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The Role of Motivation and Expectancy in the Placebo Effect

For the degree of Doctor of Philosophy

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THE ROLE OF MOTIVATION AND EXPECTANCY IN THE PLACEBO EFFECT

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of

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ABSTRACT

Aigner, Carrie J. Ph.D., Purdue University, August, 2011. The Role of Motivation and Expectancy in the Placebo Effect. Major Professor: Soren Svanum.

Placebo has been found to be an important component of treatments including psychological and pharmacological treatment of depression, transplant surgery for Parkinson's, acupuncture, smoking cessation interventions, and analgesic treatment of pain. Although the placebo effect has been observed across a wide range of disciplines, the effect sizes vary widely and it is not well understood how placebo effects are produced. The current study draws upon research in perception and motivation to propose a more comprehensive model of the placebo effect. Specifically, the model proposes that more motivated persons pay greater attention to bodily sensations and other stimuli, which are then interpreted according to expectations, producing a placebo response. In the current study, both motivation and outcome expectancy were manipulated, creating a 2x2 study design. College students (N=152) were asked to evaluate a series of placebo pheromone substances (slightly scented water) and attention/task diligence was assessed as the amount of time spent on the rating task and the number of evaluations made. The placebo response was assessed as the attractiveness rating of the chosen sample and the variability in ratings, with greater variability and higher attractiveness ratings indicating greater placebo response. It was predicted that

those in the high motivation group would have greater diligence on the rating task, which would, in turn, lead to greater placebo response. It was further predicted that there would be a main effect for expectancy on placebo response. Consistent with hypothesized effects, more highly motivated students had greater placebo responses, and the relationship was mediated by task diligence. Thus, as students spent greater time on the evaluation task, they found the scent of their chosen sample to be more pleasing and perceived greater differences among samples. No effect was found for expectancy. These findings are important because they suggest possible mechanisms for maximizing treatment effects in medical and psychological settings, where factors such as nonspecific treatment effects and placebo are believed to influence outcomes. Future research should seek to further clarify the relationship of expectancy and motivation to placebo outcomes, examining mediating factors such as attention, and carefully manipulating both variables to ensure maximum effects.

INTRODUCTION

Research on placebo largely began in the mid-20th century and has since been examined in a wide variety of phenomena across multiple disciplines (Moerman, 2002). Placebo is broadly conceptualized as an inert substance which produces beneficial change and is loosely related to phenomena such as the Hawthorne effect (Wickstrom & Bendix, 2000) and to the therapeutic effects associated with constructs such as hope (Richman, Kubzansky, Maselko, Kawachi, Choo, & Bauer, 2005), optimism (Scheier & Carver, 1992), and more controversially, religiosity (Levin, 1996). Traditionally, placebo effects have been most often studied in psychological and medical disciplines. Placebo has been found to be an important component of treatments including psychological and pharmacological treatment of depression (Kirsch & Sapirstein, 1998; Lambert & Ogles, 2004), surgeries such as transplant surgery for Parkinson's (McRae, Cherin, Yamazaki, & Diem, 2004), acupuncture (Patel, Gutzwiller, Paccaud, & Marazzi, 1989), and smoking cessation interventions (Webb, Hendricks, & Brandon, 2007), to name a few. In fact, in some cases, placebo has been found to be just as effective as commonly established 'active' treatments. For example, active placebo pills, which mimic the side effects of antidepressants, have been found to be nearly equally as effective as antidepressants in the treatment of depression, inciting controversy over whether or not antidepressants have specifically active treatment mechanisms (Moncrieff, Wessly, & Hardy, 1998). Research

on active placebo highlights the subtle methodological variations which can greatly influence the power of the placebo in different contexts.

Because placebo is a broad phenomenon which has been studied across various disciplines, definitions of terms such as “placebo response” and “placebo effect” often vary by author. In the broadest sense, “placebo” is conceptualized as any substance or procedure which has no inherent power to produce the effect which is sought (Stewart-Williams & Podd, 2004). The “placebo effect”, then, can be conceptualized as a physiological, behavioral, or perceptual effect that can be attributed to placebo. “Placebo responses” are responses on outcome variables in those persons receiving placebo. Thus, although placebo effects are attributed to a substance or procedure, they do not result from inherent powers of the substance or procedure; instead, they are produced through learning or beliefs related to the placebo (Stewart-Williams & Podd, 2004). In many studies of placebo, the established treatment is often referred to as an active treatment having specific effects, whereas placebo is deemed an inert treatment with nonspecific effects. Some have argued that classifying placebo as “inert” unfairly characterizes placebo as having no true effect, a designation which is contrary to the vast body of literature demonstrating consistent and powerful effects for placebo (Stewart-Williams & Podd, 2004). Moreover, others have argued that the labeling of placebo effects as nonspecific merely represents our current lack of understanding of placebo mechanisms and will likely change as researchers continue to provide new evidence on how placebo effects are produced (Kirsch, 1978).

Effect sizes of placebo vary widely by setting and there is evidence to suggest that placebo effects can be produced by a variety of different mechanisms (Stewart-Williams

& Podd, 2004). Many factors have been found to relate to placebo responding including characteristics of the clinician, the patient, the environment, and the placebo itself (e.g., Geers, Kosbab, Helfer, Weiland, & Wellman, 2007; Buckalew & Ross, 1981). Most of these variables have been examined within the context of an expectancy model and there is some evidence to suggest that these factors influence placebo responding through altering expectancy. Some recent theoretical models of placebo responding have included expectancy and motivation as the main mechanisms of change in placebo responding (e.g., Geers, Weiland, Kosbab, Landry, & Helfer, 2005). These expectancy-motivational models may help to explain why effect sizes of the placebo effect vary so widely; when all of the right person and situation factors are present, expectancy and motivation are maximized, thus producing maximum placebo effects. However, where these important variables are missing, placebo effects are small.

Factors that Influence Placebo Responding

Environment and Placebo Characteristics

Placebo has been found to be especially strong in medical settings where environmental cues and aspects of the placebo treatment itself can lead to increased placebo responding. Simply being in the presence of medical equipment has been found to increase responding to placebo (Ernst, 2001). Aspects of the placebo including color, taste, size, dosage, and mode of administration can also influence responding. For example, research has found that blue placebo pills produce greater sedative effects than pink and that red placebo pills work better as stimulants than blue (Buckalew & Ross,

1981). The association between color and therapeutic effect is likely due to the generally held mental representations of blue as being soothing and red as energizing. These are associations which are formed through previous experience and may shape the therapeutic expectations subjects hold for placebo pills. Taste has also been found to influence placebo responding, with more bitter tasting pills generally producing stronger placebo effects (Buckalew & Ross, 1981).

Additional research on placebo responding has further demonstrated the importance of environmental and placebo factors in shaping placebo effects. For example, research has demonstrated that people expect tailored smoking-cessation interventions to be more helpful than generic interventions and also benefit more when they are told that they are participating in a tailored intervention, even when the intervention is identical to the generic intervention (Webb, Hendricks, & Brandon, 2007; Webb, Simmons, & Brandon, 2005). One explanation is that these subjects had previously formed expectations of the superiority of tailored interventions which, when primed in the lab, produced greater responding to the intervention. The importance of previous experience in shaping placebo response was observed in one study which found that positive experience with placebo increased responding to placebo in later trials (Voudouris, Peck, & Coleman, 1985). This study experimentally manipulated the perceived effectiveness of a placebo analgesic cream in reducing pain by reducing the shock intensity when the placebo cream was applied in earlier trials. Participants who engaged in the earlier conditioning trial showed significantly greater pain reduction in later trials from the placebo cream than the group that had not experienced the

conditioning phase. Thus, learning to associate the placebo cream with pain reduction increased later placebo responding.

The research reviewed thus far suggests that associations of certain environmental and placebo factors with therapeutic benefit can increase placebo response. These associations appear to be triggered by environmental or experimenter cues in the lab and may be enhanced in those treatments, such as antidepressant drugs, where strong associations have been established through previous experiential learning or sources such as the media and advertising. In fact, research examining placebo in antidepressant drugs has found that the effect size of placebo responding has increased dramatically, along with the effect size for antidepressants, over the past 20 years (Walsh, Seidman, et al., 2002). One interpretation of this finding is that the public has become increasingly aware of psychopharmacological interventions through sources such as the media. Drug companies have greatly expanded marketing of antidepressant drugs and awareness and acceptance of these drugs to treat psychological disorders such as depression is increasing. It is possible that increased awareness and changing public perception has led to widespread associations of psychopharmacological drugs with therapeutic benefit. These findings underscore the importance of experience in shaping placebo effects.

Experimenter Factors

The clinician or experimenter can also influence placebo responding, oftentimes unintentionally. In experimental studies, if the clinician or experimenter is aware of the group to which the subject is assigned, they may unwittingly communicate expectations of success to the subject, or encourage responses that are consistent with hypothesized

effects. The importance of clinician factors in placebo was demonstrated in a meta-analysis of medical treatments which were widely believed to be effective, but were later found to be ineffective (Roberts, Kewman, Mercier, & Hovell, 1993). Despite the ineffectiveness of the interventions, initial research studies reported good or excellent outcomes in 45% to 89% of the patients, across studies. In later research, all of these interventions were demonstrated to be ineffective, raising concerns about the methodological rigor in medical treatment trials. The authors of this article posited that expectancies of the therapeutic effectiveness of these interventions largely influenced the earlier findings. It is also likely that motivation for successful outcomes, both among clinicians and patients influenced outcomes. Desire for beneficial change and belief in the effectiveness of the intervention was enough to produce positive change among many patients, despite the fact that the treatment itself had no real therapeutic effect. This review demonstrates the power of placebo when expectancy factors are maximized. Earlier meta-analyses have found that about 35% of people respond to placebo (e.g., Beecher, 1955). This study demonstrated that this response rate can be increased when expectancy among clinicians and patients is high.

