The current study employs a social neuroscience paradigm to investigate husband’s neuroaffective reactions to advice and support. Nine husbands listened to advice statements from their wives in a functional magnetic resonance imaging scanner (fMRI). Advice statements were categorized as either high or low in self-relevance for the husbands as described by the Self Evaluation Maintenance model (SEM) proposed by Tesser (1988). SEM predicts that partners will engage in more affective processing of high relevance than low relevance advice. Results indicated that highly self-relevant advice was associated with greater activation in the left retrosplenial (RC) and dorsal medial prefrontal cortices (MPFC). Activation in the RC was significantly related to the husbands’ self-reported depressive symptomatology. Findings suggest that couples should avoid highly self-relevant topics when attempting to provide support and that dysphoric individuals may interpret advice more negatively.

INDEX WORDS: fMRI, Social Support, Social Neuroscience, Depression, Marital Therapy, Advice
TELLING YOUNG HUSBANDS HOW TO FIX THEIR PROBLEMS: THE BRAIN'S REACTIONS TO POINTED ADVICE

by

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DEDICATION

I would like to dedicate this in honor of my mother, my father, my stepfather and my brother. They have all helped me tremendously along the way.
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I would like to thank all of my committee members, Steven Beach, Stephen Miller, and Nader Amir. In my case, they were not simply “just” a committee, but extremely patient in answering my frequent questions throughout the process. Through their guidance, I have felt extremely supported, challenged, and guided towards becoming an independent researcher. I am grateful to Dr. Nathan Yanasak for his help with the study design, teaching me to use SPM, and the innumerable ideas he passed along. His role extended well beyond the requirements of his job description, and without him, this project would have been impossible. I would like to thank Jess Abbott for assisting me in the early stages of the literature review and piloting, and Greg Noza for additional facilitation of the literature review. I am grateful to Andrea Pruijssers for her help and support as a developing scientist. Finally, I would like to give extra thanks to Steve Beach again, for accepting me as his student, and for his continued faith in me and the project.
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Introduction

In the current proposal, I will present a rationale and method for examining neurological reactions to supportive advice in married couples. The rationale is based on three diverse literatures: 1) Social support, 2) the self-evaluation maintenance model (SEM), and 3) social and affective neuroscience. In discussing social support, I will provide a basis for investigating supportive transactions within the marital context. I then propose that the SEM model represents a strong theoretical framework from which to examine partner reactions to support. Finally, in addressing the functional neuroanatomy of the limbic system I provide a rationale for examining particular areas of the brain.

What is Social Support, and Why is it Important?

It is clear that the support received from friends, family and spouses has an enormous influence on well-being across the lifespan. Hundreds of studies have demonstrated that social support is intimately tied to mental, as well as physical health (Cutrona, 1996; Wills & Shinar, 2000). Successful support provision is believed to be critical to relationship stability (Bradbury, Fincham, & Beach, 2000) and support seeking appears to be a key mechanism for coping across the lifespan (Cutrona, 1996). Furthermore, the support one receives from a significant other has distinct benefits (Brown & Harris, 1978; Julien & Markman, 1991). The person from whom we are most likely to receive support is a spouse or intimate partner (S. R. Beach, Martin, Blum, & Roman, 1993). Support from friends, co-workers, and other family members does not compensate for a lack of spousal support across the lifespan (Brown & Harris, 1978; Julien & Markman, 1991). This suggests that understanding support in the context of intimate
relationships is of particular importance if we are to understand the health promoting implications of social support.

The term “social support” is quite broad and encompasses a number of behaviors and processes that appear disparate. As a result, theorists in the area have attempted to describe sub-types of social support that help to better define and to clarify this construct. In 1974, Weis described six types of support including reassurance of worth, reliable alliance, attachment, social integration, guidance, and nurturing. Weis’ conceptualization clarified our understanding of “emotional sustainment.” That is, Weis’ work focused primarily on emotional processes that created a sense of connection. Extending this line of theorizing, Gottlieb (1978) called greater attention to problem solving behaviors. This could be viewed as amplifying the element of social support that Weis had referred to as “guidance.” Cutrona (1990) further elucidated and refined the emerging directive/non-directive dichotomy by describing these two processes as either “action-facilitating” or “nurturant” support. Since Cutrona’s description and her work on the optimal matching hypothesis, there has been a general acceptance of the distinction between these two distinct domains of social support.

Though the health enhancing effects of support have been well documented, there is mounting evidence that certain forms of directive support may harbor a darker side. At a minimum, some types of support that are meant to facilitate direct action are more complex than support designed to be nurturant (Cutrona, 1990). Specifically, advice, even when it is well intentioned, has the potential to cause negative emotional reactions. These reactions may be further complicated in the presence of depression or marital discord (Beach & Gupta, 2005).
Social Support and Social Neuroscience

Previous research on social support has relied upon self-report, and more recently, reaction time methodologies to explore the relationships between social support, affective reactions, and health outcome measures. However, recent technological advances have made available a host of non-invasive neuroimaging techniques, which may provide a powerful new perspective from which to investigate these questions. Affective processes are related to specific neurological structures and emotion systems (Elkin et al., 1989; Harlow, 1848; LeDoux, 1996). However, virtually nothing is known about the underlying neuroanatomy associated with social support. The current study employs functional magnetic resonance imaging (fMRI) to examine husbands’ neurological reactions while listening to advice from their wives. We hope to provide an alternate perspective from which to examine the possible affective consequences of social support and advice.

It has long been hypothesized that social information is intimately linked to emotions (Berntson & Cacioppo, 2004; Cannon, 1927; Darwin, 1872; James, 1884). In recent years data has demonstrated that emotions can be linked to neuronal activation. Currently however, to the best of the author’s knowledge, no biosocial model has attempted to explain affective reactions to advice and support. To examine these relationships, we therefore attempt to synthesize across what have traditionally been considered separate literatures.

In the current study we utilize the self-evaluation maintenance model (SEM) to predict what types of advice statements will produce affective reactions. What follows is: 1) a description of SEM’s theoretical components, 2) a review of affective and social neuroscience literature and 3) a rationale for why high relevance advice should activate specific socioaffective brain systems.
Self Evaluation Maintenance

SEM offers a rich theoretical framework from which to examine the components of advice (Tesser, 1988). It posits that we have systematic ways of reacting to information that is inconsistent with how we view ourselves. SEM is a theory of self-evaluative homeostasis. That is, when one's self-evaluation is threatened, predictable actions will be taken in order to "maintain" one's self-evaluation.

