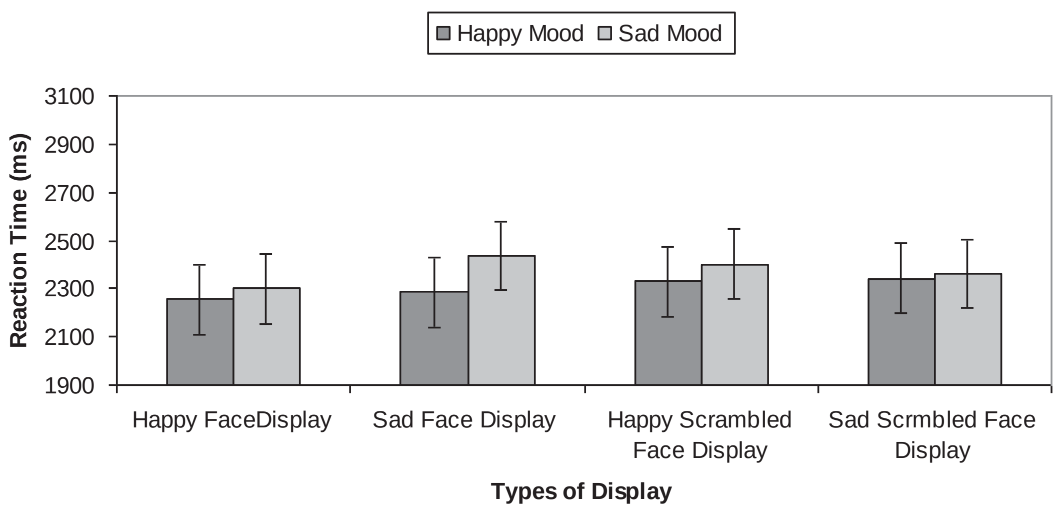

Figure 31. Reaction time values (ms) representing speed of detecting and counting a target shape in happy and sad face displays and their scrambled versions in happy or sad mood (Experiments 4 & 6). RT of happy and sad face displays was different when the observer was induced sad mood. No other effect or interaction was found. Error bars represent ±1 standard error.

Response accuracy analysis

To compare the effect of stimulus nature (meaningful or meaningless) and observer's mood (happy or sad) on correct responses in two displays an ANOVA was conducted. The results showed that the main effect of the display was not significant $F(1, 32) = .23$, $p = .64$. The main effect of mood was not significant $F(1, 32) = .37$, $p =$

.55. The main effect of stimulus nature was significant, $F(1, 32) = 4.25$, $p = .05$. That is, there were more correct responses to the scrambled face (meaningless) displays (M = 91.5%, SD = 5.20) than the correct responses to the face (meaningful) displays (M = 88.4%, SD = 4.76). The interaction between display and mood was not significant, $F(1, 32) = 2.29$, $p = .14$. The interaction between display and stimulus nature was not significant $F(1, 32) = .09$, $p = .76$. The interaction between mood and stimulus nature was not significant too, $F(1, 32) = .32$, $p = .58$. The interaction between display, mood and stimulus nature was not significant, $F(1, 32) = .02$, $p = .90$ (see Figure 32).