The important influence of experimenter factors in influencing treatment outcomes has also been demonstrated in psychotherapy research. Specifically, experimenter allegiance to clinical treatment orientation and theoretical models has been found to be related to outcomes in several studies. One meta-analysis of 58 studies on depression treatment found that theoretical allegiance was significantly related to effects, such that when the researcher's allegiance was aligned with the treatment, that treatment was found to be more successful for treating depression (Robinson, Berman, &

Neimeyer, 1990). A second meta-analysis which used self-assessment of theoretical orientation, peer-assessment, and research samples (theoretical orientation in other research articles by the same author) in assessing allegiance found similar results (Luborsky & Barrett, 2006). The average of these three allegiance ratings correlated .85 with outcome measures; thus, nearly 2/3 of the variability in treatment outcome could be attributed to theoretical allegiance. The allegiance variable examined in these meta-analyses may capture the expectancy and motivation factors that have been linked to placebo responding. Experimenters likely expect the treatments aligned with their theoretical orientation to be more successful and are more motivated for these treatments to work. Moreover, it is possible that these expectancies and motivations are communicated, either intentionally or unknowingly, to participants. This likely increases the participants' own expectancies regarding the therapeutic nature of the intervention and may also allow for factors such as demand characteristics to more easily influence results.

Personality

In addition to situational factors, individual factors such as personality have been examined in placebo responding; many personality factors have been found to relate to placebo responding and the inclusion of these factors in a placebo model helps to provide a more comprehensive understanding of how the placebo effect occurs. Personality factors which have been studied within the context of placebo responding include factors such as optimism, suggestibility, social-desirability, and religiosity. For example, it has been found that optimists respond better to placebo than pessimists (e.g., Geers, Kosbab,

Helfer, Weiland, & Wellman, 2007). Similarly, both religiosity and social desirability have been found to relate to placebo responding; some research has found that people who are high on these personality variables are more likely to respond to placebo analgesia (Gelfand, Gelfand, & Rardin, 1965; Hyland, Whalley, & Geraghty, 2007). An additional study found that people high on spirituality had greater responding to a placebo relaxation intervention.

Research has also demonstrated that high placebo responders are often higher on the trait of suggestibility (e.g., Pascalis, Chiaradia, & Carotenuto, 2001). In a study which manipulated expectancy for a placebo analgesic cream, a graded response was found between suggestibility and expectations, such that those high in suggestibility had greater expectancies than the mid-level suggestibility group, which in turn, had greater expectancies than low-level suggestibility (Pascalis, Chiaradia, & Carotenuto, 2001). In this study, these expectations were then translated into placebo responding in that higher expectancies were related to higher placebo responding. This research suggests that the way in which suggestibility leads to greater placebo responding is through increased expectancies. Other research which has examined personality and placebo responding has found that expectancy and motivation factors explain most of the variance in the relation between personality and placebo responding (Hyland, Whalley, & Geraghty, 2007; Kirsch & Braffman, 2001).

Although much research has demonstrated that certain personality traits can influence placebo responding, these findings have often been found to be inconsistent. For example, religiosity has been found to relate to placebo responding in some studies (e.g., Gelfand, Gelfand, & Rardin, 1965), but not others (e.g., Lansky & Phil, 1976).

Inconsistencies in findings suggest that personality effects in placebo responding change by context. If the relationship between personality and placebo response is at least partially explained by changes in expectancy and motivation, this may provide an explanation for the inconsistent findings in the literature. When people with certain personality traits are confronted with the right situational factors, this may trigger higher expectancies for change, thus producing greater placebo responses. However, when these situational factors are not in place or when there is not a match between context and personality style, personality will not be a predictor of placebo responding.

Placebo Outcomes

Various perceptual, behavioral, and physiological outcomes have been assessed in placebo research (e.g., McRae, Cherin, Yamazaki, & Diem, 2004). Given that placebo effects can be produced through diverse mechanisms of change, it is reasonable to assume that placebo mechanisms may produce placebo effects which are detected by certain outcome variables, but not others. In fact, research has found that in certain contexts, placebo effects are observed with only one type of outcome variable, but in other contexts, placebo effects are detected using multiple perceptual, behavioral, and physiological measures of placebo responding (e.g., Benedetti, Pollo, Lopiano, Lanotte, Vighetti, & Rainero, 2003).

Some research, most notably in the area of placebo analgesia, has found convergence among different types of outcome measures. Traditionally, research on placebo analgesic effects has assessed outcomes using self-report measures of pain. More recent research has sought to identify physiological correlates of self-reported

placebo analgesic effects. This research has generally found that placebo analgesic effects are associated with reductions in neural activity in the areas of the brain which are known to process anxiety and pain (Price, Finniss, & Benedetti, 2007). Research in clinical settings has also found consistency on physiological and self-report measures. One study in which Parkinson's patients were given either a transplant surgery or a sham surgery (placebo) found that patients in the placebo group improved on both self-reported well-being and measures of motor movement (McRae, Cherin, Yamazaki, & Diem, 2004). Thus, in some settings, consistent effects can be found on perceptual, behavioral, and physiological assessments of outcome.

However, other research has found that in certain contexts, expectancy and conditioning produce different placebo outcomes which may not be reliably assessed with all types of outcome measures. For example, one study compared the effects of an expectancy and a conditioning manipulation on both perceptual and physiological outcome measures (Benedetti, Pollo, Lopiano, Lanotte, Vighetti, & Rainero, 2003). In the expectancy manipulation, verbal expectancies were given for the analgesic benefits of an intravenously administered saline solution. In the conditioning manipulation, a placebo saline solution was conditioned with an intravenous analgesic drug. Placebo response was assessed through both self-reported pain and hormone secretion. This study found that both expectancy and conditioning manipulations produced placebo responding, as assessed by self-reported pain perception, but only the conditioning trials induced a placebo response as assessed by changes in hormonal secretion. This study suggests that some physiological markers of placebo are observed when conditioning, but not expectancy, is used.

One explanation for these findings proposes that physiological processes more highly associated with cognition and emotion may be more easily altered by expectancy manipulations (Benedetti, Pollo, et al., 2003). For example, expectancy has been found to be consistently related to changes in the pain-processing area of the brain; there is a direct link between cognition, emotion, and brain activity. However, other processes, such as hormonal secretion, appear to be less easily linked to cognitive and emotional processes. It is possible that expectancy can produce outcomes related to conscious physiological processes but not unconscious physiological functions (Benedetti, Pollo, et al., 2003). Conscious physiological processes would include processes such as pain perception and motor performance, which can more easily be conceptualized within a cognitive-emotional model. This may help to explain why expectancy has been found to affect some biological markers, but not others.

These findings are consistent with earlier work in learning which demonstrated that certain bodily functions over which an individual has no control, specifically smooth muscle or glandular responses, are altered through the process of conditioning, outside of one's awareness (Skinner, 1981). Other bodily functions over which an individual has more control, such as movement of striated muscles, can be altered through operant conditioning, within one's awareness. Similar to research findings on placebo mechanisms, operant learning and classical conditioning appear to act on different pathways, leading to different types of responses. The existence of multiple pathways in placebo should not diminish the importance of one outcome variable or pathway relative to another. Each is important in gaining more complete understanding of a person's

overall experience and will hopefully help to inform a more inclusive and comprehensive model of placebo.

Summary

The overall model suggests that a complex interplay of multiple environmental, experimenter, and person factors interact to produce placebo responding. Certain factors, such as mode of placebo administration, consistently influence placebo effects, whereas others, such as personality, do not appear to be reliably related to placebo. Environmental and placebo factors may become associated with therapeutic benefit and influence placebo responding, either within awareness, as proposed by expectancy models, or outside awareness, consistent with conditioning models. Thus, placebo is believed to be produced through multiple pathways and certain outcome variables may be more appropriate than others for detecting placebo responses, depending on the context. The complexity of factors and multiple mechanisms involved in placebo helps to explain the varied effect sizes observed in the literature and suggests a need for a comprehensive model of placebo.

Models of the Placebo Effect

Although research has examined various contextual factors which influence the strength of placebo effects, the specific mechanisms of change involved in placebo responding are less understood. Two theories of the placebo effect which have gained the most support are the conditioning and expectancy models. The conditioning model asserts that placebo responding occurs when a placebo (a neutral stimulus) is paired with

an unconditioned stimulus (UCS) that produces a response naturally, without conditioning. After conditioning, the placebo becomes a conditioned stimulus (CS) and produces the conditioned response (CR) which was originally produced by the UCS. Unlike the conditioning model, the expectancy model does not require previous experience with the stimuli. Instead, the expectancy model asserts that placebo responding occurs when people have expectancies about the beneficial nature of a placebo and that these expectations are responsible for producing placebo effects (Stewart-Williams & Podd, 2004).

These two models of placebo are not necessarily incompatible. Often, findings in the placebo literature are presented as supportive of either a conditioning or an expectancy perspective, when many of these findings can be explained equally well by both theories (Stewart-Williams & Podd, 2004). For example, it has been observed that placebo analgesic effects are stronger when the placebo is administered via injection than when administered orally through a placebo pill (Kaptuchuk, Goldman, Stone, & Stason, 2000). This observation could be explained by findings in the conditioning literature which demonstrate stronger unconditioned stimuli leading to stronger conditioned responses. However, expectancy theory could provide an equally plausible explanation; people expect injections to have stronger effects than pills and these expectancies produce stronger placebo responses. In a qualitative review of expectancy and conditioning placebo effects, the authors concluded that expectancies are involved in some examples of conditioning, whereas in other contexts, more ‘pure’ forms of either theory can best explain placebo effects (Stewart-Williams & Podd, 2004).

In some contexts, it is believed that the process of conditioning produces expectancies, which in turn, lead to the expected outcome. In support of this assertion, research has demonstrated that participants' expectancies about the conditioning relationships can influence the conditioning process (Unger, Evans, Rourke, & Levis, 2003). Theorists in favor of cognitive interpretations of conditioning point to this research as evidence that the learning involved in placebo responses occurs through the acquisition of expectancies (Stewart-Williams & Podd, 2004). However, conditioning can also produce placebo responding in the absence of expectancies. Several studies have demonstrated that conditioned placebo responses can be produced even when participants are unaware of the conditioned and unconditioned stimuli, and thus, are unable to form expectancies of outcomes (e.g., Benedetti, Pollo, Lopiano, Lanotte, Vighetti, & Rainero, 2003). There is also research which demonstrates that expectancies, in the absence of conditioning, can produce placebo responding. For example, research on asthma has found that the same placebo (inhaler) can produce vastly different placebo responses depending on the verbal expectancies given to participants (Butler & Steptoe, 1986). Thus, the differences in placebo responses were not due to conditioning, but rather the verbal expectancies communicated to participants at the beginning of the study.