There are three components, according to the SEM model, which interact to maintain homeostasis in self-evaluation: 1) the closeness of those involved, 2) an indication of poor or good performance and 3) the level of self-relevance. Let us examine the role of these components within the current study. Closeness in this case is considered the social relationship between the advice giver and the advice receiver. A spouse is considered "closer" than a stranger one meets on the street. “Closeness” is expected to increase the threat to one’s self-evaluation as well as the potential for self-evaluation enhancement. In the current study, married couples evaluate each other via advice. For this reason, closeness is of special interest given that married couples are seen as having one of the "closest" relationships. The SEM model would predict that the “closer” one is to the advice giver, the greater the potential for the information to be seen as being emotionally relevant.

Poor or good performance is defined in terms of being outperformed rather than outperforming another. Applied to the social support context, this suggests that receipt of directive advice is always an instance of being outperformed by another. For example, a husband who responds to his wife's worries about their financial future by suggesting that she work harder to bring in more money would be viewed as giving a poor performance evaluation, as he would be outperforming his partner by placing himself in the position of giving her advice on how to
perform. In response to being outperformed, the wife would need to make strategic adjustments. She could distance herself from her partner, decide that it was bad advice thereby reducing the threat, or decide that earning money was not an important area for her. Conversely, she could decide that it would be a good idea to get another job, thereby improving her performance in that domain. If she was not able to make any of these adjustments she would suffer a loss in self-evaluation and experience negative affect (Tesser, 1988). If this characterization is correct, advice given in a high self-relevance area should be associated with considerable affective processing as the individual makes adjustments.

Self-relevance is defined as how central the target behavior is to one's self-definition. In this view, there are many things at which a person can be good – but only a limited number that are truly important or defining for a particular individual. For example, imagine a successful faculty member in a given academic department. If someone outside of the department offered them advice on how to improve their golf game and the faculty member had only recently begun to play, they would likely welcome the advice. However, if someone else offered advice on ways that the faculty member could improve their research they might react defensively. SEM predicts that threats to relevant areas of personal expertise will have a greater potential to influence self-evaluation than will threats to areas low in personal relevance. This prediction, which is later described in more detail, is tested in the current study.

The way in which we predict that these components will interact in the current study is perhaps more easily demonstrated through another example. Imagine a tired husband returning home from a difficult day at work. We will call the “hard working husband” Jack and the “well intentioned wife” Jill. Jack goes into the kitchen to get a glass of water and is greeted by his smiling wife. Jack says “Hi honey! How are you doing? I am exhausted! The traffic was horrible
today.” In a caring gesture, Jill offers the suggestion “You poor thing, you look exhausted! You have really been working late with that extra project you volunteered for. Maybe you should try to cut back a little?” Jack, who prides himself on his hardworking nature, becomes defensive to this comment and starts an argument with his wife. Through this defensive reaction one can see how in attempting to provide support for her spouse, Jill has unwittingly produced exactly the opposite effect she intended.

**Empirical Support for SEM**

Pleban & Tesser (1981) manipulated the relevance of a performance task to see what effect it would have on ratings of closeness to a confederate to which a participant was being compared. Using a "college bowl" competition scenario, they found that for subjects who performed poorly, the more relevant the questions were to the participant’s self-definition, the less close they later rated themselves to the confederate. Pleban & Tesser (1981) not only measured how subjects rated the closeness of the competitor (e.g. “How much are you and the confederate alike”) they actually measured the physical distance the participant sat from the confederate in the waiting room afterwards. This study demonstrated that when compared on a relevant performance domain, where performance is deemed to be poor, one will attempt to maintain self-evaluation by decreasing the closeness, both cognitively and behaviorally with those to whom one is being compared.

Similarly, Beach and Tesser (1995) examined the effects of SEM processes on couples’ ability to solve problems. Using a computer, couples competed in a trivial pursuit style game where each could see their score, respective to their partner’s. In this way, during the game, each partner would experience either a positive or a negative comparison depending on his or her score. Afterwards, couples were instructed to engage in a ten-minute problem solving interaction
where their behavior was coded and analyzed. As predicted by the SEM model, results showed that couples who experienced negative reflection or comparison during the game exhibited negative behavior towards their partners during the problem-solving task.

SEM dynamics become particularly potent when each of the three components, closeness, performance, and relevance are held constant. Under these conditions, one is unable to use cognitive or behavioral means to manipulate the situation in order to maintain self-evaluation. In these circumstances, individuals will experience what Tesser & Millar (1988) termed an “affective outcropping”. That is, when one is unable to use SEM strategies in order to adjust, and maintain one’s self-evaluation, a negative affective reaction will follow. In a series of three studies, Tesser and Millar (1988) demonstrated this phenomenon by giving individuals negative performance feedback, compared with their close friends, on highly self-relevant topics. Participants exhibited an affective outcropping by: 1) reporting greater negative emotional arousal 2) rating emotional words more negatively, and 3) displaying negatively affective faces as rated by behavioral coding. This demonstrated that when one is unable to maintain self-evaluation, the effect is an upwelling of negative emotions.

Social and Emotional Systems in the Brain

It has long been proposed that social situations and emotions are intimately connected (Berntson & Cacioppo, 2004; Cannon, 1927; Darwin, 1872; James, 1884). Recent technological advances in neuroimaging techniques have begun to allow researchers to answer new questions regarding the relationship between social, emotional and neurological processes. In particular, this has been made possible by the advent of functional magnetic resonance imaging. Accordingly, a number of studies have associated social processes with activation through broadly distributed neuroanatomical regions, most of which overlap and connect to the limbic
system. Different social situations and stimulus modalities appear to interact in order to activate specific regions, or systems in a social-affective network. Some of the first studies to investigate this found localized activation for facial recognition (Kanwisher, McDermott, & Chun, 1997). Research began to provide strong evidence for the existence of several neurological substrata involved in viewing different emotional expressions (R. Adolphs, Tranel, Damasio, & Damasio, 1994; Ralph Adolphs, Tranel, Damasio, & Damasio, 1995; Ekman, 1992; Morris et al., 1998; M. L. Phillips et al., 1997). Replication of these findings demonstrated that faces showing expressions of fear for example activate the amygdala and a posterior region of the orbital frontal cortex. The amygdala responds as well to presentations of happy facial expressions. Like most limbic region in the brain, the amygdaloid cluster is part of an emotion system rather than an emotion specific structure. This highlights one difficulty researchers have encountered in attempting to construct a neuroaffective map (Phan, Wager, Taylor, & Liberzon, 2002).