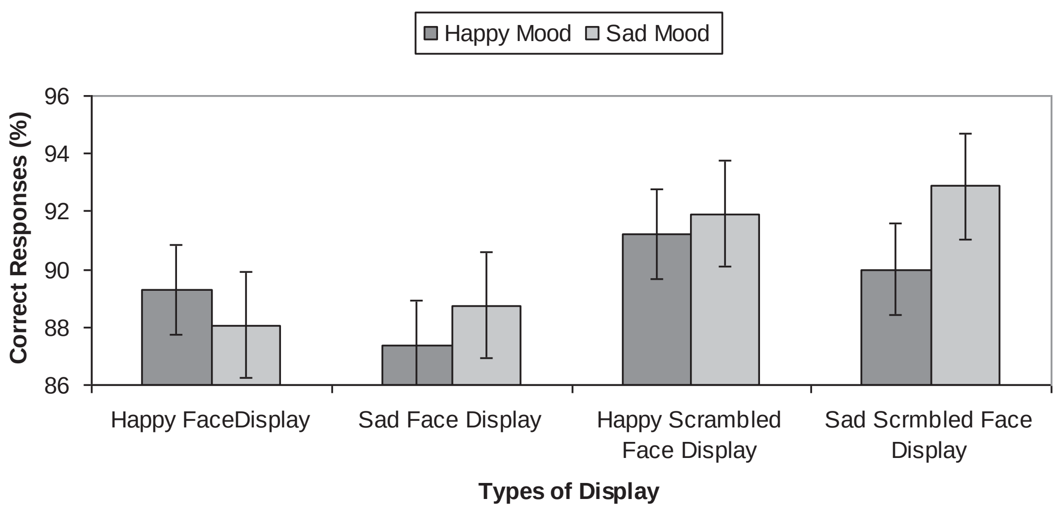

Figure 32. Correct response values (%) representing correct detecting and counting a target shape in happy and sad face displays and their scrambled versions in happy or sad mood (Experiments 4 & 6). Correct responses to scrambled displays were higher than face displays. No other effect or interaction was found. Error bars represent ±1 standard error.

Discussion

In two experiments, attending to the local details of faces and scrambled faces was studied when observers were induced into happy or sad mood. The results showed that attending to the local level of sad faces took more time than happy faces. No reaction time difference was found in scrambled happy faces compared to scrambled sad faces. This suggested that the observed difference between local processing of happy and sad faces was most likely caused by their different facial expressions. This finding, in line with Eastwood et al. (2003) suggested that sad facial expressions capture attention more effectively and block fast access to the local details compared to the happy facial expression. While, fast access to the facial features may be facilitated by efficient processing of the happy facial expression.

Comparison of the results of Experiment 4 and 6 showed that affective states of observers influence local processing only if the stimuli were meaningful.

These results provided an extra opportunity to study the meanings of the observed materials on level of processing. For example, the results showed that the error was higher when participants attended to the local level of faces than to their scrambled versions. It is possible that the meaning of the faces interfered with the participants counting performance.

The results proposed that, when the global level of the compound stimuli is meaningful, processing of the elemental parts is affected by the information conveyed by the global level. Negative valence information seems to engage attention for longer while processing of positive valence information takes place efficiently.

Chapter 9

General Discussion

In six experiments the effect of the observers' mood on attending to the local details of emotional faces was studied and the results were verified by appropriate control studies. In this chapter, the most important findings, limitations, and implications for further studies have been summarized. It also strives to integrate consistent and plausible outcomes into a broader framework.

The main idea of this research was to investigate the effect of content (visual stimuli characteristics) and context (observer's affective states) on the global interference effect. Specifically, research outcomes directly or indirectly addressed the following issues:

(1) Studying the global interference effect and its strength in different task contexts

(2) Considering emotional facial expressions and their ability to capture attention with respect to the evolutionary perspective

(3) Providing an opportunity to study meaningless visual stimuli and their ability to capture attention and lead perception in control studies

(4) Concentrating on the effect of different mood valence, intensity and duration on a visual perception task

The research consisted of six separate experiments, in which participants were requested to attend the local level of the compound stimuli and count particular parts. In four experiments (1, 3, 4, and 5) the stimuli were compound faces with happy, neutral and sad expressions and in two experiments (2 and 6) the scrambled version of the same faces were utilized as stimuli. In four experiments (3, 4, 5, and 6), happy and sad moods were induced in the participants before performing the visual search task, while, in the first two experiments, no mood induction was used before doing the counting task. The reaction times were used to measure efficient processing of the stimuli's local level; in addition, the accuracy of the responses was also considered in order to detect possible speed accuracy trade-offs. The summary of the findings is presented in Table 1.