The research reviewed thus far provides evidence that neither expectancy nor conditioning models alone can fully account for the diverse effects in placebo literature. Both expectancy and conditioning have been found to play an important role in the placebo effect and evidence suggests that they may act on different pathways. When both expectancy and conditioning are employed, placebo responding is increased. A meta-analysis which compared the effect sizes of both conditioning and expectancy

factors found that in that studies where placebo analgesia was induced by expectancy or conditioning alone, effect sizes were about .85 (Vase, Riley, & Price, 2002). However, in studies where both expectancy and conditioning were used to induce placebo responding, the effect size was 1.45. Moreover, in studies where conditioning and expectancy effects are in opposite directions, overall placebo effects disappear. For example, one study used conditioning to produce placebo analgesia, as assessed by changes in hormone secretion (Benedetti, Pollo, Lopiano, Lanotte, Vighetti, & Rainero, 2003). When hyperalgesia expectancies were induced through statements indicating that the treatment would actually increase pain, the effects of the conditioning disappeared. Thus, it appears that placebo effects are maximized when expectancy and conditioning are both used to elicit placebo response and minimized when expectancy and conditioning effects are in opposite directions (e.g. conditioning analgesia with expectancies for hyperalgesia).

In conditioning models, there is little focus on mechanisms of change; support for these models is found in the measurement of objective outcomes (Stewart-Williams & Podd, 2004). Expectancy models, which focus on internal processes and mediating behaviors, posit possible mechanisms of change in placebo. Research demonstrates that expectancies do play an important role in conditioning, although not all conditioning requires expectancy. In some contexts, expectancy appears to produce placebo responding in the absence of conditioning. Thus, it appears that expectancy is an important factor in the placebo effect and that expectancy models can account for placebo effects in a wide range of contexts. The current study examined placebo responses within the context of expectancy models (see Table 1).

One model of placebo proposes that expectancies lead to greater attention to signs of improvement, which in turn leads to placebo responding (Lundh, 1987). Placebo effects are then used as further evidence to support placebo expectations, increasing future placebo responding. There is some research which has demonstrated that somatic focus, or attention, is important in producing placebo responding. In one study, participants were given a placebo pill which was said to have symptoms of nausea and headaches. The participants who were told to focus on their bodily reactions during the 15 minutes after taking the pill had stronger placebo responding than those who were not told to attend to these symptoms (Geers, Helfer, Weiland, & Kosbab, 2006). Thus, increasing attention to symptoms may cause people to selectively focus on sensations consistent with their placebo expectations and to interpret ambiguous sensations as consistent with expectations.

Although traditional expectancy theory has some empirical support, it is unable to account for the diverse array of outcomes in placebo research. Alternate expectancy models of placebo responding have included motivational factors in order to better explain placebo outcomes. For example, the goal-activation model of the placebo effect asserts that placebo responding is produced when expectations are compatible with motivation (Geers, Weiland, Kosbab, Landry, & Helfer, 2005). Motivational forces examined within the context of expectancy-motivation placebo models include demand characteristics, self-enhancing motives, and the motivation to feel better. These more complex models of placebo have had some initial support and provide more compelling explanations of placebo responding.

Expectancy-motivation theories of placebo can account for several findings in the placebo literature that are not easily explained by more traditional expectancy theories. For example, research has found that there are greater placebo responses in research on clinical pain versus experimental pain, even when controlling for initial pain severity (Price, Milling, Kirsch et al., 1999). Participants in clinical samples are often experiencing chronic, long-standing pain and may be more invested in analgesic treatment than participants in experimental studies who are reporting equal levels of pain severity. If motivation to reduce pain influences placebo responding, as proposed by expectancy-motivational models of placebo responding, this may explain why clinical studies of pain typically have larger effect sizes.

Several studies have directly assessed expectancy and motivation variables in the context of placebo responding. One experimental study found that expectancy and motivation interact to produce placebo responding such that at high levels of motivation, placebo responding occurs, but at low levels, it does not (Geers, Weiland, Kosbab, Landry, & Helfer, 2005). In this study, trials with the highest effect sizes were those where expectancy and motivation variables were maximized. Other research on expectancy-motivation models has found more mixed support. In two other studies which assessed both motivation and expectancy, one study found that motivation, but not expectancy, influenced placebo responding (Jenson & Karoly, 1991) and one study found that expectancy, but not motivation, influenced placebo responding (Price, Milling, Kirsch, Duff, & Montgomery, 1999).

An examination of the moderators and mechanisms of the placebo effect can help to reconcile this apparent contradiction. As previously discussed, pain ratings are often

higher in clinical versus experimental settings. In the Price et al. (1999) study, pain ratings were assessed in an experimental setting with a college student population and motivation was characterized as the desire to reduce the pain. If the anticipation of and actual experience of pain was minimal, it is likely that participants would have had less motivation to reduce pain, providing a possible explanation for the findings that expectancy, but not motivation, influenced placebo responding. Jenson and Karoly (1991) similarly utilized an experimental lab design with student populations, but instead of the motivation to reduce pain, examined self-enhancing motivation. It is reasonable to assume that self-enhancing motives and demand characteristics can be more easily and reliably manipulated in a lab setting than the motivation to reduce pain, especially when working with a generally healthy college student population. This may help to explain why motivation, but not expectancy, was found to influence placebo responding in Jenson and Karoly (1991). This analysis is consistent with research on moderators of placebo responding which have identified various situational and person variables that influence placebo effects. These moderating variables, including characteristics of the subjects (i.e. clinical vs. experimental populations) may differentially influence expectancy and motivation variables, thereby influencing placebo responding.

Although there is research to support the importance of motivation in placebo responding, less is known about how expectancy and motivation work together to produce placebo effects. A more comprehensive model of placebo responding which includes potential mechanisms of change in placebo responding is the desire-expectation model. This model is based on theories of emotional experience and includes motivation, expectancy, attention, and emotion (Vase, Price, Verne, & Robinson, 2004). The desire-

expectation model proposes that high desire (or motivation) and expectancy leads to initial signs of relief at the beginning of the placebo response. When presented with a stimulus, such as a painful shock, the patient experiences negative affect. As the patient begins to notice that the treatment (e.g. placebo analgesic cream) is working, expectation for relief increases and motivation for relief decreases. The lowered desire for relief and increase in expectation results in less negative feeling, which enhances placebo response. This model has found some initial support in research which has examined model variables at different points throughout the placebo response. Specifically, one study found that that the placebo effect increased overtime as expected pain intensity, desire for pain relief, and anxiety decreased (Vase, Price, Verne, & Robinson, 2004). Although this study demonstrated that each of these variables is related to placebo responding, the desire-expectation model does not clearly outline how these variables interact to produce placebo effects.

Each of the three main expectancy theories outlined thus far has overlapping elements (see Table 1). The goal-activation model and the desire-expectation model propose that motivation and expectancy are both important elements in producing placebo responses. The desire-expectation model and Lundh's (1987) expectancy model propose that attention moderates responding. Specifically, the desire-expectation model suggests that motivation and expectancy lead to greater attention, although the process by which this occurs is not clearly stated. The expectancy model proposes that expectancy leads to greater attention of relevant body sensations, which are interpreted consistent with expectations, thereby producing placebo responses (Lundh, 1987). Together, these three placebo models posit that motivation, expectancy, and attention are important

variables in the placebo response and that motivation and expectancy factors may influence placebo responding through increased attention to relevant stimuli. However, a major shortcoming of each of these models is that they do not clearly outline how each of these important variables work together to produce placebo effects.

Although placebo models have included attention as a potential mediator in placebo effects, this process is poorly defined and ill-understood. For example, the desire-expectation model, which is the only model to include all three variables (motivation, attention, and expectancy) provides only a general explanation of proposed mechanisms and does not describe the unique contributions motivation and expectancy. Moreover, this model is limited in that it conceptualizes placebo as emotional experience and does not account for the wide variety of placebo responses observed. Both expectancy and motivation factors have been found to be important variables in placebo research and an understanding of the contribution of each in producing placebo effects is important in developing a clearer understanding of placebo mechanisms.

Motivation and Attention

Research on attention, motivation, and interpretive biases may provide further insight into the process through which expectancy and motivation influence placebo effects. Research suggests that our perception of the world is influenced by two important processes: 1) perception is selective in that people selectively attend only to certain stimuli in their environment and 2) perception is biased in that attended to stimuli

are interpreted in a biased fashion.[1] Beginning with the New Look theorists of the 1940s and 1950s, a large body of research has emerged on the important influence of attitudes, motivation, and expectancies on perception (Erdelyi, 1974). Although much of this research has been widely accepted and influential in the fields of cognitive and perceptual psychology, work on motivational influences was not as well received (Balcetis & Dunning, 2006). Research on motivation and perception was widely criticized on methodological and theoretical grounds and fell out of favor in the 1950s (e.g., Bruner & Goodman, 1947). Despite earlier criticism, research on motivation and perception has seen a recent resurgence, with many newer studies addressing the methodological shortcomings of past research. Motivation has been found to affect both attention to and interpretation of a wide variety of stimuli including the perception of visual and emotional stimuli, memory processes, and judgments of others (e.g., Balcetis & Dunning, 2006).

First, motivation has been linked to attention, in that people are more likely to pay attention to stimuli that are consistent with their desires (Balcetis & Dunning, 2006). For example, in forming impressions of others, people often quickly place others in categories of familiar social groups because this strategy requires little time and cognitive resources. However, when people are motivated to form particular impressions of others, this process of categorization is replaced by other strategies of impression formation. Research on social judgments has provided insight into how motivational processes result in selective attention (Berscheid, Graziano, Monson, & Dermer, 1976). In this research,

[1] Although these changes in perception often referred to as 'biased', this term should be interpreted carefully, as some changes in perception result in more accurate perceptual judgments.

motivation is often assessed through the concept of outcome dependency, or the relevance of the outcome to the individual. In one study on dating relationships, college students with the greatest outcome dependency and greatest motivation to like potential dates paid most attention to their future date and reported greater liking of the date (Berscheid, Graziano, Monson, & Dermer, 1976). One interpretation of these results is that the greater observations made by those in the high outcome dependency group were interpreted in a biased fashion, consistent with students' motivations to have a desirable date.