Initial attempts to chart a social-emotional system in humans relied primarily on visual stimuli; however it seemed essential to include other sensory modalities for more ecologically valid studies. Unfortunately, the results for many of these experiments were complex and difficult to interpret. Threat related vocal utterances activated posterior parietal regions (Maddock & Buonocore, 1997b), an area which shares no direct connections with the amygdala (Barak, 1979). Other studies involving social auditory emotional stimuli found activation in dorsal and ventral portions of the anterior cingulate cortex (Bush, Luu, & Posner, 2000), medial and lateral regions of the temporal lobes (Phan et al., 2002), and a host of seemingly unrelated portions of the prefrontal cortex (Steele & Lawrie, 2004).

Mapping a social-emotional network has proved to be an elusive task (Papez, 1937). We know that the brain is not a series of independently activated regions. Rather, it is a complex
network of functionally interconnected systems (Cacioppo et al., 2003; Uttal, 2001). Interpreting activation findings without the guidance of a unified theory has the possibility to lead one on a wild goose chase (Pulvermüller, 2002). Recently, several socioaffective networks have been proposed. For example, Lieberman et al. (2004) suggest that two social networks are recruited depending on the nature of one’s social processing. These two networks are distinguished as either automatic or controlled processing of self-knowledge. They describe the automatic system as the “X” system for the “X” in reflexive. It represents activation for quickly processed information in a group of structures consisting of the amygdala, the nucleus accumbens, the ventral medial prefrontal cortex, and the lateral temporal cortices. Conversely, they entitle the controlled system as the “C” system, for the “C” in reflective. It is involved in effortful, controlled processing, which is distributed through the posterior parietal region, the lateral prefrontal cortex, the hippocampus, and the medial temporal lobe.

Lieberman’s systems correspond with several metanalyses that have attempted to organize findings from hundreds of neuroimaging studies. Phan et al. (2002) reviewed 55 PET and fMRI studies to discern patterns of activation across individual emotions (fear, disgust, happiness, sadness, and anger) cross referenced by the emotion induction method (e.g. visual, auditory, olfactory, etc.). By examining 761 individual peak activations, Phan et al. concluded that the superior portion of the prefrontal cortex is involved in “general” emotional processing. Their findings indicated that this region was activated in the majority of emotion induction tasks, independent of the stimulus modality or the individual emotion.

In a separate metanalysis, Phillips et al. (2003a) further classified these findings, arguing for the existence of two complimentary emotional systems. The ventral system includes the amygdala, the insula and ventral regions of the anterior cingulate, the prefrontal cortex, and the
striatum. The dorsal system contains the hippocampus and dorsal regions of the anterior cingulate, and the prefrontal cortex. They propose that the ventral stream has two main functions: 1) to identify emotionally significant information in the environment, and 2) to produce an affective state. They believe that the dorsal stream is involved in affect regulation. Several other reviews support the distinction between these two systems (Bush et al., 2000; Mary L. Phillips, Drevets, Rauch, & Lane, 2003b; Steele & Lawrie, 2004).

**Hypotheses**

In order to better understand the neuroaffective mechanisms that may be operating for married couples when attempting to provide social support, we offer the following hypotheses:

1. Based on Tesser’s theorizing on SEM and affective outcroppings, it was predicted that listening to advice in highly self-relevant topics would produce more neurological activity in affective regions of the brain than listening to low relevance advice.

2. High relevance advice was also hypothesized to produce activation in emotion regulation centers, and that this response will correspond to the dorsal (Mary L. Phillips et al., 2003a), or “C” system (Lieberman et al., 2004) consisting of the medial prefrontal cortex and posterior parietal regions.

3. Based on recent work by Beach & Gupta (2005) it was predicted that the level of neuronal activation would be related to depressive symptomatology. Specifically, greater depressive symptomatology would be related to greater activation of the “X” and “C” systems in response to potentially threatening advice.
High relevance statements are hypothesized to be associated with dorsal emotion regulation systems for several reasons. Activation is expected to be recruited by structures involved in 1) emotion regulation, 2) self-reference and 3) auditory sensation. Activation may also be related to depressive symptomology based on recent findings regarding couple’s reactions to directive advice (Beach & Gupta, 2005).

Emotionally salient information is known to activate neuroaffective systems (Liberzon, Phan, Decker, & Taylor, 2003a, 2003b; McCabe, Gotlib, & Martin, 2000; Phan, Liberzon, Welsh, Britton, & Taylor, 2003; Phan et al., 2004). Emotional regulation systems are usually activated in parallel with arousal (Levenson, 1992). Some aspects of this system are specifically attuned to information that must be acted upon immediately, such as James’s famous bear example (1884). However, unlike imminent danger, the majority of our day to day threats are more subtle than this. Social situations often fall in this category (Amir, Bower, Briks, & Freshman, 2003; Cacioppo, 1998; Hawkley, Burleson, Berntson, & Cacioppo, 2003). Emotionally significant “threats” might simply arrive in the form of criticism, distain, or contempt during a routine conversation (John Mordechai Gottman & Levenson, 1999). Additionally, social situations are such that it is often considered inappropriate to display a strong emotion (Gross & Levenson, 1997). Thus, we often must regulate our emotions in real-time as the “threat” unfolds (John M. Gottman, 1999). Such threat situations may require that one refrains from automatically displaying excessive emotionality, thereby activating an emotion regulation system (Lindahl & Markman, 1990).

One region which has been shown to be critical for emotion regulation is the dorsal MPFC (Davidson, Pizzagalli, Nitschke, & Putnam, 2002; Davidson, Scherer et al., 2003; Tucker,
Luu, & Pribram, 1995). Phan et al (2005) found increased activity in the dorsal MPFC when subjects were asked to regulate their emotions viewing emotionally evocative pictures. Ochsner et al. (2004) instructed participants to positively reappraise negative photographs. Consistent with others, they found activation in the dorsal lateral prefrontal cortex associated with cognitive reevaluation.

High relevance advice should also be associated with self-referential memory and threat. The retrosplenial cortex (RC) has been shown to be activated for self-referential memory, valance judgments of emotional words, as well as threat related words (Maddock, Buonocore, Kile, & Garrett, 2003; Maddock, Garrett, & Buonocore, 2003). The retrosplenial cortex and the dorsal medial prefrontal cortex are both activated in response to self-referential material. Hargrave, Maddock, & Stone (2002) found hypoactivation in posterior parietal regions for patients in the early stages of Alzheimer’s. As the disease progresses, access to self-referential knowledge decreases. This supports the RC’s role in self-knowledge. Maddock (1999) proposed that the RC is involved in threat related information as well. The retrosplenial cortex receives input from dorsal medial prefrontal regions. Like the RC, the dorsal MPFC also may play a role in processing self-referential information. Phan et al. (2004) found a positive correlation between the dorsal MPFC’s BOLD response to ratings of self-relevance for emotional words.