Table 1

The overview of the six experiments results

Experiment	Stimulus	Effect of Display	Effect of Mood	Display x Mood
1 (Control)	Face	No significant effect	N/A	N/A
2 (Control)	Scrambled Face	No significant effect	N/A	N/A
3 (Low Intensity)	Face	Marginally significant slower reaction time to sad face displays	Significant slower reaction time in sad mood	No interaction between types of display and mood valence
4 (Intensified)	Face	Significant slower reaction time to sad face displays	No significant difference	Significant slower reaction time to sad face displays in sad mood
5 (Persistent)	Face	Significant slower reaction time to sad face displays	Significant slower reaction time in happy mood	No interaction between types of display and mood valence
6 (Control with Mood Manipulation)	Scrambled Face	No significant effect	No significant difference	No interaction between types of display and mood valence

Major Findings of the Thesis

The Effect of the Different Emotional Expressions on the Global Interference Effect

The global interference effect suggested that direct processing of the local elements is not possible without prior processing of the global level of the structure (Navon, 1977). Therefore, if direct access to the local elements is targeted, the global level of information interferes with the early processing of the details. Thus, global level of the form delays fast and direct access to the local details. One aim of this research was to see if information conveyed by the global level of the form has any influence on attenuating or increasing the global interference effect. To examine this idea, faces with happy, neutral and sad expressions were presented, while direct attendance to the local features was requested. Facial emotions were conveyed by the global (overall) level of the face and it was assumed that different facial emotions have different ecological importance for human cognitive mechanisms (e.g., Ohman & Mineka, 2001). In current research, it was hypothesized that the reaction time to attend to the local details of the neutral, happy and sad faces would be different, since their global levels convey different meanings. Findings showed that participants were significantly faster in detecting and counting the local elements of the neutral faces than the happy or sad faces. This proposed that access to the local level of neutral faces was more efficient due to less interference of the neutral expression; while, slower reaction time in happy and sad faces indicates that the emotional information conveyed by the global structure of faces interfered with fast access to their local element. Previous research also showed that emotional faces were more efficient than neutral faces in capturing visual attention (Vuilleumier & Schwartz, 2001; White, 1995). Moreover, the capability of happy and sad faces to capture attention happens even when they are irrelevant to the ongoing task (for a review see Frischen et al., 2008).

However, the results showed a significant difference between neutral and emotional faces, but it was not clear if the observed difference was caused by the different expressions or the perceptual characteristics of the local features. To test this, a scrambled version of the same faces was used in control experiments. Scrambled faces consisted of the same elemental parts while the global level of the forms did not convey any meaning. The results revealed a significant difference between scrambled neutral faces and scrambled emotional faces. This finding suggested that the difference between the reaction times of the neutral faces and emotional faces was not caused by their different expressions, because a similar difference was observed when the scrambled versions of these faces were presented to the observers. Based on the visual search rationale, physical characteristics of the stimuli are able to affect the search efficiency. This means that if a target stimulus has unique visual characteristics, it is more salient to detect among distracters. Therefore, search takes less time (Chun & Wolfe, 2001). This may be account for faster reaction time to detect and count the target features of the neutral faces over and above the emotional faces in this research. The schematic faces in this research consisted of curves and lines. Since the upward and downward curves share a more similar appearance, the straight line is more salient among them. This means that, detecting and grouping straight lines among curves (upward or downward) is more efficient than detecting and grouping upward curves among downward curves and vice versa. An overview of the potential face displays showed that each of them contained four faces consisting of twelve lines or curves plus four triangles. In neutral displays, mouth shape was a straight line (four repetitions of the line) and at least one of the schematic faces contained two lines as the eyes. Therefore, calculations showed the highest possible percentage of presenting lines in potential happy or sad displays was 33.33%. For the neutral displays the lowest possible percentage of lines was 50%. When a display of neutral faces was presented, regardless of the target shape, participants were able to group half of the features (lines) quickly. However, in happy or sad face displays, only one third of the features (lines) could be detected and grouped fast. In summation, the faster reaction time to the local processing of the neutral face was not related to the neutral expression, it was simply caused by the perceptual properties of the stimuli. As a result, the neutral face reaction times were eliminated from further analysis.