Other research which has examined attention under conditions which promote more accurate judgments of others has found additional evidence in support of the motivation-attention link. For example, one study found that when subjects are motivated to form more accurate perceptions of others, they typically pay more attention to information inconsistent with their expectations, when compared with students who are not motivated to accurately judge the other person (Erber & Fiske, 1984). It is posited that when people are motivated to form more accurate judgments, they pay attention to disconfirming evidence as well as confirming evidence and are less influenced by perceptual bias. This research provides additional support for the assertion that motivation influences attention to stimuli. Lastly, the motivation-attention link has been found in other research, including research on motivation and emotional experience. One study found that participants manipulated to regulate emotion selectively attended less to emotionally charged stimuli following the manipulation (Xing & Isaacowitz, 2006).

As further evidence for the importance of motivation in perception, there is research which demonstrates that the perceptual process involved in many everyday

judgments is driven by motivational variables (McMullen, Fazio, & Gavanski, 1997). In making probabilistic judgments, people often fail to account for base rates. For example, when a patient presents with a symptom, such as a cough, the doctor could access two different sample spaces, or disease populations, in making a diagnosis. First, they might think of the population of people with disease X they have treated, realizing that 70% of these people had a cough. Second, they could think of the population of people known to have that symptom (90%) and the proportion of these people known to have disease X (1%). In the first example, the doctor neglects base rates and using this sample space in diagnostic decision-making would result in over-diagnosis of diagnosis of disease X. The second example accounts for base rates and if used, would likely result in a more accurate diagnosis. Although neglect of base rates is often viewed as an automatic error in judgment common to most people, research has found that motivation influences the use of base rates in decision-making. McMullen, Fazio, and Gavanski (1997) found that when people are motivated to find one particular characteristic, they often use the population containing this characteristic as the base rate population in making probabilistic judgments. This study provides further evidence for the role of motivation in increasing attention to relevant or desired characteristics. Moreover, this study provides evidence for the assertion that motivation plays an important role in attention, even in more common, everyday judgments, where motivational factors may not be as easily identifiable.

The research examined thus far has demonstrated that motivation can influence attention to relevant stimuli. There is also research which has demonstrated that motivation influences the interpretation of information attended to, often resulting in

interpretive biases. One study found that students interpreted ambiguous stimuli in a way that confirmed several manipulated motivational states including the motivation to think about one's prospects in a favorable way, the motivation to achieve valuable outcomes, and the desire to enhance self-esteem (Balcetis & Dunning, 2006). Other research on visual perception has found similar results. For example, one study which examined the motivation to resolve cognitive dissonance manipulated the degree to which students felt that they had freely chosen to complete an embarrassing task (i.e. running a short distance across campus wearing a costume inspired by Carmen Miranda, pushing themselves uphill while seated on a skateboard), presumably creating high cognitive dissonance among those students who completed the task when there was little pressure to do so (Balcetis & Dunning, 2007). This study found that students experiencing high cognitive dissonance rated the distance run to be shorter and the slope of the hill to be less steep, supporting the assertion that the motivation to reduce cognitive dissonance biased their perception of the environment. Similar links between motivation and interpretive biases have been found in research on social judgments. In the Berscheid, Graziano, Monson, & Dermer (1976) study described above, not only did students pay greater attention to potential dates when outcome dependency was high, but they also rated potential dates as more likeable and reported being more attracted to the potential date. Thus, not only does motivation alter the environmental and internal stimuli attended to, but it also skews our interpretation of these stimuli.

Current Study

Research provides evidence that both motivation and expectancy are important variables in producing placebo responding. The process by which expectancy and motivation interact to produce placebo responses has undergone less theoretical and empirical examination. The current study, drawing on research in motivation and perception, proposes a model in which these two important variables interact to produce placebo responses (see Figure 1). There is strong evidence in the perception literature that motivation influences attention to stimuli and the interpretation of stimuli, providing support for a placebo model in which motivation causes increased attention to placebo-relevant stimuli, leading to a placebo response. When people are motivated for a treatment to work, they selectively attend to stimuli which support their motivations and interpret ambiguous stimuli in accordance with motivation. Moreover, some theorists in the perceptual bias literature have proposed that expectancies inform people of testable perceptual hypotheses (Balcetis & Dunning, 2006). Thus, motivation may increase attention to and processing of stimuli, but expectancy may help to inform the possible interpretations of these stimuli. This would be consistent with literature linking motivation to attention and with placebo literature demonstrating the importance of both expectancy and motivation in influencing placebo responses.

The current model proposes that attention or diligence is the mechanism through which motivation leads to greater placebo responding; expectancy also influences placebo responding, but does not do so through attention (see Figure 1). In the typical experimental study of placebo, participants are given a placebo treatment and are led to believe, either through verbal suggestion or the contextual factors discussed previously,

that the treatment will be effective in achieving some end. A person who is highly motivated for the intervention to work may be more diligent in attending to relevant stimuli. They may interpret these stimuli according to expectations, thus compiling more 'evidence' of the treatment's success and resulting in increased placebo responding. A second person, who has little motivation for the placebo to work, may pay little attention to signs of the placebo's 'success' throughout the experiment, thus finding little evidence for the effectiveness of the placebo intervention. In each case, it is possible that both subjects had equal expectancy for the placebo's effectiveness; however, one subject was motivated to look for signs of success, whereas the other was not. Changes in expectation may also influence the placebo response. At high levels of expectation, a highly motivated person will likely find even greater signs of 'success' whereas lower levels of expectancy might reduce the impact of the intervention, even for a person who is more highly motivated. This model provides an explanation of the processes through which expectancy and motivation lead to placebo response and is an improvement over previous models in its comprehensiveness and clear explanation of mechanisms.

The current model's emphasis on motivational factors is a slight departure from previous placebo research, where the focus has largely been on expectancy. Studies examining the influence of expectancy on placebo often neglect to assess motivation, although motivational forces are likely present (e.g., Friedman, McCarthy, Barholow, & Hicks, 2007). Moreover, many studies have manipulated expectancy only, thereby neglecting motivational influences and likely reducing the impact of the placebo (Voudouris, Peck, & Coleman, 1990). There is little research which has examined the individual effects of expectancy and motivation and no research which has successfully

demonstrated that either is sufficient to produce placebo in the absence of the other. Indeed, it is unlikely that motivation factors could easily be reduced to zero in lab settings. Moreover, it is also likely that each variable influences the other, at least to some degree. Although little research has examined the bi-directional influences of expectancy and motivation, it seems reasonable to suggest that when motivation is high for a placebo to produce change, this may influence expectations of the placebo's ability to produce this change. Lastly, it is reasonable to assume that when both expectancy and motivation factors are high, placebo effects are maximized, an assertion which has found some support (e.g., Geers, Weiland, et al., 2005).

Overall, the interrelations among expectancy, motivation, attention, and placebo have not been widely studied. Moreover, the specific mechanisms through which these variables influence placebo effects have been explored in other models, but never clearly articulated. The purpose of the current study is to examine the process through which these variables work together in producing placebo effects, with a focus on the potential mediator of attention. A conceptual understanding of this process would provide a framework for future research examining the contribution of various factors in producing placebo effects.

Study Design

The current study has three central hypotheses: 1) motivation leads to greater attention to stimuli and task diligence, 2) the relationship between motivation and placebo response is mediated by attention/task diligence and 3) expectancy positively influences placebo response. The study design allows for a test of these three hypotheses.

Both motivation and expectancy were manipulated and attention was assessed using two behavioral measures of task diligence. The resulting research design is a 2x2 matrix, with high and low levels of both expectancy and motivation. If motivation leads to greater diligence, which, in turn, leads to greater placebo response, this would provide evidence that attention (or diligence) is an important mechanism of change in placebo. Lastly, if expectancy influences placebo response this would provide evidence for the important role of both expectancy and motivation in placebo and would hopefully produce a better understanding of how these two variables interact to produce placebo effects.

In the current study, placebo mechanisms were examined using a placebo pheromone. Although the influence of pheromones on human behaviors is marked by contentious debate, pheromones have received wide public attention, a trend which is appealing when designing a study to examine placebo mechanisms. The study of pheromones appears to have entered into the realm of popular culture, suggesting that there are generally held expectancies that pheromones influence sexual attraction. In fact, a Google search of “pheromone cologne” or “pheromone perfume” produces hundreds of hits including several websites selling pheromone substances with the promise that they will increase one’s attractiveness to the opposite sex.

Research studies comparing pheromones to placebo have generally found support linking pheromones to sexual behaviors in non-humans, although the relationship between pheromones and sociosexual behaviors in humans is considerably more tenuous. While some studies have linked pheromone exposure to outcomes such as increased attraction and sexual behavior (e.g., Gustavson, Dawson, & Bonett, 1987), other studies

have found no such effects (e.g., Benton & Wastell, 1986). Typically in psychological research of pheromones, participants are exposed to a true pheromone and a placebo substance, commonly slightly scented water. Although the verbal instructions given to participants are not always adequately described in these studies, it appears that some experimenters have given false explanations regarding the study's purpose in order to reduce expectancies and demand characteristics. For example, in one study which administered pheromones to participants using a mask, participants were told that the study purpose was to examine the effects of breathing on reading; thus, these participants were not aware that pheromones were being administered (Benton & Wastell, 1986). If the participants were not aware of the study purpose, they could not form expectancies or motivations for particular outcomes. Thus, it is reasonable to assume that when the purpose of the study is disclosed to participants, expectancy and motivation would be enhanced and overall effects would be larger.

Indeed, there is some research in the pheromone literature to support this assertion. First, one study in which participants were unwittingly given greater expectancies in one trial found that participants in this trial responded more highly to the pheromone than participants in later trials (Saxton, Lyndon, Little, & Roberts, 2008). In this study, participants were recruited for a speed dating event in which members of the opposite sex communicated in dyads for brief intervals, giving participants the opportunity to become acquainted with several people throughout the course of the event. Participants in the first trial were told that experimenters were examining the effects of pheromones and attraction, whereas participants in the second and third trials were told that experimenters were examining odors and attraction. It is possible that by specifically

mentioning pheromones, researchers induced greater expectancies among participants in the first trial, thus accounting for the greater pheromone response. Moreover, the first speed dating event was composed of college students and the second two events were attended by members of the general public, having a much higher average age. As physical attractiveness is generally found to be viewed as more important in dating among younger people, the researchers postulated that perhaps motivation for the pheromone to work was greater in the first trial than in the following trials. If expectancy and motivation factors were indeed higher in the first trial, this may help to explain why effect sizes for all three experimental groups (pheromone, placebo + odor, and placebo) were higher in the first trial.

