



Interpretation of ambiguous social scenarios in social phobia and depression: Evidence from event-related brain potentials

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ABSTRACT

In the current study, event-related potentials (ERPs) and behavioral responses were measured in individuals meeting diagnostic criteria for social phobia, depression, their combination, or neither in order to examine the unique and combined effects of social phobia and depression on the interpretation of ambiguous social scenarios. ERPs revealed a lack of positive interpretation bias and some suggestion of a negative bias in the semantic expectancy N4 component across all clinical groups. Furthermore, socially phobic and comorbid individuals showed reductions in baseline attention allocation to the task, as indexed by P6 amplitude. RT and accuracy likewise revealed a lack of positive interpretation bias across disordered groups. When considered on a continuum across all samples, social phobia and depression symptoms were related to the N4 interpretation bias effect whereas P6 amplitude reduction and RT interpretation bias appeared uniquely associated with social phobia.

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1. Introduction

Much of the information transmitted between individuals in social contexts is ambiguous. What does it mean when someone smiles at you when you are giving a speech? Is that a signal of positive reinforcement for a job well done or a mocking gesture underneath which a snarky chuckle resides? The interpretation of social ambiguity is particularly relevant to social anxiety because individuals with social phobia experience overwhelming anxiety in and avoidance of social situations that may result from maladaptive interpretations of ambiguous social information (Hirsch and Clark, 2004). The body of research in this area generally refers to one who tends to interpret ambiguous social information in a more negative light (e.g., that person smiling in the audience is mocking me) as having a *negative interpretation bias* whereas one who tends to interpret ambiguous social information in a positive light (e.g., that person smiling in the audience thinks I am doing a good job) as having a *positive interpretation bias*.

Given the beliefs most socially phobic individuals hold about themselves (e.g., "I am uninteresting"; Clark and Wells, 1995; Rapee and Heimberg, 1997), it seems logical to propose that individuals with social phobia must suffer from a negative interpretation

bias. Indeed, studies employing self-report questionnaires generally demonstrate the presence of a negative interpretation bias in social phobia. For example, socially phobic individuals spontaneously generate more negative endings to ambiguous social scenarios (Franklin et al., 2005; Huppert et al., 2007; Stopa and Clark, 2000) and rate negative and ambiguous scenarios as being similar to each other (Amir et al., 1998; Huppert et al., 2003; Murphy et al., 2007). Such findings, however, do not speak directly to how socially phobic individuals interpret incoming social information at the time it is first encountered. The thoughts and beliefs measured by self-report questionnaires are acquired 'offline', such that they require the individual to contemplate their response to a social event in either an anticipatory or retrospective fashion.

How do socially phobic individuals immediately process and respond to real-time (online) ambiguous information (e.g., a stranger smiling during a speech)? Clark and Wells (1995) suggested that individuals with social phobia direct attention inward toward negative self-talk and -imagery during social interactions and thus fail to fully process external information. It may be then that individuals with social phobia do not make 'online' interpretations of social information when it is initially being processed because of internal focus and subsequently rely on their pre-existing negative beliefs and images about themselves when they recover from and anticipate future social interactions. Since 2000, Hirsch and colleagues have tested this hypothesis in a number of studies using reaction time (RT) paradigms that presumably measure 'online' interpretation bias because they require quick

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responses to ambiguous information (see Hirsch et al., 2006 for a review). In their seminal paper, Hirsch and Mathews (2000) employed an ambiguous passage task in which socially phobic patients and controls were asked to make lexical decisions about words completing ambiguous sentences in a positive or negative manner. They found that controls were faster to respond to words that completed the ambiguous sentences in a positive manner, whereas socially phobic patients demonstrated no bias; that is, the RTs of individuals with social phobia were indistinguishable between negative and positive sentence endings. This effect in individuals with social phobia has since been termed a 'lack of positive bias'. A follow-up study by Hirsch et al. (2003) showed that when non-phobic individuals were instructed to hold negative self-images in mind while completing the ambiguous sentence task they evidenced a lack of positive bias further supporting the notion that negative self-imagery blocks positive interpretation bias. The model proposed by Clark and Wells that has been borne out by Hirsch and colleagues reconciles the seeming differences between offline and online measures of interpretation bias and suggests that both reflect the influence of negative self-imagery/talk. Thus, offline and online measures should not be thought of as reflecting different interpretation biases per se, but rather as measures reflecting the impact of negative self-imagery/talk on interpretation at different stages of information processing.