Additionally, high relevance should produce activation linked to acoustic emotion areas. The retrosplenial cortex receives projections from auditory structures in the temporal gyrus (Van Hoesen, 1993; Vogt, Absher, & Bush, 2000). Moreover, Maddock’s threat related word experiments supported the notion that activation in the RC’s left hemisphere was related to the verbal material. Selke, McDonald, & Bowers (2003) hypothesized that the RC was specifically tuned to auditory emotional stimuli. To test this, they conducted a series of experiments with
patient L.C. While his hearing remained otherwise normal, L.C.’s left retrosplenial cortex had been surgically removed (Selke et al., 2003). Compared to eight normal controls, L.C. demonstrated decreased galvanic skin response to unpleasant auditory emotional stimuli.

For the current study, it is worth noting that the dorsal system reacts to regulate the emotional responses which are produced by the ventral system. Specifically, the dorsal system is thought to inhibit the ventral system’s production of affective states (Mary L. Phillips et al., 2003a). Thus, though we expect activation of dorsal structures in response to high relevance advice, it seems likely that they are indeed activated in order to regulate, or inhibit the ventral structures. Previous research has suggested that these ventral regions are recruited for more “serious”, imminently dangerous threats (LeDoux, 1992; M. L. Phillips et al., 1997). Thus, it may be the case that the ventral system is activated for high relevance advice; however the threat associated with the advice is not sufficiently grave to overcome inhibition from the dorsal regulation system.

Related to this, numerous studies have found decreased activation in dorsal structures related to depressive symptomatology (Baxter, 1989; Bench, 1993; Brody, 1999; Davidson, Irwin, Anderle, & Kalin, 2003; Henriches & Davidson, 1991). Marital discord is tied to depression (S. R. Beach & O’Leary, 1992, 1993; Bradbury, Beach, Fincham, & Nelson, 1996). Thus, as SEM processes relate to discord (Steven R. H. Beach & Tesser, 1993; Steven R. H. Beach et al., 1996; Steven R. H. Beach, Whitaker, Jones, & Tesser, 2001; Mendolia, Beach, & Tesser, 1996), it appears likely that a relationship will exist between depression, reactions to advice, and neuronal activation in the dorsal emotion regulation system.
Methods

Participants:

12 married couples were recruited through a university survey research center using random digit dialing for the seven surrounding counties, and were paid $150 for their participation. Written consent was obtained as specified by the UGA Institutional Review Board for all participants prior to participation in the study. Husbands were between the ages of 26-34, mean = 28.5, and wives 28-33, mean = 28.5. Couples were married an average of 2.3 years (range = 1 - 4). All husbands were right handed, and had a mean education of 15.3 years (range = 13 - 18). The first participant’s data was not analyzed because of a malfunction of the headphones presenting the advice statements in the scanner. Another participant’s data was lost due to experimenter error while transferring the data from one computer to another. And finally, a third participant’s data was dropped from the analysis because of magnetic resonance artifacts.

Measures:

Participants completed the Beck Depression Inventory (BDI) (A.T. Beck, Ward, Mendelson, Mock, & Erbaugh, 1961), and the Quality of Marriage Index (Norton, 1983). The BDI is a 21-item scale designed to assess depressive symptoms for the previous week. The BDI’s reliability ranges from r = .48 - .86 and has a high internal consistency (Steer, Clark, Beck, & Ranieri, 1999). The QMI is a six item scale, which is commonly used in marital research to assess marital quality. Its reliability ranges from .45 to .74 (Norton, 1983).

Generation of Advice Statements:

Upon arrival at the UGA Neuropsychology and Memory Assessment Laboratory, participants were informed that they would be taking part in a study investigating how advice and support in married couples affects the brain. Experimenters explained to participants that the
husband’s brain would be scanned while rating prerecorded advice statements from the wife. Following this, participants filled out questionnaires and demographic information. Husbands were then escorted into a separate room with the experimenter to conduct an interview while wives remained in the waiting room. In the interview, experimenters explained the distinction between high and low relevance domains, e.g. “Something that is ‘highly relevant’ to you is something you think of yourself as being good at. In your case, as a computer consultant, you are probably pretty good with computers. Even if you are modest about that, you most likely think of yourself as being ‘more skilled than most people’ in that area. So computers are a ‘high a relevance’ domain for you. Does that make sense?” They were then asked to list three high relevance and three low relevance areas in their life. If they had difficulty with this task, they were asked to choose areas that they considered themselves to be “more of an expert in” than their wives (e.g. “I am more expert than my wife at doing _____”). For low relevance categories, they were asked to choose areas which their wives were “more expert” then them. They then completed forms to rate their relative expertise for each area, compared to their spouse. Finally, husbands were asked to “describe a current or potential problem with each of the high and low relevance areas that you listed. For example, what is a problem that you might have with computers?” Accordingly, each problem was associated with either a high or a low relevance domain for the husband. Following this, participants switched rooms with their spouse. Experimenters then conducted an interview with the wives. Wives were asked to generate directive advice statements in order to help their husband solve each of the problems they listed. Advice statements were required to take the form such as “One thing you could do to deal with the recent computer problem you’ve been having is, try sitting down with one of your co-workers to work through all the possible solutions.” The wives then recorded each of their advice
statements into a microphone connected to a computer. These files were then later used for the scan session. It is important to note, that because of the nature of the design, advice statements were idiographic.

**Simulation Session:**

Husbands were also required to participate in a “mock” scan session in order to practice the experimental task and to habituate to the scanning environment. At this time, each participant made a dental bite plate in order to minimize movement of their head within the scanner. They then entered into the mock MRI bore simulator where they viewed an identical paradigm to what was later presented to them at the real MRI, with the exception of the stimuli which were changed to generic advice statements read by the experimenters in order to insure novelty during the actual scan session.