Another part of the results revealed that happy and sad facial expressions biased attention differently, even when irrelevant to the ongoing task. This articulates that allocation of attention to the local level of stimuli is influenced by the emotional meaning conveyed by the global level. Namely, the interference of the global level with the processing of the local level is not similar in all of the compound forms because the emotional meaning of the overall stimuli manipulates the interference effect. The significant difference between happy and sad faces was not seen in the control experiments in which the scrambled versions of the faces were used. This means that, the reaction time differences were more likely caused by different facial expressions.

The stronger potential of the negative expression to attract visual attention has been observed in previous research (Eastwood et al., 2001; 2003; Fox et al., 2000; Hansen & Hansen, 1988; Ohman, Lundqvist et al., 2001). For example, Eastwood and colleagues (2001) showed that negative schematic faces draw focus of attention to themselves better than positive facial expressions when the distracters were neutral schematic faces (Eastwood et al., 2001). Even if emotional expressions of the faces were irrelevant to the task demand, it seemed that negative expressions are more efficient in capturing attention and interfering in the task (Eastwood et al., 2003). Similar to current research task design, counting the elemental features of the happy or sad faces was also requested in the Eastwood and associates' (2003) research study.

Effective processing of stimuli conveying negative information (e.g., negative facial expression), has evolutionary benefits according to a considerable body of literature (Ohman, Lundqvist et al., 2001). Negative facial expression potentially signals "aversive consequences" and an unpleasant environment; so it is able to grab and direct attention more efficiently (Ohman, lundqvist et al., 2001, p.381). However, another alternative explanation can be given to interpret the faster attending to the elemental parts of positive faces: global representation of positive faces processes fluently and facilitates fast access to the component parts. For example, Fox et al. (2000) found that when visual displays are uniform, searching a happy face display takes place faster than a sad face display.

With regard to current findings, in general, we suggested that different emotions conveyed by a global representation of faces guide attention differently and interfere with attentional switch to the facial features. This attentional bias happens even if the global level of the face is not directly related to the task.

Taken together the results of this study showed that the global interference effect is not a fixed phenomenon and can be influenced by the emotional meaning of the shape.

Global Interference Effect in Meaningless Forms

In two control experiments the scrambled versions of the faces were used. By scrambling the face features, the overall form became meaningless, while, the local levels were familiar geometric forms. The control studies alongside the main experiments (face stimuli) provided an opportunity to explore how meaningless structures attenuate or increase the interference of the global level with the local details processing. One of the control experiments included a mood manipulation prior to the counting task (Experiment 6); while in the other experiment, the counting task was operated without mood manipulation (Experiment 2).

The results did not support any reaction time difference between meaningful and meaningless stimuli. Namely, when the local level of the shapes consisted of the same geometric forms, the meaningfulness or meaninglessness of the global level of them did not affect the speed of local level processing. This result was not consistent with previous findings suggesting that meaning of the observed stimulus in either level was able to affect the speed of processing. For example, Boucart and Humphreys (1992) showed that meaningfulness affects speed of matching shapes. They used a matching task in which only one of two alternative shapes could be a global match for the reference target. Boucart and Humphreys (1992) showed when the target and the match had similar global structure as well as semantic connection, the reaction time was fast, whilst the semantic connection between another alternative and the reference target interfered with the speed of detecting the match and the target based on their structural similarities.

