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Chapter

FEARFUL FACE PROCESSING IN ANXIETY

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INTRODUCTION

From an evolutionary perspective, fear in one of the most relevant emotions for the survival of species. Fear enables a rapid detection of threat in the environment and prepares the organism to respond efficiently to the threat. Among potentially threatening stimuli, the face is particularly relevant. A wealth of research shows that humans have an innate ability to processes faces. Further, facial expression has a central signal value in social interactions as it reflects the behavioural intentions of the expresser.

If healthy individuals are able to rapidly detect and decode threatening facial expression and are biologically prepared to it, the role played by facial expression processing is particularly central for those suffering from emotional disorder. The aim of the present chapter is to review empirical studies and theoretical work relevant to the processing of nonverbal threatening signals in the etiology and the maintenance of anxiety.

We will first explore core facets of the normal processing of emotional facial expression regardless of their valence. A cognitive model of emotion will be presented as theoretical framework articulating different cognitive regulation processes. Then, we will present cognitive models of anxiety which postulate that biases in the processing of threatening stimuli are involved in the maintenance of anxiety disorders. Then, we will turn to empirical evidences of cognitive biases in anxiety, examining successively attentional biases, evaluative deficit and biases in facial decoding and memory biases for threatening faces in anxiety. We will conclude by integrating these different aspects, examining their clinical implications, and suggesting future directions for research.

THE PROCESSING OF EMOTIONAL FACIAL EXPRESSION

In this section, we will explore different facets of the normal processing of emotional facial expression in general and of threatening facial expression in particular. Before reviewing data on facial expression decoding and emotional responses to threatening facial expression, we will overview data about the universality of facial expression of emotion.

Facial Expression of Emotion

According to the Darwin's evolutionary theory, facial movements have been selected by evolutionary processes because of their adaptive functions. Their main function would be to serve intra- and extra-species communication and regulation. Following this perspective, Ekman (1971) has proposed that there are innate "affect programs" linking "each primary emotion to a distinctive patterned set of neural impulses to the facial muscles" (Ekman, 1971, p.216). According to this theory, the number of so-called "primary" or "fundamental" or "basic" emotions is limited to a set of 7 emotions: happiness, sadness, fear, anger, surprise, disgust, and contempt. In addition to these basic emotions, Ekman and Friesen (1978) has proposed the existence of emotional "blends" occurring when more than one affect program are concurrently activated.

Recently, Ekman (1999) synthesized a series of characteristics that signs "basic emotions". Basic emotions would be universal distinctive signals that inform individuals on what is occurring for the person feeling the specific emotion: the specific antecedents and consequences and the internal state. Basic emotion would have distinctive universal antecedents, that is specific emotion would occur in specific situation, characterized by common features. Further, these antecedents would be similar across cultures. They also have distinctive patterns of autonomic nervous system activity and of regional brain activity. These patterns prepare the organism to respond specifically to a given emotional stimulus.

According to these characteristics, fear is one of the basic emotions. Fear is a universal distinctive signal. All over the world, a fear expression is interpreted as a response to something threatening in the environment and as indicating an urge to escape from the situation. Fear has also universal antecedents. For example, physical (e.g. facing a bear or a very angry person) or psychological harm (e.g. speaking in front of a large audience) elicit fear. Finally, there are evidences that fear differs from others emotions on several physiological responses (Stemmler, 2004). Different emotion eliciting tasks have been used to evidence differential pattern of physiological response. For example, in the directed facial action task, subjects are instructed to contract facial muscles in order to produce an emotional configuration. In the relieved emotions task, subjects have to relive emotional memories (for a review, see Levenson, 1992). These studies have evidenced larger heart rate acceleration for fear as compared to disgust and joy, and greater skin conductance response as compared to joy, and lower diastolic blood pressure, cooler surface temperatures, greater vasoconstriction and less flow in the periphery, as compared to anger.

Following Darwin's perspective, Ekman (1971, p.216) suggested that "what is universal in facial expressions of emotion is the particular set of facial muscular movements triggered when a given emotion is elicited". Ekman and Friesen (1975) have proposed that, at the

morphological level, facial expressions of emotion are best described by changes in one or more areas of the face which can move separately: forehead and eyebrows, eyes and lids, and root of the nose, for the upper face, and cheeks, chin, mouth, nose, for the lower face. These authors have developed a classification of facial muscular movements, the Facial Action Coding System (FACS, Ekman and Friesen, 1978). The FACS is " a comprehensive, anatomically based system for measuring all visually discernible facial movements" (Rosenberg, 1997, p.12). It describes 44 action units (movements of a specific part of the face which can involved several muscles), each of them being also coded in terms of intensity on a 5-point intensity scale. For instance, the main facial movement of the smile, lifting the lip corner toward the ear (through activation of the *Zygomatic Major* muscle) is coded as action unit 12 and the main facial movement of the anger, lowering brow (through activation of *Depressor Glabellae, Depressor Supercilli* and *Corrugator Supercilli*) is coded 4.

Using FACS, Ekman and Friesen (1975) have proposed that specific action unit combinations are associated with emotions. They have described the prototypical displays for seven basic emotions. Evidences of the prototypicality of an action unit combination for a given emotion came from cross-cultural and developmental data (Ekman, 1971; Ekman and Friesen, 1975). Initially, Ekman (1971) observed emotional facial expression of members of two preliterate cultures in New Guinea and concluded that some facial movements were elicited by the same emotion in Western and preliterate cultures, but that others movements were very dissimilar. In that context, Ekman and his colleagues (Ekman, 1971, Ekman and Friesen, 1975) have proposed a neuro-cultural theory of facial expression of emotion (Ekman, 1971). This theory accounts for the observation that basic facial expressions, supposed to be innate, are likely to be modified by experience and socialization and thus vary through cultures. "Display rules", varying from cultures to cultures, (Ekman, 1971, 1973) mediate the link between facial expression and emotional feeling. They can be defined as norms, which "has been learned, presumably fairly early in life, about which management techniques to be applied by whom, to which emotions, under what circumstances". (Ekman, 1971, p.225) They can interfere with the innate affect programs by modifying the expression of emotion: Ones can stop the emotional expression elicited by an event (e.g., poker players do not express any emotion whatever the deal is); ones can exaggerate (e.g. a teacher can fix a troublesome pupil to scold him) or minimize (e.g. a lot of people tend to mask their sadness when they are with others) the felt emotion by intensifying or diminishing features of facial expression; ones can hide an emotion by displaying another emotion (e.g. a person can display a smile when she receives a gift she doesn't like).

Although Ekman's neurocultural model is acknowledged as one of the important theory of emotion, some authors have pointed to the limits of the model. For example, Fridlund (1994) has underlined the over-inclusiveness of the model and the lack of independent criteria to determine in which conditions each component of the model (facial affect program, display rules) is activated. Moreover, Fridlund (1994) has stressed the circularity of Ekman's model. Ekman has developed a rationale in which facial expressions are universal because there are elicited by basic emotion (Ekman, 1971) and he called "basic emotions", emotions that activate a specific facial expression (Ekman, 1992). The concept of display rule is easily used to account for exception in the theoretical perfect matching between primary emotion and emotional facial expression.

Notwithstanding these criticisms, the Facial Action Coding System (Ekman and Friesen, 1975) remains a very valuable tool for the description of emotional facial expressions.