Additional evidence for the role of expectancy, motivation, and placebo in pheromone research can be found in studies which have compared pheromones to different types of placebos. The smell of the pheromone may or may not be detectable to participants, depending on the concentration of the pheromone used. Psychosocial effects have been observed both at high and low concentrations. Studies which use lower, generally undetectable, concentrations of pheromones likely reduce both expectancy effects and potential demand characteristics. However, at higher concentrations, pheromones give off a musky odor, introducing potential confounds. A few studies which have compared the effects of placebo musk, odorless placebo, and pheromone have found that the pheromone produces the greatest effect, followed by placebo musk, and lastly, odorless placebo (e.g., Filsinger, Braun, & Monte, 1985). It has been proposed that the effects for placebo musk may be due to conditioning; people learn to associate perfumes and musk with attraction and thus, respond positively when

presented with these substances (Comfort, 1971). It is also possible that musk substances produce expectancies for increased attraction or trigger demand characteristics by helping to reveal the study purpose to participants, thus increasing effect sizes. Both the conditioning and expectancy explanations are consistent with a placebo model and produce further evidence that placebo may be a mechanism of change in pheromone effects.

Given these findings, it is reasonable to assume that the pheromone research paradigm is an acceptable means for examining placebo mechanisms. Moreover, given the current study context, pheromones provide added benefit for two main reasons. First, the study of pheromones is within the realm of psychology; many research studies published in psychology journals have examined the effects of pheromones on sociosexual variables. Moreover, sexual attraction, a variable which is widely linked to pheromones, is also linked to the study of psychology. Thus, the study of pheromones and attractiveness within the context of psychology is likely a believable research endeavor to those participating in the study. As previously discussed in the introduction section of this paper, there are several environmental cues which have been found to increase the effect of placebos. When testing the effectiveness of a medical treatment, environmental cues, such as a hospital setting, the white coat of a doctor, and medical equipment, can increase expectancies for the effectiveness of this substance (Ernst, 2001). If a substance such as a placebo analgesia was tested in the psychology department where these cues were absent, this would likely be less believable to participants, thus reducing expectancies. This problem is addressed by the use of a placebo pheromone study design.

A second advantage to using a placebo pheromone is that this procedure will help to maximize motivation. In the current study, students who were not involved in a committed relationship were recruited for a study on "dating and attraction." The motivation to find a dating partner is a universal human motivation which has relevance to students even outside the lab setting (Maner, Matthew, Gailliot, Rouby, & Miller, 2007). Moreover, in the current study, students were told that they would be 'matched' with potential dates based on the results of a personality and attitude survey (although no actual date matching would occur). The relation between similarity and variables such as attraction and liking has been widely studied and there is much evidence to suggest that we like those who are more similar to us (e.g., Byrne, 1997). For example, giving people feedback which suggests that others share similar attitudes has been found to increase attractiveness towards that person (e.g., Schlenker, Brown, & Tedeschi, 1975). The desire to perceive like-minded dates as attractive is one which occurs naturally and triggering this desire in a lab setting will likely increase the impact of the placebo pheromone. In the current study, students in the high motivation group were told that their potential dates have been chosen for them based on the results of a personality survey, thus increasing similarity to the date. Moreover, they were told that they will have the opportunity to meet this person by participating in a follow-up study. Thus, the use of a pheromone placebo should help to produce both a believable and desirable outcome for participants.

METHOD

Procedures

Participants in this study consisted of undergraduate students enrolled in psychology courses at IUPUI who were not currently involved in a committed romantic relationship. Students were recruited using the university's Experimetrix website for a study on "dating and attraction" and received extra credit for participation. Students were randomly assigned to one of the following four experimental groups: 1) high motivation/high expectancy, 2) low motivation/low expectancy, 3) low motivation/high expectancy, or 4) high motivation/low expectancy. Research assistants conducted the experiments and were not informed of the research hypotheses.

When students reported to the lab, they first filled out a questionnaire containing a personality inventory, relationship attitudes scale, optimism scale, social desirability scale, and demographic questionnaire (see Appendix A). Participants were informed that the results of these surveys would be used to 'match' them to members of the opposite sex (students who identified as homosexual on the demographics questionnaire were told the samples were of the same sex). They were given, depending on the experimental group to which they had been assigned, one of four sets of instructions, intended to introduce the study to participants and to manipulate motivation and expectancy (see Appendix C). In the high motivation condition, students were informed that if they found the scent of their match to be most pleasing, they would have the opportunity to return to

the study at a later date with their match to participate in a second phase of the study (see Appendix B). In the low motivation group, students were informed that the data collected in this study was for academic purposes only, the identities of their match would not be revealed, and that they would not have the opportunity to meet the potential dates. In the high expectancy group, students were told that there is much research to suggest that pheromones can influence how attractive we find others and that people have been found to respond differently to the pheromones of others, suggesting the presence of 'chemistry' between certain individuals (see Appendix B). In the low expectancy condition, students were told that the research examining the influence of pheromones on attraction has been somewhat unfavorable, with only a few studies finding support for this relation and that people have a difficult time detecting the pheromone scents of others.

After the introduction to the study and corresponding expectancy/motivation manipulations, students participated in the placebo pheromone task. The placebo pheromone was identical for all four experimental groups and consisted of slightly scented water, consistent with other pheromone research. Moreover, similar to the design in other pheromone research, samples of the pheromone were applied to a surgical mask (e.g., Kirk-Smith, Booth, & Davies, 1978). Four identical samples of placebo pheromone were presented to all subjects. Participants were told that one of the pheromone samples was from their 'match' and the other three were random samples taken from volunteers not involved in the study. Students were asked to put on the mask and subsequently rate each of the four samples on arousal, attraction, and sexiness and then to select the best sample. Students in all groups were told to take as much time as they need on these tasks

and that they may smell each sample as many times as they needed to in order to make their best assessments. They were asked to make their final ratings of samples only when they felt that they had had sufficient time to make their ratings. These ratings of arousal, attraction, and sexiness were then averaged to obtain an overall rating of desirability for each placebo sample.

Two measures of attention were collected during this rating task. First, attention was assessed as the total amount of time it took students to complete the entire rating task. Time began once students were instructed to start the rating task and ended when students completed their ratings for all four samples and indicated to the experimenter that they were finished with the task. A second measure of attention was assessed as the number of times students smelled each sample. Because the samples were applied to surgical masks, students had to raise the mask to their nose in order to make assessments. It was assumed that those subjects who were most highly motivated for the pheromones to enhance arousal would take more time in assessing the samples (as measured by seconds taken to complete the task) and would make more assessments of each sample (as measured by the number of times each sample is smelled). The more diligence with which subjects approach this task should provide more opportunity for subjects to interpret ambiguous feelings and physiological sensations according to their expectations and desires.

The placebo response was assessed using two measurements. The first measure of placebo response was the variability in ratings of desirability (overall desirability is the average of arousal, attractiveness, and sexiness) of the four samples. Because each sample was exactly the same substance, greater variability in desirability ratings of these

samples should indicate greater placebo response. This is consistent with other research on motivation and attention which has demonstrated that more highly motivated people tend to look for, and find, differences in ambiguous stimuli (Balcetis & Dunning, 2006). Secondly, placebo response was also assessed as the desirability rating for the selected sample. Thus, it was assumed that students who responded more highly to the placebo pheromone would not only find more differences among identical samples, but would also rate their selected sample as higher in desirability, when compared to low placebo responders.

Consistent with Hypothesis 1, it was expected that those subjects in the high motivation group would display more diligence on the rating task, thus taking longer to complete the task and smelling samples a greater number of times. Consistent with Hypothesis 2, it was expected that attention/diligence would mediate the relationship between motivation and placebo response. This would provide evidence for the role of attention as an important mechanism of change in placebo. Hypothesis 3 states that expectancy will predict the two outcome variables of placebo response, but will not influence measures of attention and task diligence. In other words, high expectancies for pheromone effectiveness should have a greater influence on the subjects' interpretation of ambiguous stimuli, as indicated by a higher placebo response, than on task diligence, as measured by time engaged in the task and number of assessments made.

These hypothesized results are consistent with a strong interpretation of the motivation-attention model in which only motivation influences attention. As previously discussed, it is possible that expectancy would influence motivation and/or attention to some degree, leading to greater attention in the high motivation/high expectancy group

(as compared to the high motivation/low expectancy group). In this more moderate interpretation of the model, motivation would have the largest influence on attention and expectancy would exert an influence on attention, but to a lesser degree. An examination of potential interactions in the current model should produce a better understanding of the role that expectancy may play in task diligence.

Measures

Initial Survey

Although the main purpose of the pre-screening personality and attitudes survey was to increase the strength of the motivation manipulation, the measures selected for this survey are psychometrically sound and provided data for exploratory analysis. The initial survey assessed general personality traits and attitudes pertaining to relationships and consisted of the Big Five Inventory (BFI), a relationship attitudes scale, the LOT-R, and a measure of social desirability. Each of these surveys are face valid and should appear to students as a valid means of matching them with potential dates.

The Big Five Inventory

The Big Five Inventory (BFI) is a 44-item test which assesses the Big 5 personality traits. The BFI provides a brief assessment of the Big 5 personality traits and is often used as an alternative to the NEO-R (Costa & McCrae, 1995). The BFI has five subscales (extraversion, agreeableness, conscientiousness, neuroticism, openness) that assess different dimensions of personality. Test takers are asked to determine how well

(from strongly disagree to agree strongly) a list of short descriptors (i.e. gets nervous easily) describes their personality (see Appendix A). The BFI has been found to be internally consistent, with a Cronbach's alpha values typically ranging from .75 to .90 (Benet-Martinez & John, 1998). The scale has also been found to be stable over time, with test-retest correlations ranging from .80 to .90. As evidence of construct validity, BFI self-report scales have been found to correlate .61 with reports from family members and peers (Soto & John, 2009). Moreover, BFI scales have shown convergent validity with Costa and McCrae's (1995) factor definitions (Soto & John, 2009).