Although the studies described above offer insights into interpretation bias in social phobia, it is inherently difficult to determine the exact nature and time course of the bias because they employed measures (self-report and RT) that reflect an amalgam of cognitive processes such as stimulus detection, identification, categorization, response selection, and response execution. Given the model proposed by Clark and Wells (1995) and the nuances of interpretation bias revealed by different measures, we recently addressed this issue using event-related brain potentials (ERPs) to study interpretation bias in social phobia (Moser et al., 2008). ERPs are ideally suited for this work because they are direct measures of online neural activity characterized by excellent temporal resolution. Specifically, ERP waveforms allow for the examination of the sequence of constituent operations involved in stimulus- and response-processing on the order of milliseconds. Stimulus-related processes are reflected in stimulus-locked ERPs that occur as the operative stimulus is initially being attended to and registered in working memory. Response-related processes are reflected in response-locked ERPs that occur around the time that an action is taken toward the stimulus and typically follow the processes reflected in stimulus-locked ERPs. Therefore, ERPs provide more specific information about the mechanisms underlying interpretation bias and help to separate out processes involved in stimulus evaluation from those of response execution. ERPs may also be especially sensitive to detecting the presence of biases, as several studies have demonstrated ERP differences between negative affective (anxious and depressed) and control groups in the face of comparable behavioral performance (Fallgatter et al., 2004; Hajcak et al., 2003, 2004; Hajcak and Simons, 2002; Shestyuk et al., 2005).

In our first ERP study (Moser et al., 2008), we employed a sentence-processing task similar to that of Hirsch and Mathews (2000) in which ambiguous social scenarios were completed with either a negative or positive terminal word. We found that the P6 component of the ERP revealed a lack of positive interpretation bias in high socially phobic community volunteers. The P6 is a stimulus-locked ERP that shows its maximal amplitude at the center of the head, peaks around 600 ms, and whose amplitude is enhanced by violations of expectancy related to identification and categorization (Coulson et al., 1998a,b; Gunter et al., 1997). Specifically, when a reader's expectations are violated in sentence processing tasks, enhanced P6 is proposed to reflect the language system's check of the reader's initial analysis of the sentence (van Herten et al., 2005),

as if to say "Did I read that correctly the first time? I better go back and check". Whereas low phobic individuals evidenced larger P6 amplitudes to sentence endings that completed ambiguous social scenarios in a negative fashion, the high socially phobic individuals showed equally large P6 amplitudes to negative and positive sentence endings. That is, low phobic individuals evidenced a positive interpretation bias because negative endings were seen as more unexpected/violating their expectations whereas high phobic individuals showed no bias. The lack of positive bias we reported in the P6 is consistent with Hirsch and Mathews's (2000) RT finding and Clark and Wells's (1995) theoretical model.

Although this study showed preliminary evidence that ERPs may contribute additional information to the study of interpretation bias in social phobia, it suffered from two limitations: (1) it did not have interview-based Diagnostic and Statistical Manual (DSM; American Psychiatric Association, 1994) diagnostic information on participants from either group; rather, participants were grouped based on extreme scores on a self-report questionnaire, the Social Phobia Inventory (SPIN; Connor et al., 2000), and (2) the socially phobic group also showed higher levels of self-reported depression than the low socially phobic group. Therefore, it is important to ascertain whether the findings would generalize to individuals diagnosed with social phobia. Moreover, the role of depression in the above findings is particularly important given that social phobia and depression are highly comorbid (Lépine and Lellouch, 1995; Ohayon and Schatzberg, 2010; Regier et al., 1998) and share common features, yet it is unclear whether they share similar underlying mechanisms (Brown et al., 1998; Heinrichs and Hofmann, 2001; Hirsch and Clark, 2004; Huppert, 2008; Kessler et al., 1994).

There is considerable overlap in cognitive theories of social phobia and depression, especially as both are proposed to involve biased processing of social signals (Abramson et al., 1989; Clark and Beck, 1991; Coyne, 1976; Hirsch and Clark, 2004; Joiner, 2000; McCann and Lalonde, 1993; Rapee and Heimberg, 1997). Depression (Butler and Mathews, 1983; Nunn et al., 1997) and social phobia (see above review) are both associated with a negative interpretation bias in studies using self-report measures. This negative interpretation bias in depression is indeed applied to social situations (Anderson and Arnoult, 1985; Bruch and Belkin, 2001). Furthermore, comorbid depression seems to exacerbate the tendency for socially phobic patients to believe that negative social events will result in a variety of negative consequences (Wilson and Rapee, 2005). Some have therefore concluded that social phobia and depression share a common interpretation bias (e.g., Mathews and MacLeod, 2005).

On the other hand, studies of online interpretation bias in depression do not yield a consistent picture. Lawson and MacLeod (1999), for example, failed to show an interpretation bias in depression using an ambiguous sentence-priming RT task. Recently, however, Dearing and Gotlib (2009) found an interpretation bias in young females at risk for developing depression using a RT paradigm similar to that of Hirsch and Mathews (2000). Although the authors interpreted their findings as evidence for a negative bias in the at-risk females, in fact, the group difference was due to faster RTs to positive endings in the control group and not to differences between the positive and negative endings in the at-risk group. Hirsch and Mathews interpreted the same pattern of findings in their study of social phobia as evidence for a lack of positive bias. Last, because it has been argued that reaction time is more variable and thus less reliable in depressed populations for reasons such as psychomotor retardation, Lawson et al. (2002) used the startle eyeblink response to study interpretation bias in depression. Findings from their study revealed a negative interpretation bias in individuals scoring high on self-reported depression symptoms.

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