**Experimental Paradigm:**

Subjects were assisted into the scanner and fitted with a response device on their right hand. The IFIS computer screen was also displayed above their head. Before beginning the experimental paradigm subjects were given an audio test while the scanner was engaged (i.e. producing the loud knocking sound characteristic of an MRI). This was done to insure that participants would later be able to hear the recorded pieces of advice at an adequate volume. The audio test consisted of questions such as “if you can hear this, press your index finger response button now” - “if the sound is now in your left ear, press the response button for your pinky.” All subjects answered the audio test questions correctly, indicating that they could indeed comprehend and respond to the test’s recorded instructions, and later, the advice statements. Finally, in order to assure that participants listened to the entire length of the statements, a bell
chimed after 15 seconds (the midpoint of the block) indicating that they should respond. This was also practiced in the MRI simulator prior to arriving at the scanner.

Functional scans were collected over four runs which each lasted 7 minutes and 45 seconds. The total functional scan time was therefore 31 minutes (see table 1). Within each run, there were three possible trials that were presented in randomized order, either high relevance, low relevance, or picture trial (see figure 1). This lasted half the run, or approximately 4 minutes. This same procedure was then repeated to complete the eight-minute run. Thus, in each run, stimuli were presented in two randomized groups of three (see figure 1).

1. 15 Seconds of rest: Participants were instructed to focus their attention at the center of the white “fixation” cross on the screen at the beginning of the first block for each trial.

2. For the high and low relevance advice blocks, participants experienced one of two conditions. They heard either 30 seconds of their wife giving them advice in a “high relevance problem area” or 30 seconds of advice in a “low relevance problem area.” While in the scanner the high and low relevance advice was randomized and presented in the same manner, thus, there was no visual cue for participants to know the category of the advice.

3. The third condition was a neutral task where the wife’s voices were digitally recorded giving positive partner comments. They read passages such as “I think you’re a wonderful husband because you take so much care and attention with our children.” These statements were intended to bring the participants’ BOLD response back to baseline.

4. Disgust and neutral faces from Paul Ekman “Pictures of Facial Affect” (Ekman, 1973) were shown in the second and third block of the third trial.
Scanner Protocols:

Images were acquired on a 1.5 Tesla magnetic resonance imaging scanner (GE LX Horizon: GE Medical Systems) located at Healthsouth Diagnostics of Athens, Georgia. Behavioral paradigms used E-Prime software and the Integrated Functional Imaging System (IFIS; Psychology Software Tools, Inc., 1999) hardware configurations. Three-dimensional structural T1 datasets were collected for anatomic definition. One T1 weighted 3D spoiled gradient recall image covering the head volume was acquired covering 120 locations per slab. The 3D volume is rendered in a series of 2D images with each slice corresponding to a thickness of 1.3 mm. Anatomical brain imaging was performed on each participant using the following protocol: 120 axial T1-weighted volumetric 3D Spoiled Gradient Recall (industry standard protocol – for fast high resolution 3D) images, flip angle = 20º, TR = 10.8 ms, TE = 2.8 ms, slice thickness = 1.3 mm, field of view 24 x 24 cm, and matrix size 256 x 256 pixels, for a reconstructed in-plane resolution of 0.94 mm.

T2 weighted gradient recall was used to acquire the functional volumes with a readout that traverses k space with a spiral trajectory. Four extra pulses were used at the beginning of each functional scan in order to reach magnetization saturation. The spiral scan images and the structural T1-weighted images were normalized into standard Montreal Neurological Institute (MNI) space. For blood oxygen level dependent (BOLD) fMRI imaging, a T2*-sensitive gradient recalled echo pulse sequence with a spiral readout was used. Parameters for the fMRI sequence were 1200 ms TR, 40 ms TE, 77º flip angle, two interleaves, spatial resolution = 64 X 64 mm, slice thickness = 5 mm with no gap. 15 adjacent axial slices of fMRI data were collected with the fourth slice from the most inferior part set parallel with the AC/PC line in order to
obtain data for all of the cingulate gyrus as well as the prefrontal cortex (see scan region lines in figures 2-4).

Data were analyzed using Statistical Parametric Mapping 99 (SPM, Welcome Department of Cognitive Neurology, London, UK) implemented in MatLab (Mathworks Inc., Sherborn MA). Data was prepared for statistical analysis within SPM99. Motion artifact was controlled using SPM’s realign option. Statistical parametric maps were computed to characterize regionally specific effects using the general linear model. Statistical parametric maps were computed on a voxel by voxel basis for each participant.

**Data Analysis:**

Functional neuroimaging data was processed and analyzed using Statistical Parametric Mapping 99, (SPM, Wellcome Department of Cognitive Neurology, London, UK). Functional images were first realigned to adjust for participant movement then subsequently registered to each participant’s corresponding anatomical image. Next, all images were normalized to the Montreal Neurological Institute’s (Evans et al., 1993) T1 template. Images were then smoothed using a 7.5 by 7.5 by 10 full width half maximum Gaussian kernel. Finally, linear contrasts were computed for each comparison of interest using the default settings within SPM (however, images were not globally scaled). Activations and regions of interest were verified using Automated Anatomical Labeling (Tzourio-Mazoyer et al., 2002) and cross referenced with the Talairach atlas (Talairach & Tournoux, 1988) by using a MNI to Talairach conversion routine within SPM.

For the functional group analysis, data were averaged across participants. The general linear model (GLM) within SPM was used to compute a t-test at the p. < .001 (uncorrected voxel level) comparing activation patterns for high relevance advice minus low relevance advice. A
cluster level threshold was set such that only activation patterns greater than 8 contiguous voxels were considered activated. This was done in order to decrease the type I error rate (detecting false positives) for only a few highly activated voxels (Xiong, Gao, Lancaster, & Fox, 1995).

**Results**

Data analyses were conducted in three steps. We first analyzed the behavioral data, and then analyzed the fMRI data. The self-report questionnaire data was then tabulated and correlated with the fMRI results.

**Behavioral Results:**

Participants were instructed to rate how pleasant or helpful the recorded statements were on a likert scale ranging from 1-5 depending upon the stimulus that was presented. A summary of these tasks is presented in table 2. These behavioral data were recorded by IFIS for each participant while they were in the scanner.

There was no significant difference between ratings for high relevance versus low relevance advice (DF = 8; t = 1.03; P > .31). Results of a paired samples t-test indicated a significant difference for participants’ ratings between “positive partner comments” and the low relevance advice category (DF = 8; t = 3.48; P > .01).