Regarding the focus of this chapter, we will briefly describe the action units involved in anger and fear displays. Examples of prototypical facial displays are shown in Figures 1 and 2. In anger, eyebrows are drawn down and together; this movement produces vertical wrinkles between brows. The lower lids are tensed and may be raised whereas the upper lids are also tensed and may be lowered. The gaze is fixed and seems to be hard. In the upper face, the lips may be either pressed firmly together either the mouth is opened or the lips are tensed in a squarish shape. The nostrils may be dilated. In fear, the eyebrows are raised and drawn together. Horizontal wrinkles cross the centre of forehead. The eyes are largely opened with the eyelid raised and the lower eyelid drawn up. Mouth is the place where the intensity of fear can be observed. The mouth is always opened but either the lips are tensed slightly or stretched and drawn back.

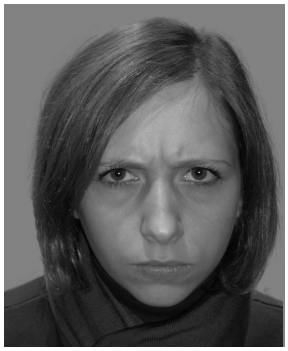

Figure 1: Facial expression of anger

Figure 2: Facial expression of fear

In this section, we have presented a tool, the FACS (Ekman and Friesen, 1975), that describes facial movements involved in the expression of emotion. We also presented Ekman's neurocultural theory accounting for neural, innate and cultural determinants of emotional facial expression and the limits of this model. In the next section, we will focus on

the decoding of facial expression. Research on this topic has investigated whether individuals, regardless of their culture, can decode accurately emotional facial expression.

Facial Expression Decoding

Human have an innate ability to process faces, both in terms of identity and expressivity (Russell and Ferández-Dols, 1997). The ability to identify one's emotional state from his or her facial expression develops from birth to adolescence (Gross and Ballif, 1991; Nelson and de Haan, 1997). This assumption comes partly from studies on facial expression decoding. Studies on this topic have been largely initiated by Ekman as well as by Izard and their collaborators.

Researchers have used different types of methodologies to study the decoding of facial expression of emotion. The most used method is the "judgment approach". Subjects are presented with pictures of facial emotional expression and are asked, either to choose a label from a list of emotion words to describe the face ("forced-choice method") or to freely attribute an emotional label to the face ("free-response-method") (Ekman, 1971; Ekman and Friesen, 1975). A common measure for the decoding of emotional facial expressions is defined as the percentage of subjects who attribute to the facial expression the label corresponding to the emotion predicted by the experimenter. One of the limitations of the "forced choice method" (for a critical review, see Fridlund, 1994) is that the categories, provided by the experimenter, rely on the classical distinction of "basic emotions" (Ekman, 1982).

As mentioned above, several researchers (Ekman, 1992; Izard, 1992) contend that facial expressions of emotion have a universal basis. To test this hypothesis, studies, using the methods just described, have been conducting with participants from Western and non Western literate cultures. Taken together, these studies have shown that, regardless of their culture, individuals are able to recognize emotion in facial expression at greater than chance level. However recognition scores vary according to the features of the displayed emotion, the culture, the education level and the measurement method (e.g., facial stimuli sampling, response format).

The best recognized emotion in both Western and non-Western cultures is "happiness" with median scores of correct recognition of respectively 96.4% and 89.2%. (for a review, see Russell, 1994). Curiously, fear has one of the lowest recognition score, 77.5%, in Western culture (65%, in non Western culture) while anger is the worst recognized emotion in non-Western culture with a score of 65% (81.2% in western culture). According to Matsumoto (1992), the difference in recognition rates are not due to absence of universality for emotional expressions but are determined by display rules, i.e., culturally learned rules about how emotions can be expressed and recognized.

Another factor influencing recognition rate is the education level. Wolfgang and Cohen (1988) have shown that the higher the education level, the higher the decoding score with 81 % for people with an university level, 43% for those with only a primary school education.

Finally, Russell (1994, p.235) has concluded from a large literature review that "only the forced choice method supports that, across individuals from (literate) cultures, a very high proportion of subjects agree on a specific emotion for each of hypothesized facial expression". This conclusion is more cautious than Ekman's assumption of universality.

Emotional Responses to Threat Relevant Facial Expressions

In the previous section, we have reviewed studies showing that individuals are able to accurately recognize emotional facial expression in terms of "basic emotions". Research has also documented that individuals react to the facial expressions of their partner, in terms of subjective, physiological, and behavioural responses, as well as in terms of their own facial expression. Such observations are consistent with Seligman's theory of "preparedness" (1971) that states that individuals are prepared to react emotionally to different social situations that are important for the survival of the species, such as face-to-face interaction. In the following sections, we will review the literature relevant to this topic.

Autonomic responses to facial expression. Studies on autonomic conditioning to facial stimuli have documented that some emotional facial expressions possess particular features with respect to evaluative conditioning. In these studies (for a review, see Dimberg, 1988; Öhman, Dimberg and Öst, 1985; Öhman, 1999), subjects were exposed to photographs of facial emotional expressions displaying happy, angry or neutral feeling states. These pictures were used as conditioned stimuli (CSs) associated to an aversive unconditioned stimulus (UCS; electrical shocks on the fingers). Dependant variables were skin conductance responses and heart rate measured during three phases: an habituation phase in which the faces were simply shown to subjects, an acquisition phase in which faces of a specific valence (happy, angry or neutral faces according to the experimental condition) were associated to the aversive stimulus (electrical shock) whereas other faces were not followed by the shock, and finally, an extinction phase in which faces were not followed by a shock. According to the "preparedness" theory (Seligman, 1971), the more a situation is likely to be dangerous, the more individuals are prepared to react rapidly and strongly to it. Given that people expressing anger could represent a potential danger, angry faces should induce more persistent aversive response during the extinction phase compared to happy and neutral face.

In their 1978's study, Öhman and Dimberg observed that the skin conductance responses conditioned to angry faces were more resistant to extinction than those conditioned to happy or neutral faces. In several following studies (Dimberg, 1986; Lanzetta and Orr, 1980, 1981), it was observed that angry faces had an excitatory effect whereas happy face have an inhibitory effect on aversively conditioned responses (Lanzetta and Orr, 1981). Other factors were determinant for the resistant conditioning of angry face: orientation of the head, eye contact and the identity of the person whose face was conditioned(for a review, see Dimberg, 1988; Öhman, Dimberg and Öst, 1985). All these factors are particularly critical in face-to-face interaction. They inform individuals whether they are the target of aggressive threatening intents expressed by the angry face of the interaction partner and thus, whether it is adapted to respond by fear to the anger display.

Facial reactions to facial expression. Studies presented above have focused on the autonomic components of emotional reaction to facial expressions. They supported the hypothesis that human beings are biologically prepared to associate angry face, but not happy face, with aversive consequences. Another component is also particularly relevant to social interaction: the expressive response. Indeed, in face-to-face interaction, the partners react to each other facial expressions by displaying facial expressions in return (Dimberg, 1997). Mimicry is a concept particularly relevant for this issue. Regarding our specific interest, facial mimicry could be defined as the imitation of an "interaction's partner facial expression"

(Hess, Philippot and Blairy, 1999). In this perspective, the question is whether, when exposed to emotional facial expressions, individuals display congruent facial expressions.