In another study, Poirel et al. (2008) asked participants to detect a target on the global or local levels of meaningful and meaningless shapes. They recorded and compared participants' reaction time to attend on global or local level of meaningful and meaningless shapes. Poirel et al. (2008) proposed that meaningful, familiar and recognizable stimulus in any level of a compound shape can affect processing of the other level. They explained that meaningful shape presented in either level activates an inevitable object identification processing along side with visual processing (Poirel et al., 2006).

One potential reason for the difference between the results of this research and previous studies could be because this research was not originally designed to examine the effect of nature of stimuli on global precedence effect; so it is possible that the design of this study was not sensitive enough to detect the deference between meaningful and meaningless forms. For example, Boucart and Humphreys' (1992) matching task was designed to detect how the meaning of shapes affects the perception of their overall similarity, however the task was not directly addressed to the global interference effect. In Poirel et al.'s (2006; 2008) experiments, processing of the global and local level of meaningful and meaningless shapes were considered and therefore the comparison between processing of both levels in meaningful and meaningless shapes was possible. However, in this current research, studying the global interference effect was the aim and participants were only requested to attend to the local level of the forms. Therefore, no information about participants' performance on the global level of the faces was provided. It seems if a task situation were to include processing of both levels of the form, it would have had better potential to track the effect of the meaningfulness on the level of processing.

The results of the response accuracy revealed more accurate responses to the meaningless displays. This difference was only observed when the mood manipulation was applied before doing the task. It is possible that the global level of meaningful shapes interfered with the quality of the task performance.

The Effect of the Observers' Mood on Global Interference Effect

The main intention of this research was to study the effect of observers' affective states on processing of the emotional visual stimuli. In this research, participants' affective states were manipulated in terms of valence, intensity and persistency to investigate the effect of different mood properties on visual processing. In three experiments (3, 4, and 5), happy and sad mood were induced in different groups of participants. Through a single mood manipulation strategy, happy and sad mood with low intensity were induced (Experiment 3). A combination of two mood manipulation strategies was used in Experiment 4 in order to induce intensified happy and sad mood. In Experiment 5, the mood manipulation strategy was continued throughout the task.

The results showed, when the induced mood had low intensity, happy observers were more successful in overcoming the interference from the global level of the faces and attending to the local elements. These results were supported by the flexibility paradigm which proposed that happy mood increases flexibility of the attentional resources (Baumann & Kuhl, 2005). Happy mood facilitates disengagement of attention from the global level of the form and attending to the local level, when the task demands attention to the local level of the stimulus. On the contrary, when the happy and sad moods were experienced for longer duration and concurrent with the task, the pattern of the reaction time was reversed. The results showed faster reaction time in sad mood than happy mood. This means that long time exposure with happy mood promotes adopting global level processing, while persistence of sad mood facilitates attending to the local details. This pattern seems to be consistent with level of focus hypothesis (Clore et al., 2001; Gasper & Clore, 2002; Gasper, 2004) and broaden and build hypothesis (Fredrickson, 1998), both of which suggest that happy mood expands observer's attention over the entire situation and promotes processing of the global level of the scene. Sad mood, on the contrary, narrows down the attentional scope to the details. Careful analysis of details enables the observer to deal with possible signals of threat in the environment.

The findings of this research suggest that happy and sad mood influence perceptual processes to allocate attention to the local details differently. Moreover, the difference between performance in happy and sad mood was dependent on the other attributes of the mood such as intensity or persistency.

The results of this research also revealed that particular mood valence might have a different effect on attention and perception if experienced with different intensity (strength) or persistency (duration). For example, long duration of experiencing happy mood made processing of the global level more prominent and consequently, increased the reaction time to attend to the local level. Experiencing short-lived happy mood facilitated overcoming the global precedence effect; therefore, responding to the local level was efficient. On the contrary, as the intensity and experiencing time with sad mood increased, local level processing was promoted and reaction time to the elemental parts became faster. Gasper (2004) proposed that sad mood is not necessarily related to the slower reaction time but, as the sadness level increases the local parts become more prominent.