Participants were also asked to rate advice statements 15 seconds into each advice presentation when a bell chimed in order to insure they were attending to the length of the statements. Results indicated a mean reaction time of 19.6 seconds with a standard deviation of 5.1 seconds.
fMRI Results

High Relevance Advice > Low Relevance

Results showed activation in the retrosplenial cortex (RC), the dorsal medial prefrontal cortex (MPFC), and a superior portion of the internal capsule, slightly inferior to part of the motor cortex (see figure 2). A single participant’s data appeared responsible for the white matter activation. With this participant’s data removed, at the same significance level (p > .001), activation in the white matter was no longer visible (see figure 3). The greatest level of activation was observed in the MPFC (see table 3). To verify that the RC and the MPFC was activated across participants, a region of interest analysis (ROI) was conducted in both regions for each participant. The ROI for both RC and MPFC was defined by taking a 10 mm sphere (the approximate size of the activation clusters) from the maximum intensity projection (MIP – the most highly activated voxel within a cluster) using the small volume correction (SVC) option within SPM. At the p<.05 level, 8 out of 9 participants showed activation in the RC, and 7 out of 9 showed MPFC activation. Additionally, when the group data threshold within SPM was lowered to p<.005, additional activation was observed bilaterally in medial temporal regions (x = -54, y = -30, z = 4;) and (x = 52, y = -52, z = -2;). This result is also consistent with “C” system activation.

Low Relevance > High Relevance Advice (Deactivations)

When the contrast of low relevance advice minus high relevance advice was conducted, “X” system activation was observed in parts of the basal ganglia and the insula. The contrast of low minus high relevance advice is theoretically equivalent to metabolic deactivation while listening to high relevance advice. Specifically deactivations were observed in the putamen (x = 28, y = -
4, z = -4; p < .005) and the anterior insula (x = 42, y = 11, z = -7; p < .005). The putamen is part of the basal ganglia (Heimer, 1991). Lieberman et al. (2004) refer to it as part of the “X” system, and likewise observed deactivation in response to a task designed to activate the “C” system. The insula shares strong connections to the amygdala (Augustine, 1996) and to other ventral emotion production structures (Mary L. Phillips et al., 2003a). This area is often activated for “automatic” non-controlled emotional responses. It is possible that this deactivation is the result of an inhibitory process from the dorsal, or “C” system structures. Phillips et al. suggests that this area is involved in the overt display of emotion.

**High Relevance Advice > Facial Expressions of Neutral Affect**

Results of the contrast high relevance advice minus facial expressions of neutral affect showed activation in the superior temporal gyrus, the superior frontal gyrus (SFG), the cuneus, and the posterior cingulate cortex, or RC (see figure 4). The cuneus, which is adjacent the PCC, is often activated in conjunction with the PCC. The SFG activation is slightly rostral to the activation seen the in the high relevance > low relevance contrast. It is possible that this activation is evident because of emotion processing and affective regulation processes discussed above. This contrast was conducted to demonstrate that retrosplenial activation was related specifically to an auditory task (see Selke et al., 2003). Given the RC’s strong connections with the temporal gyrus, this is interpreted to provide evidence in the RC’s role in processing auditory emotionally valanced stimuli (see table 4). Finally, though data were also collected for participants viewing pictures of disgust and neutral faces (Ekman, 1973) with the exception of the contrast listed above, this data will be reported in a separate experiment.
Correlational Analysis:

Participant’s BDI scores were correlated with the percent signal intensity change in the RC and the MPFC. The percent signal intensity is the change in the T2* signal for a particular region relative to the signal intensity throughout the brain volume for a given contrast. An ROI was determined using the Marsbar utility within SPM (Brett, 2002). Specifically ROIs for both anatomical areas were defined as the cluster of activated voxels for each group analysis. Marsbar calculates beta weights for the activation time course which is then averaged across the ROI to obtain a percent intensity signal change value for each participant. This score was then correlated with individual’s BDI scores. Figure 5 reveals a positive correlation between BDI totals and the BOLD response in the RC ($r = .78$, $p < .02$). One out of the nine participants did not have significant activation in the RC. Results demonstrated that when conducting the correlation again excluding this participant, the relationship between BDI scores and the RC BOLD response remained significant ($r = .77$, $p < .03$). Furthermore, there was no significant relation between BDI scores and the MPFC BOLD response ($r = -.07$, $p = .87$, $ns$).

Discussion

Consistent with hypothesis 1, we found greater activation in the posterior cingulate and medial prefrontal cortex while listening to advice statements pertaining to highly self-relevant topics. Specifically, greater activation was found in the retrosplenial, or posterior cingulate cortex, and the medial prefrontal cortex. The retrosplenial area is associated with self-referential emotionally salient information (Hargrave et al., 2002; Maddock, 1999). The medial prefrontal region is involved in general emotional processing, and emotion regulation (Phan et al., 2002). These findings highlight the possible affective consequences of providing advice about a
problem that one considers important to one’s self definition and confirms previous research which has found that self-relevant information is associated with activation in affective regions (Phan et al., 2004). Highly self-relevant information is likely to be more emotionally relevant (Damasio et al., 2000) and therefore associated with activation in affective systems. It makes sense that our brains would be more attune to information that directly pertains to us. “Advice” would be expected to further augment activation in these areas since it may be perceived as a negative evaluation, or as a threat.

Results also provided support for hypothesis 2, that dorsal or “C” system regions would be activated in response to high relevance advice. These findings corroborate previous theorizing that self-relevant, emotionally “important” material will activate what Lieberman et al. (2004) termed the “C” system. Phillips et al. described (2003) patterns in posterior parietal and dorsal prefrontal areas as involving emotion regulation. By combining these neurological theories with SEM, we believe that when one’s self evaluation is threatened, top down, controlled emotion regulation processes are recruited in order to regulate, or in SEM’s terminology, to “maintain” emotional homeostasis. Moreover, it is possible that this neurological mechanism represents the biological analog of Tesser’s (1988) “affective outcropping.” The pattern of activation that was observed for high relevance advice seems to be involved with emotion regulation and controlled processing systems.

In addition to activating dorsal emotion regulation systems, results also revealed deactivations in ventral, or “X” system structures such as the anterior insula and portions of the basal ganglia, e.g. the putamen. Though a dynamic causal model was not specifically tested in the current study, it is possible that the dorsal emotion regulation structures acted to inhibit the
deactivated ventral system. This deactivation of emotion generation areas may be the result of effortful emotion regulation as participants attempted to “maintain” their self evaluation.

An important note however is that one cannot assume that activation in emotion regulation regions automatically represents negative affect. Maddock et al. (2003) found activation in the retrosplenial cortex for judgments of both positive and negative words. Phan et al. (2002) described the dorsal prefrontal cortex as an area associated with emotion processing, independent of the type of emotion (e.g. anger, positive induction, etc.).