This component of emotional reaction had been mostly studied with the technique of electromyography (EMG). This technique allows for the measure of subtle muscle reactions elicited by a broad range of stimuli in different situations. In EMG studies, subjects are repeatedly exposed to different visual or auditory stimuli while surface electrodes record the muscle activity over specific facial regions, such the *Corrugator Supercilii* and *Zygomatic Major* muscle regions. This technique was first developed to measure facial reaction during emotion induction (Lanzetta, Cartwright-Smith, and Kleck, 1976). Cacioppo and Petty (1981) and Schwartz , Fair, Salt, Mandel, and Klemer. (1976) have reported evidences that negative emotions increase the *Corrugator Supercilii* muscle activity whereas positive emotions increase the *Zygomatic Major* muscle activity. Dimberg and co-workers (Dimberg, 1982; Dimberg and Thunberg, 1998; Dimberg, Thumberg and Elmehed, 2000) used EMG to measure facial reaction to the presentation of emotional facial expression. Subjects were exposed to pictures of happy and angry faces. Results have indicated that angry faces increase *Corrugator Supercilii* activity whereas happy faces decrease *Corrugator Supercilii* activity and increase *Zygomatic Major* activity. This pattern is congruent with the result found during emotion induction. This differential muscle activity occurred after only 500 ms of exposure (Dimberg and Thunberg, 1998) and even after a subliminal exposure (Dimberg, Thunberg and Elmhed, 2000). In the latter study, subjects were randomly assigned to 3 different groups according to the valence of the faces displayed (happy-neutral, neutral-neutral or angry-neutral). The exposure of the target face was brief (30 ms) and followed by a neutral masking face displayed during 5 s, in order to prevent any conscious perception of the faces. Results showed that, in the happy-neutral group as compared to angry-neutral group, the activation of *Zygomatic Major* muscle was larger and the activation of *Corrugator Supercilii* muscle was lower.

Taken together, these data suggest that individuals respond with different patterns of facial muscle activity when exposed to different emotional facial expression. In other words, these results confirm that individuals tend to mimic the emotional facial expression they are observing in others.

Behavioral responses to facial expression. Given the importance of threat expression, one could suppose that face processing must enable a rapid detection of potential threatening expression in the environment. Hansen and Hansen (1998) have proposed a research program to test this hypothesis. They used the paradigm of the visual research task developed in experimental psychology for distinguishing between automatic and controlled processing (Shiffrin and Schneider, 1977). They hypothesized that an angry face in a crowd of happy faces should be more easily detected than a happy face in a crowd of angry faces. In this experiment, subjects were presented with an array of 4 or 9 faces. In half of the trials, all the faces had the same emotional expression and in the remaining trials, there was one discrepant face. Subjects were asked to detect the presence of a discrepant face, that is, the face displaying a different emotional expression, in an array of photographs.

Their findings supported the hypothesis of an anger superiority effect: An angry face was more easily detected in a happy or neutral crowd than a happy or neutral face in an angry crowd (Experiments 1 and 3). Moreover, reaction time to detect an angry face in a happy crowd was shorter than the detection time of a happy face in an angry crowd. This asymmetry increased with the size of the crowd. In a similar task (experiment 2), subjects had to identify

verbally the location of a discrepant face among a crowd of 4 photographs. The crowd was followed by a mask. The location threshold, that is the necessary exposure duration of the crowd for correct location, was measured. It was found that correct location threshold for an angry face in a happy crowd was lower than the threshold for a happy face in an angry crowd. From these results, despite the evidence of an impact of the size of the crowd, Hansen and Hansen (1988) drew the conclusion that threatening faces pop out of crowds and that this detection is automatic.

Fox and al. (2000) have raised several problems regarding the conclusion drawn by Hansen and Hansen (1988). Firstly, the "face in the crowd" effect doesn't allow to determine whether angry faces are quicker to detect *per se* or whether the effect is determined by the increase of search time through angry distracters. Fox and al. (2000) have underlined methodological problems with material: By controlling contrast artefact (e.g. dark spot on the chin of the angry faces), Purcell, Stewart and Skov (1996) failed to replicate the Hansen and Hansen' s results. Moreover, other studies also failed to replicate the "face in the crowd effect" (Nothdurft, 1993; White, 1995) or have found inconsistent results (Hampton, Purcell, Bersine, Hansen and Hansen, 1989; Suzuki and Cavanagh, 1992). Fox and al. (2000) conducted a series of five experiments designed to test whether angry faces are detected more efficiently. They used the visual search task with schematic faces. They replicated the "face-in-in the crowd effect" with angry schematic faces: angry faces were more easily detected through a matrix of four faces, displaying neutral expression or happiness (Fox and al., 2000; experiments 1, 2, 4 and 5) than the reverse. In contrast to the objection addressed to Hansen and Hansen (1988), these findings cannot be accounted for by low level features of the display: When displays were inverted (faces presented "upside down"), preventing configural processing of emotional expressions, there were no reaction time differences between angry face in neutral crowd and happy face in neutral crowd. (Fox and al., 2001; experiment 3).

Taken together, these results suggest that angry expressions are more efficiently and rapidly detected, compared to happy face. However, the present evidences do not allow to conclude that this detection advantage is automatic in the sense of automaticity developed by Shiffrin and Schneider (1977).Indeed, the fact that detection of angry faces was affected by the crowd size suggested serial rather than parallel processes. More globally, these results support the evolutionary view according to which individuals have the ability to detect efficiently in their environment stimuli relevant for their survival, in this case, angry faces.

COGNITIVE FORMULATIONS OF ANXIETY

In the previous section, we have reported evidences supporting the assumption that "the key purpose or function of anxiety is probably to facilitate the detection of danger or threat in potentially threatening environments" (Eysenck, 1992, p.4), in order to allow individuals to initiate effective responses to avoid danger. Research has shown that the pre-attentive processing of biologically relevant stimuli, such as photographs of angry faces, orients attentional resources towards threatening stimuli in all individuals. In this section, we will develop the notion that threatening information, including threatening facial expression processing, plays a particularly important role for individuals suffering of emotional disorder.

This assumption, based on an evolutionary perspective, is central to the development of cognitive models of anxiety disorders. There is an evident survival value for the rapid detection of danger cues. Cognitive models of anxiety (e;g; Mogg and Bradley, 1998) postulate that anxious individuals tend to overestimate threat in their environment and to become hypervigilant to threatening signals. Differences in emotional information processing could be a causal factor in the development and the maintenance of emotional disorder (Mathews and Mac Leod, 1994). Before reviewing empirical evidences documenting such biases in the processing of threatening facial expression in anxiety disorders, we will present relevant cognitive and cognitive-motivational models of anxiety.

The first cognitive models of anxiety were developed aside from experimental cognitive psychology and cognitive science. Clinician psychologists (e.g. Beck, Rush, Shaw, and Emery, 1979) concluded from their clinical observations that cognitive processes were impaired in emotional disorders and elaborated a therapy based on the modification of cognitive impairments. This "clinical intuition" has since then been partly supported by a broad range of empirical data relating cognitive factors to emotional disorders (Clark, 1999).

Beck's schema-based model of anxiety (1976; 1979; 1985).

One of the most popular formulations of emotional disorder had been proposed by Beck (1976). Although the Beckian cognitive approach has received many criticisms (e.g., Teasdale, 1993) that we will present latter, and although Beck (1996) has recently proposed an update of his model, it remains important to present the first version of his model because it is still the most commonly used by therapists.