This research was not able to induce intensified happy mood in the experimental settings, thus studying the allocation of attention and processing local details of stimuli in intensified happy mood will be worth re-visiting in future.

The results suggested that intensified sad mood created a bias to the sad emotional faces. This finding is in line with some studies that showed that attention is biased to negative materials in sad mood (Becker & Leinenger, 2011; Bradley et al., 1997). This effect was only seen when the sad mood was experienced with higher intensity. This proposes that for attentional bias to the negative materials, intensity of sad mood is an important factor.

Implications

The present research added to our knowledge of global interference effect in several ways. The findings of this research demonstrate that the global interference effect is a context dependent phenomenon, and factors like emotional valence of the global shape affects the overcoming of the interference of the global shape. Stimuli's negative valence showed stronger potential to hold attentional resources for longer and blocked fast access to the local elements[12]. This research also indicated a fluent processing for the global representation of positive faces. Moreover, the results showed that the ability of the negative face expression in capturing attention is involuntary. This means that even if the sad facial expression is irrelevant to the situation's requirements, attention will be allocated to that.

This research supports the evolutionary perspective indicating that negative facial information contains a stronger signal for organism survival. Attention is captured by a negative face and engaged with that until enough processing has been completed.

A second contribution of this research has been to show the effect of the observer's mood on the processing of schematic emotional faces. This research has shown how attentional allocation to different levels of a compound shape is affected by mood valence as well as other mood attributes. This means that happy or sad mood is not specifically associated with specific attentional allocation and processing levels; but, intensity and persistency of happy or sad mood are determinant factors in directing attention. In other words, temporary happy mood guides attention differently than temporary happier mood or persistent happy mood. The results support this notion that different paradigms and hypotheses might be valid in different task contexts.

As the final contribution, this research showed that when a task directly requires attending to the local level of a shape, interference of the global level on fast processing of the local level is not influenced by the meaningfulness or meaninglessness of the global level. However, the response accuracy analysis showed that the error rate is

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[12] The priority of the negative expression in capturing attention and interfering with fast local processing was only observed in experiments that mood was manipulated before doing the task. In the experiment without mood manipulation (Experiment 1) only a tendency of slower reaction time for negative expression was observed.

higher when the global level is meaningful (this result was only observed when mood manipulation was applied before doing the task). This suggests that the effect of meaningful or meaningless shape on processing of the local level might affect the reaction time and the response accuracy differently.

Limitations and Future Direction

Some of the limitations of this study related to the methodological design which needed to be considered or to be replicated.

The first limitation of this research related to the use of schematic faces instead of photographs of the real faces. Even though considerable research studies have suggested that schematic faces are processed in the same way as real faces (Chang, 2006; Sagiv & Bentin, 2000), there are still some doubts as to the ecological validity of schematic faces (Juth et al., 2005). Although schematic faces are easy to control in cognitive studies, it is important to note that these very simple structures and their similar features might bias the results. Therefore, replication of the research with face stimuli with more similarity to real human faces is recommended. Recently, Becker & Anderson et al. (2011) used computer-generated faces. In these faces all the elemental parts and the metric distances are calculated precisely with special software (Becker & Anderson et al., 2011). Computer programmes are capable of controlling the degree of a particular expressive emotion from the neutral expression. These versions of faces are more similar to the real human face and also allow the researcher to have control of the stimuli's characteristics.

The second limitation that I encountered in this research was designing an appropriate schematic face with a neutral expression. The neutral faces used in this research had been designed according to the previous research (e.g., Lipp et al., 2009);

while the results showed that their perception was affected by their features characteristics. Since straight lines among curves are more prominent shapes, designing schematic faces with different emotion should be revisited.