Previous research has suggested however that it is unlikely one would react positively to directive advice. Beach & Gupta (2005) found that depressed individuals rated directive advice to be less pleasant and less helpful than non-depressed participants when compared to emotional support. Our findings support Beach & Gupta’s results that depressed individuals perceive directive advice more negatively than non-depressed individuals.

Hypothesis 3 predicted that reactions to high relevance advice would be associated with depressive symptomatology, and that greater depressive symptoms would be related to stronger activation of the “X” and “C” systems. The .78 correlation provided support for this hypothesis demonstrating a strong relationship between the BOLD response in the retrosplenial cortex and participant’s subjective report of depressive symptoms. Furthermore, the correlation was significant even with the small n of 9. These results are interpreted to mean that depressed individuals process advice, particularly highly self-relevant advice, differently than do non-depressed individuals. Consistent with the cognitive model for depression (Aaron T. Beck, 1991), it is possible that those who are depressed may be more likely to interpret directive advice negatively. It could be viewed as a statement that they are inadequate. Receiving advice in such a personal domain when depressed may simply add evidence to one’s negative self-view.
Depression may limit one’s ability to protect one’s self, or to regulate emotions. Dysphoric individuals are less able to receive the benefits of social support (Cutrona & Suhr, 1994; Davila, Bradbury, Cohan, & Tochluk, 1997). One possible reason for this is that much of support is given in the form of advice. It is possible then that depressed individuals are less able to receive social support because they interpret the advice negatively. This could represent one incarnation of a social support “stress-generation” model (Adrian & Hammen, 1993; C. Hammen, 1991; C. L. Hammen, Burge, Daley, & Davila, 1995). Through this process, dysphoria continues as one partner continually rejects offers of support. Eventually, offers of help diminish and the depressed partner is indeed left without support. This highlights the importance of spousal sensitivity to their partner’s mood so that they can provide support that will not be rejected, or interpreted negatively. In this way it may be possible to break the stress generation cycle, alleviating dysphoria by allowing spousal support to be effective.

Summary Implications for Clinical Practice

In light of these findings, there are several implications for clinical interventions with couples. In particular, marital therapist should consider relevance and depression when assisting couples to engage in supportive interactions. For example, it may be very important for couples to learn to give emotional support rather than directive advice when their partner is depressed. This is likely to be especially important for husbands given that they have been shown to be more likely to give directive advice than emotional support (Beach & Gupta, 2005). Furthermore, if problem solving is necessary, it also may be important for therapists to train couples to avoid directive advice for highly self-relevant topics. It is possible that this could exacerbate depressive symptomatology, and increase the likelihood of interpersonal discord.
It may also be important for therapists to teach couples to cope with directive advice. Even with trained couples, situations will likely arise where one partner gives directive advice which leads to an emotional, or defensive reaction. Teaching individuals coping strategies may allow them to regulate their emotions in these situations, thereby reducing the affective impact of the advice. Gottman (1999) has stressed that it is essential for husbands to be able to self-sooth in order to avoid diffuse physiological arousal and flooding. Therapists could help clients generate alternative interpretations for threatening advice e.g. “They’re actually trying to help me, and they really do have my best interests in mind.”

Finally, our findings highlight the importance of depression in the context of marital discord and social support. It may for example be necessary for therapists to address one individual’s depression prior to engaging in marital interventions designed to increase social support. That is, one partner’s attempts to provide support may be rejected, or may exacerbate discord while the other partner is depressed. In this case, treatment of depression may take precedence in order to interrupt the stress-generation cycle and allow couples to receive the benefits of social support.

Limitations

This study has limitations. Functional brain imaging data was only obtained for men. Other research in this area (Beach & Gupta, 2005) suggests that there may be meaningful gender differences for reactions to advice. Future research must surely address this.

Due to technical and design restrictions, investigators did not obtain imaging data for the entire brain. That did not allow the current study to investigate possible activations in several important structures in the inferior portion of the brain. It is therefore impossible to rule out
possible activations which would conflict with the dorsal – ventral (Mary L. Phillips et al., 2003a), or the “X” – “C” (Lieberman et al., 2004) dichotomy.

It is also possible that hypothesized activation in the retrosplenial area was confounded with high BOLD response due to the self-referential material (Hargrave et al., 2002). Though the retrosplenial cortex has been characterized as an affective region (Maddock, 1999) it clearly serves several functions. Although the current design did not allow investigators to disambiguate these two alternative hypotheses there is a growing body of literature which links the PCC to depression (Ebmeier, 2000; Gundel, O’Connor, Littrell, Fort, & Lane, 2003). The strong relation to participant’s BDI scores suggests that an affective reaction was involved. Furthermore, self-referential material is by nature affectively valanced (Phan et al., 2004). SEM theory posits that affective reactions will follow because the advice one receives is self-referential. Thus, though the RC may have been activated due to the self-referential material, it appears likely that an affective reaction is convolved with the same effect.

Another limitation was that unexpectedly, participants did not differ with respect to their subjective ratings of helpfulness regarding the high and low relevance advice statements. Furthermore, the subjects’ ratings were not related to the BOLD response in the activated brain regions. There are several possible reasons for this. The most plausible seems to be that the behavioral task was not sensitive enough to detect a differential reaction to high relevance advice versus low relevance advice. In similar research, investigators were able to ask participants for reactions to advice statements along multiple domains, including helpfulness and impact. The current design did not incorporate such a measure.

Another possible reason is that there was a ceiling effect on the data. The participants rated advice as helpful (mean = 3.98) on a 5 point scale. No participant rated any advice
statements as a “one” for helpfulness. The skewed high relevance responses (skew = -.668) indicate that the vast majority fell at the upper end of the range. It is possible that one could counter balance, or reverse code questions to account for this.

Future investigations should employ behavioral paradigms that have more variable responses in the scanner so that they are not at the upper extreme of the scale. For example, investigators could have asked participants to respond to a different kind of question, e.g. “How much better does this make you feel?” Finally, it is possible that the neuroimaging data are simply a more direct measure of an emotional response than self-report, and are therefore a more sensitive means of detecting an affective reaction.