Beck's first theory of emotional disorders (1976) was quite simple and linear and relied on a definition of the concept of "cognition" coming from common sense, that is consciously experienced images and thoughts. He proposed that (unpleasant) emotions result from (distorted) conscious cognitions. The model is schematically represented in Figure 3.

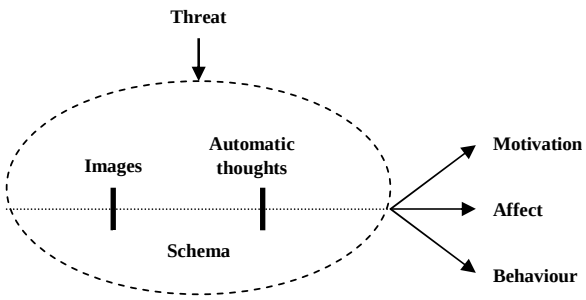

Figure 3: Beck's model (according to Beck, Rush, Shaw, and Emery, 1979)

Specifically for anxious disorders, Beck, Emery, and, Greenberg (1985) proposed that the individuals' response to a threat situation depends on a rapid analysis of the risk of the situation and on their capacity to cope with it. In this perspective, the organism has learned,

through previous similar experiences, to recognize a threat situation and the best way to cope with it. This information would be encoded in a schema. The *schema* is a central component of Beck's model. Several definition of the schema can be found in the literature (Bouchard and Freeston, 1995). The definition given by cognitive therapies must be distinguished to the concept of schema developed within cognitive sciences. In the context of cognitive therapies, a schema is a general and stable structure of beliefs that can take a declarative form. In contrast, in multi-level models of emotions (Leventhal, 1984; Teasdale, 1996), the notion of schema refers to an abstract and implicit representation structure, non-declarative in nature (Philippot, Baeyens, Douilliez, and Francart, 2004).

With reference to the former definition of a schema, Beck and al. (1985) suggested that emotional disorders are determined by dysfunctional schemas. For instance, in social anxiety, individuals would hold dysfunctional beliefs, emanating from their schema, about themselves and how they must behave in social situation (e.g., "If I show that I feel anxious, I will look ridiculous", "if I am not perfect, other will not love me" or "I am useless"). When activated by a stressful event, for example a public speech situation, the content of the schema would influence individuals' perception, interpretation and memory towards schema-congruent information and organize emotional, motivational and behavioural responses. Anxiety prone individuals would be biased towards threat in the selection and processing of schema-congruent stimuli (we will review evidences of such biases in the next section). For instance, socially anxious individuals would perceive more quickly that a conversation partner is frowning than would non-anxious individuals. This selective bias is accompanied of a set of physiological responses. According to Beck and al. (1985), dysfunctional schemas are maintained by judgment errors, such as the overestimation of probability ("If I give a speech, I will stutter"), the overestimation of negative outcomes ("If I blush, everybody makes fun of me") or dichotomous though ("If my speech is not perfect, I am stupid). Moreover, by focusing only on schema-congruent information, anxious individuals sustain the schema activation and are unable to detect information disconfirming their erroneous beliefs (e.g., anxious individuals don't realize that a lot of people are in fact interested in their speech).

Undoubtedly, the Beck's model has offered an interesting framework for earlier efficient treatments of anxiety and depression but it also raises several of problems. We summarize here Teasdale's criticisms (1993): (a) Negative thinking is not an antecedent of depression, as postulated by Beck, but a consequence of it. This claim is suggested by the fact that research has shown that anti-depressant drugs as well as other efficient treatments of depression--that are not targeting negative thinking--are as efficient as cognitive therapy in reducing negative thinking. (b) Irrational believes, assumed to be a specific predisposing factor for emotional disorder, can be activated by inducing a corresponding mood state in healthy individuals. Therefore, schema activation is mood-dependent rather than an enduring feature of vulnerability. (c) Although Beck postulates a necessary mediating links between though and emotion, people can feel an emotion without being able to identify the related negative though. (d) Most patients "rationally" know that their believes are irrational (e.g. "Rationally, I know that nobody will reject me if I am blushing… ") and, consequently, giving rational arguments as advocated by Beck is not efficient to change "emotional" believes (e.g. "…but emotionally. I feared to be rejected"). Moreover, the schema-based model doesn't account for difference in processing biases found between anxiety and depression (Mogg and Bradley, 1998). Indeed, there are empirical evidences for attentional biases in anxiety disorders. Anxious individuals preferentially process negative information (for a review, see Mogg and

Bradley, 1998), and for memory biases in depression: Depressed patients have a recall advantage for negative material (Mac Leod, 1990), whereas research has failed to find consistent memory biases in anxiety (Mac Leod, 1999) or attentional biases in depression (Wells and Mathews, 1994)

Other problems can be mentioned. For instance, Beck's definition of cognition as "any ideation with verbal or pictorial content" (Beck, 1979) that might be conscious does not account for implicit cognition. Moreover, Philippot (2000) has also criticized the notion of continuum between preconscious and conscious thoughts assuming that cognitive processes are similar in nature. Indeed, these processes could be from a different nature.

In a recent reformulation of his model, Beck and Clark (1997) have proposed a three-stage schema-based information model of anxiety that attempts to address previous criticisms. These different stages imply different levels of automaticity from rapid, involuntary, and unconscious processes to controlled, strategic, and elaborative processes (for a definition of automaticity related to anxious disorders, see Mc Nally, 1995). The model is schematically represented in Figure 4. The first processing stage, *initial registration*, involved an automatic recognition of the valence or the personal relevance of stimuli, named *orienting mode*. If the stimulus is assessed as threatening, attentional resources are allocated to process it. In anxiety, the orienting mode is hypersensitive to detect negative stimuli. For example, when giving a speech, a socially anxious individual would appraise negatively the yawns of an audience 's member. This appraisal activates an orienting mode of danger. The attentional resources are oriented towards this threatening stimulus. Empirical evidences support the notion of a bias towards negative stimuli in preattentive processing in anxiety (for a review, see Mogg and Bradley, 1998).