Life Orientation Test- Revised

The Life Orientation Test- Revised (LOT-R) is a 10-item self-report measure assessing generalized expectancies for positive versus negative outcomes (Scheier, Carver, & Bridges, 1994). Because optimism has been found to relate (although unreliably) to placebo responding, this scale can be used in exploratory analyses following completion of the study. The scale consists of three positively worded items (e.g. In uncertain times, I usually expect the best) and three negatively worded items (e.g. I hardly ever expect things to go my way) which are rated on a scale ranging from 0 (strongly disagree) to 4 (strongly agree) (see Appendix A). After reversing the scoring for the negatively worded items, the item scores are summed to yield an overall score, with higher scores reflecting greater optimism. The LOT has been demonstrated to be a reliable and valid measure of optimism. The scale is internally consistent, with a Cronbach's alpha of .82. Additionally, when compared to scales such as self-esteem and

self-mastery, the LOT appears to have adequate predictive and discriminant validity (Scheier et al., 1994).

Relationship Attitudes

In order to increase the strength of the manipulation, students were asked a series of 10 questions assessing their attitudes and preferences regarding romantic relationships (see Appendix A). These questions were compiled from a wide variety of scales such as the Conflict Communication Scale and were not intended to be scored. The primary purpose of these questions was simply to increase the believability of the matching exercise.

Social Desirability

The Crowne- Marlowe Social Desirability Scale consists of 33 true/false questions and is a commonly used measure of social desirability. Items include a wide variety of behaviors, both desirable (e.g. no matter who I'm talking to, I'm always a good listener) and undesirable (e.g. I can remember "playing sick" to get out of something). Internal consistency has been found to be adequate, with Cronbach's alpha values ranging from .70-.77 (Crino, Svoboda, Rubenfeld, & White, 1983). Test-retest reliability over a period of a month was found to be high ($r = .86$) (Crino et al., 1983). Tests of validity have demonstrated that persons who score highly on this measure of social desirability have difficulty admitting to stigmatized behaviors including cocaine use (Johnson & Fendrich, 2002). Moreover, positive correlations have been found between social desirability and positive self-evaluations.

Lab Measures

Expectancy and Motivation

In research on placebo mechanisms, expectancy is most often assessed before the presentation of placebo with one item which assesses the degree to which the participant believes the treatment will benefit them (e.g., Hyland & Whalley, 2007). Motivation, although not as widely studied, is often assessed similarly (e.g., Vase, Robinson, Verne, & Price, 2005). The method used in the current study to assess expectancy and motivation was similar, although ten items were used to assess each construct using a 7-point Likert scale (see Appendix B). These items were face valid measures of expectancy (e.g. I think that the pheromones will influence my attractiveness ratings) and motivation (e.g. I hope that I find the scent of my matches to be most pleasing) and the original items were found to have high reliability in the pilot study (alpha values greater than .80). The ten items were averaged to provide an overall assessment of motivation and expectancy. The purpose of these measures was to serve as a manipulation check.

Desirability

Students rated their feelings of attraction on the following bi-polar dimensions: unattractive-attractive, unsexy-sexy, un-arousing-arousing (see Appendix B). They indicated their feelings of attraction by marking on a continuum. Following the study, these marks were translated to numerical data (e.g. unattractive- 1 to attractive- 9). The sum of the numerical ratings of attractiveness, sexiness, and arousal was averaged to

obtain an overall rating of desirability for each of the four scents.[2] Attraction, arousal, and sexiness are ideal outcome variables with which to assess placebo effects because these are sensations which are largely influenced by perception. Participants must assess their feelings and physiological states in order to determine their level of attraction. Because these internal states are ripe with ambiguity, this task provides an excellent means for placebo responses to develop.

Measures of Attention

Task diligence was assessed in two ways: 1) the total time (in seconds) participants spent on the scent rating task and 2) the total number of times that the participant smelled the scents. In order to provide the most unobtrusive means of assessment, time was measured using a stopwatch on a cell phone, which was placed on the experimenter's lap. The time began once students were instructed to start the rating task and ended when students completed their ratings for all four samples and indicated to the experimenter that they were finished with the task. The number of times participants smelled each sample was recorded by the experimenter, who was seated across from the participant. Distinct sniffs were identified when participants removed the mask at least 2 inches from the face and reapplied the mask to make another assessment.

[2] Cronbach's alpha values over .85 for each scent rating provided support for the use of an overall construct of 'desirability'.

Placebo Response

Placebo response was assessed as the overall desirability rating (average of arousal, attractiveness, and sexiness) of the selected scent and the variability, as assessed by standard deviation, in the overall ratings of the four scents. Those who rated the scent to be more desirable displayed greater response to the placebo. Moreover, as each scent sample is identical, students who reported greater differences among scents, as assessed by variability, demonstrated greater placebo response. Other measures of variability including range and variance were analyzed, but did not change study results.

Statistical Design and Power

The current study has three main hypotheses. First, that greater motivation would lead to greater attention, second, that attention would mediate the relationship between motivation and placebo response and third, that expectations would positively influence placebo response. In order to test the first hypothesis, regression analyses (one for each measure of attention/diligence) were conducted in which the dummy-coded group variables motivation and expectancy were entered as predictors and the 'time in seconds for task completion' and 'number of times smelled' were entered as the dependent variables. It was predicted that greater levels of motivation, but not expectancy, would lead to greater attention. In order to test the second hypothesis, a regression test of mediation was used, which is described in greater detail in the results section. Lastly, placebo response was regressed on the dummy-coded experimental expectancy group in order to test that hypothesis that expectancy would positively influence placebo outcomes. The presence of interactions between expectancy and motivation would

provide further insight into the role of these two variables in producing placebo responses.

Given that effect sizes vary widely by setting, it is difficult to choose as estimated effect for the current study. Studies which examine the mechanisms of placebo responding, as in the current study, have been found to have larger effect sizes, likely due to the careful consideration of factors which are known to increase effects (Price, Finniss, & Benedetti, 2008). Thus, given a general range of effect sizes in experimental placebo studies of .51 to .95, a conservative estimate of effect size would be at the low end of this range of values (an effect size of about one half a standard deviation). With a power of .80 and an effect size of .50, a total sample size of 75 is needed.

Pilot Study

Because the study utilized a new research design in examining placebo mechanisms, a pilot study was conducted to gauge the appropriateness of the study design for examining placebo mechanisms. The pilot study consisted of a total sample of 40 undergraduate students. Regression analysis indicated that there was an effect for motivation, $\beta = .43$, $t(37) = 2.88$, $p < .01$, but not expectancy, $\beta = .01$, $t(37) = .08$, $p < .93$, on the dependent variable of placebo response, 'best scent,' or the desirability rating of the chosen scent. There were no effects for either motivation, $\beta = .24$, $t(37) = 1.50$, $p < .14$, or expectancy, $\beta = .16$, $t(37) = 1.02$, $p < .31$, on the other primary dependent variable of placebo response, 'variability of the scent ratings'(as assessed by standard deviation). Motivation predicted task diligence as assessed by 'number of times smelled,' $\beta = .50$, $t(37) = 3.51$, $p < .01$, but not 'total time smelled', $\beta = .17$, $t(37) = 1$, $p <$

.32. Expectancy did not predict either measure of task diligence. Lastly, ANOVA analyses revealed no significant differences between experimental groups on the manipulation check expectancy measure, $F(1, 38) = 8.5$, $p<.47$, and motivation measure, $F(1, 38) = 1.43$, $p<.26$.

Motivation influenced 'best scent' (measure of placebo response) and 'number of times smelled' (measure of diligence), but not the other study variables; expectancy influenced none of the study variables. Although not all of the hypothesized effects were observed, it is possible that these effects were present, but were difficult to detect given the small sample size. Support for this assertion can be found in a simple examination of means, which suggests small, but non-significant effects in hypothesized directions. Of additional concern, the manipulation check suggested that none of the four experimental groups differed on levels of motivation and expectancy. There are several potential reasons for the lack of significant findings on the manipulation check measure. First, it is possible that the manipulation check was poorly designed and that groups did differ on levels of motivation and expectancy, but these differences were not detected by the measures. Support for this assertion can be found in the observed effects for motivation consistent with the hypotheses, although the manipulation check suggested motivation had not been manipulated. Second, it is possible that expectancy and motivation were not manipulated and that the effects that were observed are not a good test of the study's hypotheses.

The current study design was altered in several ways in order to address these concerns. First, the manipulations were made stronger. More detail was added to the scripts for each experimental group, with the intention of increasing the impact of the

expectancy and motivation manipulations. In addition, participants were asked to answer the following question after the prompt in order to help ensure subjects attended to the information in the prompts: "Do you see how pheromones do/do not influence attraction?" Next, the design of the dating component of the study was altered so that subjects believed they would have the opportunity to complete a second phase of the study with their match, rather than have the opportunity to contact the match after the completion of the study. This change was made after several subjects (both male and female) indicated that contacting their match after the conclusion of the study would be 'weird.' Giving subjects the opportunity to meet their matches under the guise of research study involvement seemed to eliminate much of their apprehension. Next, participants in all four experimental groups were told, prior to engaging in the scent rating task, that they were to respond honestly and if they didn't perceive differences among smells, it was o.k. to indicate this in their ratings. This statement was added to the prompt after the follow-up interviews revealed that some students made extreme ratings not because these ratings reflected their true response to the scents, but because they wanted to be cooperative. Thus, the intent of this statement was to reduce the effect of demand characteristics such as desire to please the experimenter and social desirability, effects which were not within the domain of the current study. Lastly, the manipulation check measure was altered to include more items which assessed a broader domain of expectancy and motivation. The measure was increased from 6 items to 20 items. These changes are all described in greater detail in the 'Current Study' and 'Measures' sections.

RESULTS

Sample Description

One hundred fifty four participants completed the study. Two participants were dropped from the analysis because they reported being involved in an exclusive relationship at the time of the study. The final sample of 152 participants ranged in age from 18 to 51 with a mean age of 22 (SD = 6) (see Table 2). Seventy-one percent of the sample was female; the majority of the subjects reported their ethnicity as Caucasian (69%), followed by African American (13%), Asian American (7%), Hispanic American (3%), and Other (8%). Ninety-four percent reported a heterosexual orientation, followed by homosexual (3%) and bisexual (3%). Year in school for the sample was as follows: freshman (47%), sophomore (28%), junior (17%), senior (5%), and other (3%). Of the 152 participants in the total sample, 38 were assigned to group 1, 39 to group 2, 38 to group 3, and 37 to group 4.

Study Variables

Mean, standard deviation, and dispersion statistics for all study variables are listed in Table 3. Skewness and kurtosis statistics near zero indicate symmetric and normally distributed data. General rules of thumb for interpreting skewness and kurtosis statistics suggest that statistics which fall outside the range -1 to 1 or +/- twice the standard error of each statistic indicate significant skewness and kurtosis (Tabachnick & Fidell, 1996).