**Future Research**

Other variables which could potentially mediate or moderate the reactions to advice are closeness, rejection sensitivity, and gender. For example, the effect of closeness was not tested in the current study. SEM however would predict that advice may be interpreted very differently from one’s spouse than from an acquaintance. The effect of this variable may be more complex depending on the nature of the relationship and the interaction (Steven R. H. Beach & Tesser, 1995). “Closeness”, or the depth of an interpersonal relationship is an important variable which deserves more scrutiny in social neuroscience. This could be tested by running a similar paradigm and varying the level of closeness by changing who gives the advice (e.g. a stranger, etc.) Rejection sensitivity has also been hypothesized to mediate defensive reactions (Levy, Ayduk, & Downey, 2001). This could be tested by administering a rejection sensitivity measure in a similar study. Finally, as mentioned previously, future research must also address gender differences with regard to neurological reactions to advice in order to gain the full picture of partners’ neurological reactions to directive advice.
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### Tables:

**Table 1: Head Volumes Per Condition**

<table>
<thead>
<tr>
<th>Time/Block</th>
<th>Block 1</th>
<th>Block 2</th>
<th>Block 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Condition 1 - Volumes</td>
<td>6 vols</td>
<td>13 vols</td>
<td>13 vols</td>
</tr>
<tr>
<td>Condition 2 - Volumes</td>
<td>6 vols</td>
<td>13 vols</td>
<td>13 vols</td>
</tr>
<tr>
<td>Condition 3 - Volumes</td>
<td>6 vols</td>
<td>13 vols</td>
<td>13 vols</td>
</tr>
</tbody>
</table>

**With 2 presentations per run, 4 runs have the following volume totals:**

| Condition 1 - Volumes | 48 vols | 104 vols | 104 vols |
| Condition 2 - Volumes | 48 vols | 104 vols | 104 vols |
| Condition 3 - Volumes | 48 vols | 104 vols | 104 vols |
Table 2: Stimuli

<table>
<thead>
<tr>
<th>Stimulus</th>
<th>Instructions</th>
<th>Rating Scale</th>
<th>Unique # of Stimuli</th>
<th># of Presentations</th>
<th>Repetitions Per Unique Stimuli</th>
</tr>
</thead>
<tbody>
<tr>
<td>HR</td>
<td><em>Please rate the helpfulness of this advice.</em></td>
<td>1-5</td>
<td>4</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>LR</td>
<td><em>Please rate the helpfulness of this advice.</em></td>
<td>1-5</td>
<td>4</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>POS</td>
<td><em>Please rate how pleasant this comment is.</em></td>
<td>1-5</td>
<td>4</td>
<td>16</td>
<td>4</td>
</tr>
<tr>
<td>DISG</td>
<td>Please rate how pleasant each face is.</td>
<td>1-5</td>
<td>4</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>NT</td>
<td>Please rate how pleasant each face is.</td>
<td>1-5</td>
<td>4</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>REST</td>
<td>Please look at the center of the cross hairs.</td>
<td>NA</td>
<td>1</td>
<td>24</td>
<td>8</td>
</tr>
</tbody>
</table>

Stimulus: HR = High Relevance Advice; LR = Low Relevance Advice; POS = Positive Partner Comments; Disgust = Disgust Faces; NT = Neutral Faces; Rest = Fixation Cross - Instructions: *Italicized font indicates the instructions were displayed on the screen while the stimulus was presented*, non-italicized font indicates participants were explained the instructions before entering the scanner – Rating Scale: Indicates the range of response choices from 1 unhelpful, or unpleasant to 5 Very “Helpful” or “Pleasant” – # of Presentations: Total number of times each category was presented (e.g. HR, LR, etc.) - Repetitions Per Unique Stimuli: Number of times each stimuli (e.g. “To help your problems at work you should try XY & Z” was heard by participants).
Table 3: Brain Regions More Active When Listening to High Relevance Advice than Low Relevance Advice (All Husbands Participants)

<table>
<thead>
<tr>
<th>Region</th>
<th>Broadman area</th>
<th>L/R</th>
<th>X</th>
<th>Y</th>
<th>Z</th>
<th>Voxels</th>
<th>Z score</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High Relevance Advice &gt; Low Relevance Advice</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MFG</td>
<td>9</td>
<td>L</td>
<td>-28</td>
<td>44</td>
<td>33</td>
<td>21</td>
<td>3.98</td>
</tr>
<tr>
<td>RC</td>
<td>31</td>
<td>L</td>
<td>-2</td>
<td>-49</td>
<td>32</td>
<td>31</td>
<td>3.61</td>
</tr>
<tr>
<td>IC</td>
<td>6</td>
<td>L</td>
<td>-24</td>
<td>-6</td>
<td>41</td>
<td>18</td>
<td>3.54</td>
</tr>
</tbody>
</table>

Note. L = left; R = right; MFG = Middle Frontal Gyrus; RC = Retrosplenial Cortex; IC = Internal Capsule
Table 4: Brain Regions More Active When Listening to High Relevance Advice than Viewing Facial Expressions of Neutral Affect (All Husbands Participants)

<table>
<thead>
<tr>
<th>Region</th>
<th>Broadman area</th>
<th>L/R</th>
<th>X</th>
<th>Y</th>
<th>Z</th>
<th>Voxels</th>
<th>Z score</th>
</tr>
</thead>
<tbody>
<tr>
<td>STG</td>
<td>22</td>
<td>L</td>
<td>-53</td>
<td>-11</td>
<td>6</td>
<td>1249</td>
<td>4.68</td>
</tr>
<tr>
<td>STG</td>
<td>22</td>
<td>R</td>
<td>57</td>
<td>-8</td>
<td>0</td>
<td>855</td>
<td>4.87</td>
</tr>
<tr>
<td>SFG</td>
<td>9</td>
<td>L</td>
<td>-8</td>
<td>56</td>
<td>32</td>
<td>9</td>
<td>3.53</td>
</tr>
<tr>
<td>Cuneus</td>
<td>18</td>
<td>L</td>
<td>-18</td>
<td>-69</td>
<td>15</td>
<td>79</td>
<td>3.37</td>
</tr>
<tr>
<td>PCC</td>
<td>23</td>
<td>R</td>
<td>2</td>
<td>-59</td>
<td>16</td>
<td>14</td>
<td>3.23</td>
</tr>
</tbody>
</table>

Note.  L = left; R = right; STG = Superior Temporal Gyrus; SFG = Superior Frontal Gyrus; PCC = Posterior Cingulate Gyrus
Figures:

Figure 1: Experimental Design
Figure 2: High Relevance Advice > Low Relevance Advice

P < .001 uncorrected – All Husbands
P < .001 uncorrected – With participant #7 removed

Figure 3: High Relevance Advice > Low Relevance Advice
Figure 4: High Relevance Advice > Facial Expressions of Neutral Affect

P < .001 uncorrected – All Husbands
Figure 5: High Relevance > Low Relevance Advice % Change Related to Husband’s BDI

(r = .78, p < .02)