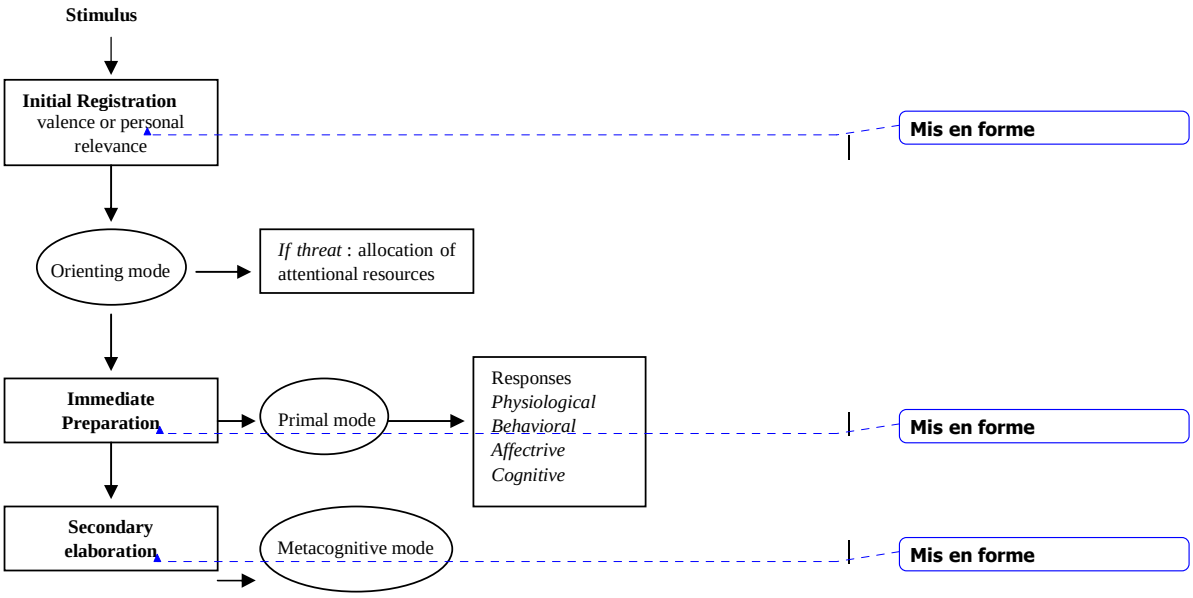

Figure 4: The three-stage schema–based information processing model of anxiety (Beck & Clark, 1997)

The second stage, *immediate preparation*, involves the activation of a *primal mode* that triggers a series of physiological, behavioural, affective and cognitive responses. In anxiety, this primal mode results in biased cognitive processing, such as hypervigilance to threat cues rather than safety cues and automatic negative thoughts.

Finally, the *secondary elaboration* stage is characterized by a full semantic activation as well as the activation of other relevant schema. Individuals activate a metacognitive mode in which they evaluate the availability and the efficiency of their coping resources. This mode of processing is necessarily conscious and explicit.

Beck's conception of anxiety bares important implications for treatment. According to Beck and Clark (1997, p.55), "because (…) threat assignment is the *sine qua non* of anxiety disorders, effective treatments must modify the threat appraisal process". Many clinicians shared the belief that anxious individuals overestimate the threat meaning of trivial stimuli and aim to modify such erroneous "decoding" using verbally mediated therapy, like cognitive therapies. However, Mc Nally (1995) raised doubt on the capacity of cognitive therapies, based on conscious verbally processes to modify cognitive biases that are automatic. By contrast, Mansell (2000) reviewed evidences for a modification of automatic processes by conscious appraisal.

Mogg and Bradley's cognitive-motivational model (1998).

In order to account for differences in cognitive biases in depression versus anxiety, as postulated by Beck and al. (1985), Mogg and Bradley (1998) have proposed to examine two factors largely developed in psychobiological and personality theories: the emotional valence and the goal engagement. Within this two-dimensional framework, depression is characterized by a negative valence of the environment (e.g., lack of pleasure and interest) and a disengagement from external goals with a cognitive focus on the internal life (e.g., towards depressive thoughts). Anxiety is also characterized by a negative valence of the environment (e.g., threatening and likely dangerous) but is conversely characterized by an engagement towards external goals (e.g., preparation to escape from the aversive situation)

According to the distinction between these two factors, Mogg and Bradley (1998) have proposed a cognitive-motivational view of anxiety. They distinguished two motivational systems that mediate cognitive and behavioural responses to emotional stimuli: the Valence Evaluation System and the Goal Engagement System. The Valence Evaluation System automatically assesses the stimulus threat value according to the nature of the stimulus, the situational context, the person's state anxiety, and prior learning experiences. The Goal Engagement System orients allocation of attention as a function of the output of the former system. If a stimulus in the environment is evaluated as threatening, the Goal Engagement System interrupts ongoing activities and orients attention toward the threat stimulus. This model thus postulates that attentional biases in anxious individuals result from a negative and automatic appraisal of social situations (Mogg and Bradley, 2002).

This cognitive-motivational view of anxiety is quite similar to the model proposed by Williams, Watts, MacLeod, and Mathews (1988). This latter model is also based on two mechanisms, the Affective Decision Mechanism and the Resource Allocation Mechanism. These two mechanisms have similar functions as Mogg and Bradley' s systems presented above. The only important difference between these models rests in the system that determine

vulnerability to anxiety. According to Williams and al. (1988), individual differences in vulnerability to anxiety (anxiety trait) influence the Resource Allocation Mechanism. Thus, high trait anxious individuals have a tendency to orient their attention towards threat, whereas low trait anxious individuals shift their attention away from threat. According to Mogg and Bradley's model, individual differences in vulnerability to anxiety would be due to a greater sensitivity of the Valence Evaluation System. Thus, anxiety-prone individuals would tend to over-estimate the threat value of stimuli that would be assessed as trivial by low anxious individuals.

In summary, the cognitive-motivational view (Mogg and Bradley, 1998) postulates that attentional biases in anxious individuals result from a negative and automatic appraisal of situations (Mogg and Bradley, 2002). Anxious individuals would appraise their anxiogenic stimuli as more negative and would consequently allocate more attention to them than non anxious individuals would.

EMPIRICAL EVIDENCE OF FEARFUL PROCESSING BIASES IN ANXIETY

The models of anxiety disorders described in the previous section are based on empirical evidences coming from studies using paradigms of experimental cognitive psychology. Several studies were conducted on general cognitive deficits in the processing of complex information, regardless of its emotional valence in anxiety. However, in this chapter, we will specifically focus on studies concerning the processing of emotional, and particularly fear-relevant, information. These studies have evidenced processing biases for threatening information in clinical and sub-clinical anxious samples. These cognitive biases appear to affect all processing levels: attention, memory, and interpretation.

We will now reviewed studies relevant for the purpose of this chapter, that is studies focused on fearful facial expression in anxiety disorders. Some of these studies have focused on a particular anxious disorder, social phobia. Indeed, there is a strong belief that faces are specifically relevant for social phobics. Actually, the basic fear in social phobia is about being negatively evaluated by others. Facial expression constitutes a central medium for conveying positive and negative evaluations in face-to-face interactions. Thus, they are particularly relevant for social phobics.

Attentional Biases

Studies focusing on attentional processes have mainly used three types of paradigms: the emotional Stroop task, the probe detection task and the face-in-the crowd task. In most of these studies, words were used as material, but some studies, using the probe detection task or the face in the crowd task, used faces as stimuli.

The Probe Detection Task. The paradigm of probe detection was proposed by Mac Leod, Mathews and Tata (1986) in order to offer a more direct measurement of the allocation of the visual attention than in the Stroop task. The probe detection task is based on a paradigm coming from the cognitive psychology according to which the spatial attention can be

evaluated through reaction time to visual signals (Navon and Margalit, 1983; Posner, Snyder and Davidson, 1980), i.e. individuals tend to respond faster to a signal presented in the attended area of the visual field. Typically, pairs of stimuli are presented on a screen, one below the other or one beside the other. In critical trials, a stimulus is emotional and the other neutral. Each pair is presented during a fixed time (generally 500 ms). When the pair disappears, a probe stimulus (a dot or an arrow pointing either up or down) appears in the area previously occupied by one of the two stimuli. The subject is asked to press as quickly and accurately as possible one of two keys corresponding to the location of the dot or to the direction of the arrow. Shorter reaction time when the probe is located on the area previously occupied by a given stimulus reveals an attentional bias towards this type of stimulus.