Dispersion statistics for primary study variables are as follows: number of times smelled (skewness = 1.53, kurtosis = 2.72), time smelled (skewness = 1.13, kurtosis = .80), variability of ratings (skewness = .41, kurtosis = -.37), best scent (skewness = -.69, kurtosis = 1.57). Both tests of significance yielded similar results, with the variable 'number of times smelled' displaying high levels of skewness and kurtosis. 'Time smelled' was characterized by significant positive skewness and 'best scent' displayed significant positive kurtosis. Positive kurtosis indicates values more closely clustered around the mean whereas negative kurtosis indicates greater dispersion, relative to a normal distribution. Positive and negative skewness indicate an extended right and left tail, respectively. Logarithmic transformations successfully corrected data distributions problems, but did not affect primary results or data interpretation. Results reported below are based on non-transformed data.

Manipulation Check

A 20-item questionnaire including 10 self-report expectancy items and 10 self-report motivation items was used to assess the effectiveness of the manipulation. Cronbach's alpha values for the 10 item expectancy and motivation measures were .82 and .80, respectively. Mean and standard deviation values are listed in Table 3. It was expected that both high motivation groups would score higher on the motivation measure than the two low motivation groups and similarly, that the two high expectancy groups would score higher on the expectancy measure than the two low expectancy groups. Some, but not all, of these expectations were observed. One-way ANOVA tests were significant for group differences on the expectancy, $F(1, 152) = 10.7$, $p<.01$, but not

motivation measure, $F(1, 152) = 1.52$, $p<.21$. Post-hoc group comparisons revealed that the low-motivation, low-expectancy group was significantly lower on the self-report measure of motivation than the high-motivation, high-expectancy group; no other differences on the motivation measure were found between groups (see table 4 and figure 3). On the 10-item measure of expectancy, the low-expectancy, low-motivation group was significantly lower than both of the high expectancy groups and, unexpectedly, was also lower on the measure of expectancy than the low-expectancy, high-motivation group (see table 5 and figure 2).

Both self-report measures predicted all primary study variables. Those scoring higher on the expectancy measure also displayed greater task diligence, as assessed by time smelled, $\beta = .23$, $t(150) = 2.85$, $p < .01$, and number of time smelled, $\beta = .20$, $t(150) = 2.49$, $p < .01$, and placebo response, as assessed by best scent, $\beta = .22$, $t(150) = 2.68$, $p < .01$, and variability in ratings, $\beta = .17$, $t(150) = 2.11$, $p < .04$. Similarly, the motivation measure predicted all variables: time smelled, $\beta = .29$, $t(150) = 3.73$, $p < .01$, number of times smelled, $\beta = .21$, $t(150) = 2.62$, $p < .01$, best scent, $\beta = .33$, $t(150) = 4.22$, $p < .01$, and variability in ratings, $\beta = .21$, $t(150) = 2.66$, $p < .01$. When included as a predictor, along with the self-report measures of expectancy and motivation and the expectancy experimental group, the motivation experimental group remained a significant predictor of all primary study variables, best scent, $\beta = .18$, $t(147) = 2.16$, $p < .03$, variability of scent ratings, $\beta = .17$, $t(147) = 2.04$, $p < .04$, number of smells, $\beta = .25$, $t(147) = 3.01$, $p < .01$, and time smelled, $\beta = .22$, $t(147) = 2.68$, $p < .01$. Moreover, when all four variables were included as predictors in simultaneous regression, self-reported motivation and

manipulated motivation were predictive of both measures of task diligence and only manipulated motivation was predictive of placebo response, as assessed by best scent, $\beta = .53$, $t(147) = 2.16$, $p < .03$, and variability in scent ratings, $\beta = .172$, $t(147) = 2.04$, $p < .04$. Thus, statistically significant unique variance could be attributed to self-reported motivation and manipulated motivation in the prediction of mediators and only to manipulated motivation in predicting placebo response.

Analysis of Hypothesized Effects

The current study has three main hypotheses. First, that greater motivation would lead to greater attention, second, that attention would mediate the relationship between motivation and placebo response and third, that expectations would positively influence placebo response. In order to test the first hypothesis, which predicted motivation would lead to greater attention/task diligence, regression analyses were conducted for each measure of attention, number of times smelled and total time smelled (in seconds), with both the motivation and expectancy experimental groups entered as predictors. The overall regression equations were significant for number of times smelled, $F(2, 149) = 5.09$, $p<.01$, and total time smelled, $F(2, 149) = 4.94$, $p<.01$ (see Table 6). Motivation significantly influenced number of times smelled, $\beta = .25$, $t(149) = 3.19$, $p < .01$, and total time smelled, $\beta = .24$, $t(149) = 2.99$, $p < .01$. Thus, students in the high motivation conditions displayed greater task diligence and the first hypothesis was supported. Expectancy did not influence either the number of times smelled, $\beta = -.03$, $t(149) = -.33$, $p < .74$, or the total time smelled, $\beta = .08$, $t(149) = .97$, $p < .34$.

The second hypothesis which posited that attention would mediate the relationship between motivation and placebo response was examined through a regression test of mediation. In order to demonstrate mediation through this test, it must first be demonstrated that the IV predicts both the mediator and DV and that the mediator predictors the DV, and secondly, when the mediator is added to the overall regression equation, the influence of the IV on the DV is decreased (Baron & Kenny, 1986). Consistent with these criteria, it was demonstrated that motivation predicted both measures of placebo response, variability of ratings, $\beta = .21$, $t(150) = 2.65$, $p < .01$, and best scent, $\beta = .23$, $t(150) = 2.86$, $p < .01$, and both measures of task diligence, number of times smelled, $\beta = .25$, $t(150) = 3.19$, $p < .01$, and total time smelled, $\beta = .24$, $t(150) = 2.99$, $p < .01$ (see Table 6). Secondly, number of times smelled predicted both measures of placebo response, variability of scent ratings, $\beta = .20$, $t(150) = 2.51$, $p < .01$, and best scent, $\beta = .33$, $t(150) = 4.21$, $p < .001$. Similarly, total time smelled predicted both variability in scent ratings, $\beta = .24$, $t(150) = 3.03$, $p < .01$, and best scent, $\beta = .44$, $t(150) = 5.97$, $p < .001$. Thus, the predictor variable (motivation) predicted both measures of the outcome variable (placebo response) and both measures of the mediator (task diligence). In addition, the mediator variable (task diligence) predicted both measures of the outcome variable (placebo response).

Furthermore, the mediation was found to be significant for most paths. Adding the mediator variable 'time smelled' as a predictor reduced the effect of motivation on placebo response, as measured by 'best scent.' The overall regression equation was significant, $F(2,149) = 19.57$, $p<.01$, and the standardized regression coefficient for

motivation dropped from .23 (β = .23, t(150) = 2.85, p < .01) to .13 (β = .37, t(149) = 1.74, p < .08). Sobel's test statistic, which assesses the significance of the change in Beta value, indicated that this drop was significant (Sobel statistic = 6.38, p<.01). Similar results were found for the regression of 'best scent' on 'number of times smelled' and motivation, F(2,149) = 10.98, p<.01. The addition of the mediator reduced the standardized regression coefficient for motivation from .23 (β = .23, t(150) = 2.85, p < .01) to .16 (β = .16, t(149) = 1.96, p < .06), which was found to be significant (Sobel's statistic = 2.69, p<.01). Lastly, adding the mediator variable 'time smelled' as a predictor reduced the effect of motivation on placebo response, as measured by 'variability in ratings.' The overall regression equation was significant, F(2,149) = 6.75, p<.01, and the standardized regression coefficient for motivation dropped from .21 (β = .21, t(150) = 2.65, p < .01) to .16 (β = .16, t(149) = 2.03, p < .04). Sobel's test statistic indicated that this drop was significant (Sobel statistic = 1.98, p<.05). Adding the mediator variable 'number smelled' as a predictor reduced the effect of motivation on placebo response, as measured by 'variability in scent ratings', but this drop was not found to be significant (Sobel's statistic = 1.70, p<.09). Overall, the results suggest partial mediation; the effect of motivation on placebo response was partially mediated by attention/task diligence.

Lastly, the third hypothesis, which predicted that expectancy would influence the level of placebo response, was not supported. The regression of placebo response, as assessed by 'best scent' on the experimental groups of expectancy and motivation was significant, F(2,149) = 4.06, p<.02, but expectancy was not found to be a significant predictor, β = -.01, t(149) = -.11, p < .91 (see Table 6). Similarly, the regression of

placebo response, as assessed by 'variability of scent ratings', on the experimental groups of expectancy and motivation was significant, $F(2,149) = 4.15$, $p<.02$, but expectancy was not found to be a significant predictor, $\beta = .09$, $t(149) = -1.13$, $p < .26$.

In conclusion, regression tests of mediation indicated that 'number of times smelled' and 'total time smelled' mediated the relationship between motivation and the outcome variables 'best scent' and 'variability in scent ratings' (although the mediation for variability was only significant for the mediator 'time smelled' and not 'number smelled'). Thus, motivation led to greater task diligence as measured by greater time engaging in the scent rating task and greater number of ratings made. Task diligence, in turn, led to greater placebo response as measured by more attractive ratings of the chosen scent and variability in the scent ratings. Inconsistent with hypothesized effects, expectancy did not influence placebo response.

Secondary Measures

All subjects completed a survey which consisted of the Big Five Inventory (BFI), a relationship attitudes scale, the LOT-R, and a measure of social desirability. Although the main purpose of this survey was to increase the strength of the motivation manipulation, the survey results also provided interesting data for follow-up analyses. Examining the five BFI subscales (extraversion, agreeableness, conscientiousness, neuroticism, openness), significant correlations were found between agreeableness and variability of scent ratings, $r(150) = -.21$, $p<.01$, openness and total time smelled $r(150) = .17$, $p<.04$, and openness and best scent, $r(150) = .17$, $p<.04$ (see table 7). No other significant correlations were found between BFI subscales and the mediating variables of

'time smelled' and 'number of times smelled' or the primary dependent variables of 'best scent' or 'variability of scent ratings.' Social desirability was found to be negatively related to both of the primary outcome variables, best scent $r(150) = -.22$, $p < .02$, and variability of scent rating $r(150) = -.23$, $p < .01$. Optimism, as assessed by the LOT-R, was not found to be related to any of the four primary study variables (total time smelled, number of times smelled, best scent, and variability of scent ratings). Moreover, when controlling for social desirability and openness, the motivation experimental group remained a significant predictor of both primary dependent variables, best scent, $\beta = .17$, $t(149) = 2.18$, $p < .03$, and variability of scent ratings, $\beta = .20$, $t(149) = 2.44$, $p < .02$.