The third limitation of this study relates to the inadequacy of the available mood induction procedure in inducing happy mood with varying intensity in experimental settings. In previous research, combining two strategies was assumed in creating mood with higher intensity, while the attempt to induce intensified happy mood via combining music with memory recall was unsuccessful. Since it was found that people's current mood is not neutral and has a tendency to be happy, the happy mood induction procedure needed to be developed. It is also possible that the mood rating scale was not sensitive enough to distinguish between different strengths of happy mood. Creating and testing another mood induction procedure that has a potential to be used simultaneously with a cognitive task is recommended for future. However, in this research, music as the context had been applied with enough care and control it is still possible that background music may have an effect on cognitive performance in some unknown way.

Another limitation of this research related to the lack of appropriate information regarding the effect of neutral mood on local level processing. However one experiment (Experiment 1) was conducted without any mood manipulation, but later studies showed that participants' mood had a tendency toward positive mood. Therefore, developing mood manipulation strategies to induce neutral mood is recommended for future studies.

In this research the valence, intensity and persistency of happy and sad mood were addressed. Nevertheless, arousal is an important factor which is related to different mood valences. For example, Gable and Harmon-Jones (2010) suggested that the effect of mood on level of processing is related to motivational intensity and arousal level of happy or sad mood Therefore, future investigations should address the effect of arousal level as well as mood valences.

The experimental design in this research focused only on the processing of the elemental features of the emotional faces and processing of the global faces was not one of the aims. If the reaction time to attend to the global level of the form is studied in similar research, there will be a chance to compare attention to the local level and global level reaction times.

Conclusion

This research examined one perceptual phenomenon in different task conditions and studied the effect of contextual factors on this phenomenon. Global interference effect suggests that in processing of a compound shape, the global level of the shape interferes with fast and direct perception of the local details. The aim of this research has been to study whether global interference effect is a context dependent mechanism. To follow the aim, the effect of the emotional valence of the observed stimulus (emotional content) and observers' mood (affective observer) was studied on global interference effect. Research participants' mood was manipulated to happy and sad mood and then they were engaged in counting elemental parts of neutral and emotionally expressive faces.

The results suggested that, some emotional materials interfere with fast processing of the local elements more than other emotional materials and some emotional information is processed more efficiently than others. Sad facial expression may capture and engage attention for a longer time period, while positive facial expression may be processed fast and efficient. This means that sad facial expression blocks fast access to its features more effectively than happy faces. This is the case even when the face expression was irrelevant to the ongoing task. In line with the evolutionary perspective, the negative facial expression contains the signal of something unpleasant in the environment and has the potential to capture attention and get processed.

The results of this research also showed that affective states of an observer influence the global interference effect. However, this effect may vary in terms of the intensity of a specific mood and the duration of experiencing that mood. Namely, when happy and sad mood were experienced temporarily and with low intensity, attending to the local level of the faces was faster in happy mood than sad mood It supports that happy mood promotes attentional flexibility, facilitates overcoming global level interference and attends to the local level. However, when happy and sad mood were experienced for a longer time with higher intensity, this pattern reversed. Persistent and intensified sad mood facilitates detail processing and therefore adopting the local level focus was promoted. The finding of this research showed that, in terms of the effect of mood on level of processing, both flexibility paradigm and level of focus paradigm can be valid. Though, this research highlighted this point that not only an observer's mood valence determines the attentional strategy, but at the same time the intensity and persistency of that mood is important as well.

According to this study, the attentional allocation to different levels of a shape is context dependent. The characteristics of the observed materials and the observer's attributes influence the attentional and perceptual mechanisms.

So, *it always depends…*

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Appendices

Appendix A

This research was presented in following conferences:

Mokhtari, S., Buttle, H. (2011, July). Observer's mood manipulates level of visual processing: evidence from face and non-face stimuli. Asia- Pacific Conference on Vision (APCV). Hong Kong, HK.

Buttle, H., and Mokhtari, S. (2011, June). Emotional content and affective context: Levels of processing effects with schematic faces. Presentation given at the University of Exeter's Centre for Cognitive Neuroscience, Exeter, UK.