This paradigm has allowed to evidence the presence of attentional bias towards threatening words in generalized anxious disorder (Mac Leod, Mathews and Tata, 1986, Mogg, Mathews and Eysenck, 1992) and social phobia (Asmundson and Stein, 1994). A similar bias was also reported in non pathological anxiety (Mogg, Bradley, de Bono and Painter, 1997; Mac Leod and Mathews, 1988).

Notwithstanding this robust evidence, several researchers (Mogg and Bradley, 1999) have underlined the lack of ecological validity of words and have proposed the use of emotional faces as stimuli. The latter are particularly ecological and relevant stimuli for any human being (Mogg and Bradley, 1998). As developed in previous sections, individuals have a particular and innate capacity to process human faces (Dimberg, 1988; Öhman, Dimberg and Öst, 1985).

We have reviewed twelve studies using the probe detection task with faces to test the hypothesis of an attentional bias for threatening information in clinical and non clinical samples. When the stimulus duration is 500 ms, high trait anxious individuals show a vigilance bias for angry faces (Bradley, Mogg, Falla and Hamilton, 1998; Mogg and Bradley, 1999; Mogg, Philippot and Bradley, 2004) and for fear faces (Fox, 2002, experiment 1). Similar results are observed for longer exposure durations (1100 ms or 1250 ms) for high trait anxious individuals (Bradley and al., 1998) and for high-state anxious individuals (Bradley, Mogg and Millar, 2000).

Presentations of masked faces in the probe detection task were used to test whether anxiety-related biases might imply processes outside awareness. Mogg and Bradley (1999, experiment 3, 2002) and Fox (2002) reported that high-trait anxious individuals have an increased tendency to orient attention towards the spatial location of negative faces displayed under subliminal conditions.

These findings were replicated among patients suffering from generalized anxiety (Bradley, Mogg, White, Groom, and de Bono, 1999) regardless the stimuli duration (500 or 1250 ms). The generalized anxious patients selectively attended to threatening facial expressions, but they were also more vigilant than controls for emotional faces in general. This study also showed a complex pattern of attentional bias towards the happy faces. The social anxiety scores of the participants were positively correlated with attentional bias scores for threat in all tasks.

The previous findings underline the crucial role of processing threatening facial expressions in social anxiety. Bradley Mogg, and Millar (2000) reported that high levels of social anxiety predict an attentional bias for threatening faces. This study assessed the orienting of initial eye movement during a probe detection task. This measure was recorded by using eye tracker sensors positioned below the right eye. However, Bradley, Mogg, Millar,

Bonham-Carter, Fergusson, Jenkins, and Parr (1997) did not find attentional bias for angry faces when the students were divided in two groups on the basis of social anxiety measures. Mansell, Clark, Ehler and Chen (1999) have found a significant an attentional bias but in the opposite direction: Socially anxious individuals showed an attentional bias away from emotional faces (not only threatening faces). The task used was slightly different from the one used in previous experiments. One difference rests in the material presented. In the "classical" probe detection task, participants were presented with neutral-happy and neutral-angry face pairs. In contrast, in Mansell's study, the negative (anger, dislike, fear, sadness), happy or neutral faces were paired with a photograph of neutral household object. The second difference is that participants were assigned either to a social-evaluative threat condition, that is, a condition within they believed they would give a speech, or to a no-threat condition. Under condition of social-evaluative threat, high socially anxious individuals showed an attentional bias away from emotional faces whereas under the no threat condition, high and low socially anxious individuals did not differ from each other. However, in the no threat condition, attentional bias scores were positively correlated with trait anxiety. High-trait anxiety individuals showed an enhanced vigilance bias to negative faces. This latter result is consistent with studies previously described (Bradley, Mogg and Millar, 2000; Fox, 2002; Mogg and Bradley, 1999; Mogg, Philippot and Bradley, 2004). These results suggest that socially anxious individuals, under condition of social-evaluative threat situation, avoid positive and negative faces more than neutral ones. As Bradley et al. (1999) as well as Mansell et al. (1999) suggested that socially anxious individuals react in the same way to happy and negative faces because both can be seen as potentially threatening. But the direction of the postulated bias is different. In contrast to Bradley et al. (1999), Mansell et al. (1999) suggest that socially anxious individuals shift their attention away from emotional faces and increase their self-focused-attention. This pattern could enhance anxiety, generate negative images of themselves and contribute to the maintenance of social anxiety (Clark and Wells, 1995).

The studies presented just above were conducted in sub-clinical samples, that is individuals high in the social-anxiety-trait but without reaching the criterion defined in the DSM IV (APA, 1994). Studies conducted on clinical samples might help in resolving the contradictions observed in the results of sub-clinical studies, i.e. whether the attention is oriented towards or away from threatening faces in social phobics. Chen, Ehlers, Clark and Mansell (2002) have presented faces and household objects simultaneously for 500 ms to 20 social phobics and 20 normal controls. They have found that social phobics directed their attention away from the faces, regardless of emotional expression and towards household objects. Mogg, Philippot and Bradley (2004) found the reverse pattern of results. Social phobics and matched controls completed a probe detection task with only facial expressions as stimuli and no household objects. Moreover, in order to observe whether or not the focus of attention changed over time, the stimulus duration was manipulated (either 500 ms or 1250 ms). Results indicated that, in the 500ms condition, the same duration as in the Chen's et al. (2002) study, social phobics showed an initial attentional bias towards angry faces, relative to happy and neutral faces. In the 1250 ms condition, this bias disappeared. It is important to stress the difference in control stimuli (neutral face vs household object) in those two studies as well as between the Mansell and al. (1999) and Bradley and al (1997)' s studies. A possible explanation for these discrepant results is that, when socially anxious individuals have

inanimate objects in their environment, they attend to those non social stimuli rather than to faces.

In order to reconciliate these different findings, Amir, Freshman, and Foa (2002) have proposed a two-stage model of information processing. According to this view, anxious individuals would show an initial hypervigilance focus for threat-relevant stimuli. This hypervigilance would be the consequence of automatic processes and it could be observed without conscious perception of threat relevant information (Mogg and Bradley, 1999). However, at further and less automatic stages of information processing, people would actively turn away from threatening information to escape the discomfort associated with it. This model thus postulates a dynamic shift of attention allocation from initial threat hypervigilance to later threat avoidance. For instance, while speaking to other people, socially anxious individuals would have their attention automatically attracted to frown more readily than non anxious individuals. Because of this perception bias, socially anxious individuals are likely to automatically over-activate a state of social anxiety. However, as soon as a frown would be detected, they would turn away their attention from it, and more generally from others' faces, to avoid the threatening stimulus and the discomfort associated with it. Unfortunately, in doing so, they are likely to maintain their anxiety: Not only are they likely to socially behave inappropriately, but they will also be unable to determine whether the frowns were a sign of actual social threat, or rather just a sign of perplexity, for instance.

In sum, studies using dot probe paradigm showed vigilance towards threatening faces, in generalized anxiety disorder and in sub clinical anxiety measured by the STAI (State-Trait Anxiety Inventory, Spielberger, 1983). The data for clinical and sub-clinical *socially* anxious individuals are less clear. It seems that, when confronted to facial expression material only, socially anxious tend to focus on threatening faces. However, if they have the choice between attending to facial expressions or to non-social object, they attend to non-social object.

The principal limitation of the dot probe task is that it presents a "snapshot" of the attentional bias, depending on stimuli duration. This technique measures the initial orienting of attention but cannot detect attention shifts during stimulus display. Indeed, subjects might repeatedly shift their attention towards and away from threat during exposure to facial expressions (Mogg and Bradley, 1998).

Face in the Crowd. In a previous section, we presented a paradigm, named the "Face in the Crowd" paradigm (Hansen and Hansen, 1988). It was designed to test the assumption that human beings are able to detect efficiently angry faces in their environment. The existence of this "face-in-the-crowd" effect was reported for normal subjects with photographs of emotional faces (Hansen and Hansen, 1988) and with schematic facial expressions (Fox and al., 2000). The evolutionary view of anxiety (Eysenck, 1992) predicts an enhanced ability to detect threat in anxiety.

Byrne and Eysenck (1995) used this paradigm to investigate whether anxious individuals detect more quickly threat than normal controls or not. Their data have established that high-trait anxious individuals were faster than low-trait anxious individuals to detect angry faces in a neutral crowd, whereas the two groups did not differ in detection speed of a happy face in a neutral crowd. Similar results were found in a clinical sample of social phobics (Gilboa-Schechtman, Foa and Amir, 1999): Compared to controls, social phobics reported a greater attentional bias for angry than for happy faces in a neutral crowd. Moreover, social phobics were slower than controls when making decisions for angry and happy than for neutral crowds. Esteves (1999) has replicated the "anger superiority" effect with schematic facial

expressions. However, individuals with high social anxiety measured by the FNE (Fear of Negative Evaluation, Watson and Friend, 1969) and the SADS (Social Avoidance Scale and Distress, Watson and Friend, 1969) failed to display faster detection of angry faces but made more errors than the low anxiety group.

In summary, these studies underline two important aspects of the processing of threatening facial expressions. Firstly, threatening facial expression seem to be better detected in all human beings and to be a particularly fear-relevant stimuli. Secondly, social phobics show a greater detection bias for angry faces. This bias, however, is not shown by sub-clinically socially anxious individuals.

*Conclusions.*In this section, we have presented evidences coming from several paradigms that generalized anxious individuals and individuals with a high anxiety-trait show an attentional bias towards anger and fear faces. Such evidences support the postulate of cognitive models of anxiety (Beck and al., 1985; Beck and Clark, 1997, Mogg and Bradley, 1998) and are congruent with the evolutionary view (Eysenck, 1992). These results have important implication for the understanding of the factors that maintain anxiety disorders. Indeed, anxious individual, selectively attending to threat information, subjectively perceives the world as more threatening and unsafe than it is. This attentional bias prevents them to attend to other elements in their environment than threat. As a consequence, such aversive perception of the environment reinforces their anxiety. The few data addressing this issue in social phobia didn't resolve the question of the orienting—towards or away—of the attentional bias. More research is needed to specify the role of attentional biases for face - a particularly relevant stimulus- in social phobia.

Evaluative Deficit and Biases in Facial Decoding

In the previous section, we reviewed empirical evidences addressing whether anxious individuals display an attentional bias towards threatening facial expressions. In this section, we will examine whether anxious individuals present an evaluative bias in judging facial expressions. This is, do they over-attribute threat to facial signals? Regarding verbal material, a wealth of research has now shown an interpretative bias toward threatening interpretation of ambiguous stimuli (Mac Leod, 1999). This evidence supports models of anxiety such as those of Beck (1985). Further, Mogg and Bradley's model of anxiety (1998) hypothesizes that attentional biases result from evaluative biases. This notion is widely accepted by clinicians (e.g. Beck, Emery and Greenberg, 1985) but, curiously, has been submitted to very little empirical investigation for nonverbal material. We will demonstrate that the empirical evidences reported by studies conducting on this topic are inconsistent with this hypothesis.

Few studies have been published on evaluative biases in the decoding of emotional facial expression by socially anxious individuals. All these studies used different paradigms. Firstly, Merckelbach, Van Hout, van den Hout, and Mersch (1989) observed no differences between nine social phobics and nine controls in their evaluation of angry, neutral, and joyful faces with respect to pleasantness. Moreover, they didn't observe differences between social phobics and normal controls in psychophysiological reactions (skin conductance response, eyeblink rate) to the presentation of facial stimuli.

Douilliez and Philippot (2003) replicated these results with individuals with a high level of social anxiety as measured by the FNE (Fear of Negative Evaluation, Watson and Friend,

1969): Participants were asked to evaluate the threatening value of angry, joyful, and neutral faces. No differences between anxious individuals and controls were observed for the evaluation of faces.

Using a different procedure, Winton, Clark, and Edelmann (1995) found some differences between socially anxious and non-anxious individuals. Socially anxious and non-anxious students were very briefly (60 ms.) exposed to negative and neutral facial expressions. Following this subliminal presentation, participants had to rate the emotion of each facial expression on a nine-point scale ranging from “negative” to “positive”. It appeared that students with high scores of social anxiety detected more accurately negative facial expressions than did non-anxious students while the opposite pattern was observed for neutral expressions. However, further analyses demonstrated that these effects were due to an overall negativity bias in the anxious students, and the authors concluded to an “absence of an enhanced ability to discriminate between different emotional states in others” (p. 193) in their socially anxious participants.

Finally, Philippot and Douilliez (2005) investigated this question with a facial expression decoding task. Participants-- patients with social phobia, patients suffering from anxiety disorders without social phobia and normal controls-- were presented with 40 facial expressions of happiness, anger, sadness, disgust and fear differing in emotional intensity by 30 % steps from neutral to full-blown emotional expression. Participants had to judge each expression on seven-point scales for seven emotions: happiness, anger, sadness, disgust, fear, surprise and shame. No differences between groups were found in the way participants judged emotional facial expressions.

The previous studies were conducting among adults, but some studies have also attempted to relate EFE decoding skills and social anxiety in children. In a sample of 8- to 10-year olds, McClure and Nowicki (2001) did not find a relationship between self-reported social anxiety and the ability to correctly label emotional facial expressions presented for 1 s. In a study similar to Winton et al.’s (1995), Melfsen and Florin (2002) exposed 8- to 12-year olds to emotional facial expressions for 60 ms. These children were asked to guess whether the emotional facial expression presented was positive, neutral, or negative. Compared to non-anxious children, socially anxious children more often reported that they saw emotion when a neutral face was presented. However, there was no indication of an enhanced ability to decode negative facial expressions in socially anxious children, nor was there a specific tendency to interpret neutral or positive faces as negative.

In the previous section, we presented several empirical studies suggesting that socially anxious and phobics individuals are more sensitive to threatening facial expression and would automatically detect more readily such information. According to Mogg and Bradley (1998)’s model, these attentional biases in anxious individuals result from a negative and automatic appraisal of social situations (Mogg and Bradley, 2002).

The results presented here suggested that socially anxious individuals do not process emotional facial expression more thoroughly and that they do not explicitly attribute a different meaning to emotional facial expressions as compared to non-anxious individuals. The present evidences suggest that socially anxious individuals know as well as non anxious that an angry face means anger and a sad face means sadness, for instance. We have proposed (Philippot and Douillez, 2005) that the higher sensitivity in the automatic evaluation of emotional facial expressions in socially anxious individuals would not concern valence per se (this stimulus is more or less negative), but rather personal concern (this stimulus signals

something potentially important for the way one might be evaluated by others). This proposition is actually congruent with the model of Mogg and Bradley (1998) who proposed that Valence Evaluation System "integrates information from nonconscious automatic appraisal processes with other information resulting from more detailed, elaborate analyses of stimulus and its context and consequences" (p. 841). The terms " valence evaluation" are thus a bit misleading here, as this system refers to relevance for the person's concerns.