Mokhtari, S., Buttle, H., & Stillman, J. A. (2010, September). Is the level of processing in emotionally expressive faces affected by observer's mood? 27th BPS Cognitive Psychology Section Annual Conference, Cardiff, UK.

Mokhtari, S., Buttle, H., & Stillman, J. A. (2010, April). Levels of processing with schematic faces: Emotional content or affective context?
37th Australasian Experimental Psychology Conference, Melbourne, Australia.

Mokhtari, S., Buttle, H., & Stillman, J. A. (2009, November). The effect of mood and emotion on attention and memory in face perception. NZ Postgraduate Conference, Wellington, New Zealand.

Published abstracts:

Mokhtari S, Buttle H. (2011). Observer's mood manipulates level of visual processing: evidence from face and non-face stimuli. *i-Perception, 2,* 249.

Mokhtari, S., Buttle, H., & Stillman, J. A. (2010). Levels of processing with schematic faces: Emotional content or affective context? In N. Voudoris & V. Mrowinski, (Eds.), Combined abstracts of 2010 Australian Psychology Conferences held in Melbourne, Australia, 8-10 April 2010 (p.32). The Astralian Psychology Society: Australia.

Appendix B

Self-rate mood manipulation check scale

Before mood manipulation

Please give a score to your current mood between 1 and 7:

1………..….2……..……..3………..….4…………..5………..…6…………..7
Very sad   Very happy

After mood manipulation

Please rate your current mood again:

1….………..2…………….3…………..4…………5…………..6…………….7
Very sad   Very happy

Appendix C

The effect of emotion on attention and working memory

INFORMATION SHEET

My name is Setareh Mokhtari and I am a PhD student of Massey University. This study will be a part of my PhD research which is being conducted in order to study the effect of emotional states (positive or negative or neutral) on doing a task. Here the task concerns diagrammatic figures. If you are willing, you can participate in this research project.

In this study I want to recruit 60 participants who are fluent in English, aged 18 to 40, with normal vision (you can wear glasses or contact lenses). All participants are volunteers who have been recruited through advertisements and are interested in participating in this project.

Participants will be paid ($15) toward their time and travel expenses to the research location. No discomfort or harm is expected to occur to you in relation to participating in the task.

The procedure will be listening to some music and then filling in a brief questionnaire; this will be followed by a computer-based task, which involves responding to and counting some parts of diagrammatic figures. It is estimated that you need 1 hour to complete the whole task.

Your reaction time and accuracy of the responses will be record by the computer and then statistically analysed along with the other participants' data.

In order to protect your privacy, all information collected from the computer-based task and the questionnaire is **anonymous** and will at all times be treated as **confidential**. The data just will be used for the purpose of this study and will not be shared.

You are under no obligation to accept this invitation. If you decide to participate, you have the right to:

- decline to answer any particular question.
- withdraw from the study at any time before data collection is complete

- ask any questions about the study at any time during participation;
- provide information on the understanding that your name will not be used in any publication arising from the study
- be given access to a summary of the project findings when it is concluded.

This project has been reviewed and approved by the Massey University Human Ethics Committee: Northern, Application 08/ 066R. If you have any concerns about the conduct of this research, please contact Dr Denise Wilson, Chair, Massey University Human Ethics Committee: Northern, telephone 09 414 0800 x9070, email humanethicsnorth@massey.ac.nz.

If you have any queries about this study, you are welcome to contact either myself or my research supervisor

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Appendix D

The effect of emotion on attention and working memory

PARTICIPANT CONSENT FORM

This consent form will be held for a period of five (5) years

I have read the Information Sheet and have had the details of the study explained to me. My questions have been answered to my satisfaction, and I understand that I may ask further questions at any time.

I agree to participate in this study under the conditions set out in the Information Sheet.

Signature: .... **Date:** ....

Full Name - printed ....

If you wish to receive information regarding the results of this study, Please complete the box below:

Address: ....
....

Email: ....