Memory Biases

Very little research as been conducted on memory bias in fear and anxiety. Three studies have used paradigms that involve incidental memory to examine memory biases for threatening EFE. These studies have provided inconclusive results. Lundh and Öst (1996) have observed a recognition bias for "critical" faces by social phobics. Participants--social phobics or normal controls--were initially presented with 20 photographs and were asked to judge whether the person in the photograph was a critical or accepting person (encoding task). Following a distracting task, participants were instructed to look through a file with 80 faces and to identify the 20 persons they had seen in the first task. Social phobics, compared to controls, recognized a higher proportion of critical as compared to accepting face. It is interesting to note that, on the average, social phobics did not rate the faces as more critical than the controls did.

Similarly, Foa, Gilboa-Schechtman, Amir, and Freshman (2000) have observed that socially anxious individuals exhibit a negative memory bias towards threatening emotional facial expression. In experiment 1, participants (generalized social phobics or normal controls) were presented 12 photographs of persons displaying various emotional expressions. In the learning task, they learned the name of the person in the photograph. In a second task of emotional encoding, participants were presented 12 photographs of the same person but displaying another emotional expression than in the first task. They were instructed to name the person and to identify his or her emotional expression. In a free recall task, participants were asked to write down the name of the 12 persons with their emotional expression displayed in the previous task. In the last task, a cued recall task, participants received a list of the names of the 12 persons presented previously and were asked to write down the emotional expression displaying by each person in the second task. Results showed that social phobics, compared to normal controls, exhibit better free recall and cued recalls for facial expression associated with names (cued recall). Socials phobics remembered angry expressions better than did normal controls but there were no significant difference for happy and neutral expressions. In experiment 2, participants were asked, in the learning task, to pay attention for 5 seconds to 12 photographs of person displaying various emotional expressions. In the recognition task, participants were presented the 12 photographs seen in the first task but displaying another emotional expression and 12 photographs of another persons and were instructed to identify "old" (seen in the first task) and "new" photographs. Foa et al. (2000) observed that social phobics, as compared to normal controls, showed a better recognition of facial expressions. Moreover, social phobics presented a recognition bias towards negative emotional expressions. In sum, social phobics exhibited a better recall and recognition for all facial expression, with an enhanced recognition for negative expressions as compared to non-negative expressions.

Perez-Lopez and Woody (2001) failed to observe such a memory bias. Before the encoding task, participants (social phobics or normal controls) were instructed to give a speech in front of a live audience and a video camera. In the encoding task, they were asked to look through a series of photographs of faces displaying threatening and reassurance expressions. After that, participants prepared their speech. In the recognition task, participants were shown two photographs of the same person (a reassuring one and a threatening one) and were asked to indicate which photographs had been previously presented. Socials phobics, compared to normal controls, were less accurate in identifying the expression associated with faces that they had previously seen. This accuracy bias was mediated by the anxiety state generated by the speech task. But, contrary to the results of Lundh and Öst (1996) and Foa, Gilboa-Schechtman, Amir, and Freshman (2000), social phobics did not exhibit a memory bias towards threatening facial expressions.

In this section, we reviewed three studies on memory bias in social phobia using three different methodologies. The results are inconsistent. Fox and al. (2000) and Lundh and Öst (1996) evidenced an enhanced memory for negative faces whereas Pérez-López and Woody (2001) did not observed this bias but showed that social phobics were less accurate than non-anxious controls in a facial recognition memory task.

CONCLUSION

In this chapter, we have presented several lines of research investigating emotional facial expression in normal individuals and in those suffering from anxiety. Studies on decoding and detection of emotional facial expression as well as studies on physiological and expressive responses to emotional facial expression confirmed that human beings have an innate ability to process emotional facial expression, in general, and threatening expression in particular. This conclusion is consistent with the Darwin's evolutionary view of emotion and with Seligman's theory of "preparedness" (1971) that states that individuals are prepared to react emotionally to fear-relevant situation.

At a psychopathological level, many cognitive models postulate that cognitive biases, including evaluative, attentional and memory biases, play a key role in anxiety disorders. Specifically, most cognitive models of anxiety assume that anxious individuals overestimate threat in facial expressions, preferentially allocate attention to threatening face and better recall and recognize negative faces. Some models (e.g. Mogg and Bradley, 1998) postulate a causal link between evaluative and attentional biases: Attentional biases in anxious individuals may result from a negative and automatic appraisal of anxiogenic situations.

While there are strong evidences that generalized anxious individuals and individuals with a high anxiety-trait show an attentional bias towards anger and fear faces, the direction of the bias is less clear for social phobia. Further research is needed to explore the direction of this bias. This issue is particularly important for the comprehension of the most prevalent anxiety disorders: social phobia. In fact, opposed results regarding this bias in social phobia can be found in the literature: some studies evidencing a bias *towards* threatening faces (hypervigilance for threat), others reporting a bias *away* from threatening faces (avoidance). We have shown that these diverging results come from two paradigms differing in their control condition. In the Bradley, Mogg and co-workers's studies, both threatening and

control material were facial expressions while in Clark, Chen and co-workers' studies, target stimuli were emotional facial expression and control stimuli household objects. A vigilance bias for threatening facial expression is congruent with several cognitive models of general anxiety (Beck and al., 1985; Mogg and Bradley, 1998) and social phobia (Rapee and Heimberg, 1997) whereas an avoidance bias supports Clark and Wells' (1995) model of social phobia. The latter model suggestes that social phobics avoid external threat cues and focus their attention on internal threat cues (anxiety symptoms). A hypervigilance-avoidance model has been proposed to reconciliate theses discrepant findings (Amir and al., 2002).

Quite evidently, further research has to specify the nature of these attentional biases in social phobia. Firstly, studies should compare allocation of attention to facial expression at different stages of the information processing, in order to determine whether attention allocation shifts from threatening to non-threatening stimuli. Secondly, studies should design, in the same experiment, two control conditions, one with neutral faces, and one with non-facial neutral information. Finally, studies should investigate the competition in attention allocation between external and internal cues.

In any case, several cognitive models (Beck and al., 1985; Mogg and Bradley, 1998) postulate that attentional biases are the consequence of an evaluative bias. In social phobia, Clark and Well's model (1995) suggests a more elaborate bias in the appraisal of social situations: Social phobics would appraise social situations as more threatening because they hold negative assumptions on their ability to behave adequately and on negative consequences of their behaviours. There is also a strong belief among clinicians in the existence of bias or of deficit in the interpretation of others' emotional signals, especially of others' facial expression.

However, despite a clinical belief and theoretical claims, studies we reviewed didn't show an explicit evaluative bias for facial expression in social phobics. This discrepancy between theoretical and clinician believes, on one hand, and experimental evidences, on the other hand, open a debate that is particularly important for treatment perspectives. Should anxious individuals be trained to reappraise more positively anxiogenic situation—a proposal implying that they are biased in their evaluation of such situation? Or, rather, should they be trained to confront and sustain voluntary their attention on threat cues—a proposal implying that their attentional bias plays a major role in the elicitation and maintenance of anxiety? Present evidences seem to favour the latter solution. However, moreresearch is needed to disentangled this Gordian node of anxiety.

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