Experimenter Effects

There were a total of five experimenters involved in data collection. One-way ANOVA analyses revealed no differences by experimenter on any of the primary study variables: best scent $F(1,150) = .54$, $p < .75$, variability of scent ratings, $F(1, 150) = .44$, $p < .82$, time smelled, $F(1,150) = .54$, $p < .75$, and number of times smelled, $F(1,150) = 1.48$, $p < .20$.

DISCUSSION

Motivation has not been widely studied as a mechanism of change in placebo, with most research focusing on the role of expectancy in placebo outcomes. Although motivation is not often measured or manipulated, it is reasonable to assume that placebo effects observed in traditional placebo research may represent motivational influences in addition to expectancy effects. It follows that when motivation is manipulated and measured, as in the current study, the strong effects of motivation in placebo become apparent. Current findings suggest that motivation effects have a greater influence on placebo than previously thought and may even overshadow expectancy when motivation is maximized.

The current study identifies an important mediating variable in placebo and expands on previous findings by clearly outlining a model of change. Moreover, the findings suggest that motivation-attention models are a meaningful way to conceptualize placebo change. Those students more highly motivated to respond to placebo were more involved in assessing the placebo substance and as a result, responded more highly to the placebo. This process is consistent with findings in perception literature, which highlight the important role that motivation plays in forming perceptions of various affective states (Xing & Isaacowitz, 2006), social judgments (Erber & Fiske, 1984), and visual stimuli (Balcetis & Dunning, 2007).

The results of this study are consistent with a cognitive or motivational interpretation of placebo. As previously discussed, placebo responses are believed to be produced through two pathways, one within awareness, consistent with the expectancy model, and one outside of awareness, which is more consistent with a conditioning model. This distinction is important, as different mechanisms are believed to underlie each model. Research on the psychological processes involved in placebo analgesia has demonstrated that activation of opioid and dopamine systems in areas such as the nucleus accumbens may underlie changes in self-reported pain perception (e.g., Scott, Stohler, Egnatuk, Wang, Koeppe, & Zubieta, 2007). Other research has demonstrated that alternative pathways may also underlie placebo responses. For example, both expectancy and conditioning placebo manipulations can produce lowered pain perception, but only conditioning manipulations have been found to impact hormone secretion, a marker of pain (e.g., Benedetti, Pollo, Lopiano, Lanotte, Vighetti, & Rainero, 2003). Neurophysiological research on pain perception has also identified distinct pathways. Sensory neurons appear to communicate the affective component and physical pain component to the brain through different pathways, suggesting that research on motivational-expectancy influences on placebo may be acting on the former, rather than latter, pathway (Lumkin, Marshall, & Nelson, 2010). It is believed that these pathways do not act in isolation, but rather interact and share information, ultimately influencing a person's overall subjective experience of sensory input.

The failure to take into account these different pathways can lead to an incomplete understanding of clinical treatment effects. A recent study on placebo effects in irritable bowel syndrome treatment found that even when assignment to the placebo

group was clearly communicated to participants, presumably reducing treatment expectancies, the placebo treatment effect equaled that of the regular treatment group (Kaptchuk, Friedlander, Kelley, Sanchez, Kokkotou, et al., 2010). The authors concluded that the simple act of engaging in a medical ritual may be helpful to some patients, regardless of their expectation of benefit. Examining these findings within the context of placebo theory, it is possible another variable, such as motivation, influenced responding or that patients had been conditioned to respond to medical settings, consistent with a conditioning theory of placebo. As suggested in research on physiological mechanisms of placebo, expectancy, motivation, and conditioning theories imply different pathways which are believed to act on different biological systems. This study demonstrates the importance of considering the multiple pathways of placebo and suggests that even when one pathway is not acted on, placebo responses may be produced through another.

Examining a motivation-attention model of placebo in relation to physiological models of placebo provides a broader framework through which to view current findings. This study examined the process of placebo change at the perceptual and behavioral level, specifically by examining changes in motivation, behavioral markers of attentional bias, and perception of smell. Although little research exists on the role of placebo in olfactory sensation, the physiological underpinnings of this process may reasonably be expected to occur in areas of the brain which are more readily associated with reward, motivation, and expectations, as found in other research on placebo mechanisms (e.g., Scott, Stohler, Egnatuk, Wang, Koeppe, & Zubieta, 2007). Thus, manipulating motivation may alter the affective component of smell, altering an individual's overall experience of the scent. The current study provides a possible explanation for one

component of the placebo process as it relates to psychological variables, and highlights that even within a broader context of neurophysiological systems, factors such as motivation and attentional bias play an important role in one's perceptual experience and placebo responding.

Methodological Shortcomings

One concern with the study design is whether or not the variables were manipulated as intended. Although results of the manipulation check suggested that many groups did not differ on levels of expectancy and motivation, the differences that were observed were consistent with expectations. The low-motivation, low-expectancy group was significantly lower on the self-report measure of motivation than the high-motivation, high-expectancy group. The low-expectancy, low-motivation group was significantly lower than both of the high expectancy groups on the measure of expectancy. One possible interpretation of these findings is that the manipulation check measure is a valid measure of the constructs of interest and that the lack of significant findings demonstrates a failure to manipulate motivation and expectancy. It is also possible that motivation or expectancy, or both, were in fact manipulated but that this measure did not adequately assess these constructs. Examining the study results, there is more evidence for the assertion that motivation was manipulated, but poorly measured, than there is regarding the manipulation of expectancy.

There were strong effects for the motivation variable, which were consistent with hypothesized effects, providing some support for the assertion that motivation was manipulated, but not well-detected by the motivation measure. The analysis of the

expectancy measure is less clear. There were differences between groups on the measure of expectancy which were consistent with expectations, but only a few of these group comparisons rose to significance. Moreover, the expectancy manipulation did not influence study variables. Thus, it may be that expectancy was not manipulated or if it was manipulated, it did not influence placebo outcomes. Due to the null findings for the expectancy group variable and failure of the manipulation check to demonstrate manipulation of expectancy, caution should be used when interpreting the results. The current study's findings are more informative in examining the role of motivation in placebo effects.

Although scores on the self-report expectancy and motivation measures did not correspond exactly to manipulated levels of each variable, both measures predicted task diligence and placebo response and were moderately correlated, $r(152) = .36$, $p<.01$. It is possible that these self-report measures indicate individual differences in expectancy and motivation, beyond the experimental manipulation. Data analysis revealed that even when including the self-report measures of motivation and expectancy as predictors in regression, manipulated motivation remained a strong and significant predictor of all study variables. A second interpretation of this data is that the self-report expectancy and motivation measures tapped constructs of study involvement, interest, or demand characteristics and that students high on these measures were more engaged in all stages of the study, regardless of the experimental manipulation. These constructs are certainly within the realm of placebo and some researchers have conceptualized placebo as exactly this (e.g., Geers, Kosbab, Helfer, Weiland, & Wellman, 2007). However, given the current study's interest in placebo mechanisms, the goal of outcome assessment was to

measure experienced internal states, while minimizing demand characteristics (although it is easy to appreciate the difficulty in disentangling the two).

Further complicating assessment, motivation and expectancy were moderately correlated and may have had bi-directional influences, in that the manipulation of one variable altered levels of the other. Consistent with this assertion, the low-low group ranked lowest and the high-high group ranked highest, on both measures of self-reported expectancy and motivation. These differences did not all rise to levels of significance, but a trend clearly indicated that groups where both expectancy and motivation were maximized or minimized resulted in the greatest change in each variable. More moderate effects were observed in mixed (high-low, low-high) groups, suggesting that maximization of one variable was more difficult in groups where the other was minimized, and vice versa. These findings lend some support to the assertion that expectancy and motivation may have had bi-directional influences, thus complicating data interpretation by making it more difficult to examine the individual effects of each.

Secondary Measures

Interestingly, social desirability was found to be negatively related to both of the primary dependent variables, best scent and variability of scent ratings. This is somewhat contradictory to other research studies which have found placebo effects to be related positively to social desirability (e.g., Gelfand, Gelfand, & Rardin, 1965) although, as previously discussed, the consistency of such findings is debated. Conversely, two study variables, ‘total time smelled’ (measure of diligence) and ‘best scent’ (measure of placebo response) were found to be positively related to the personality variable

'openness.' An examination of the constructs of social desirability and openness within the context of the current study design may help to explain these findings.

Social desirability is meant to capture a general concern with how one presents oneself to others and is associated with behaviors such as unwillingness to report psychological distress (Johnson & Fendrich, 2002). The trait of openness to experience as assessed by the BFI, captures characteristics such as imagination, insight, and intellectual curiosity; those who score low on this scale tend to be more traditional in their outlook and behavior (Soto & John, 2009). In this study, students were asked to rate the pheromone samples of members of the opposite sex by how arousing, attractive, and sexy they found the samples to be. This task could be perceived as potentially embarrassing and anxiety provoking, especially by those people who are less comfortable expressing sexuality and attraction. Thus, it may have been difficult for some people to endorse feelings of arousal and attraction, especially in the presence of a researcher. It may be the case that social desirability in this study manifested not a general desire to please the experimenter, but as a hesitation to express potentially embarrassing feelings of sexual arousal. Those scoring high on openness, in contrast, would have presumably been more open to engaging in the scent rating task and reporting feelings of arousal, consistent with the results showing a positive correlation between openness and placebo response. Although this is certainly only one interpretation of the results, it does offer a compelling explanation for the observed pattern of findings.

As mentioned above, these findings are inconsistent with previous studies which found a positive relation between social desirability and placebo (e.g., Gelfand, Gelfand, & Rardin, 1965) and lend support to the current understanding of placebo as not reliably

related to personality factors. The findings of this study suggest that one possible explanation for the lack of consistency may be that personality factors manifest in different ways depending on the nature of the placebo treatment and other situational factors. For example, expressing pain relief (e.g., Gelfand, Gelfand, & Rardin, 1965) may be more agreeable to those high on the trait of social desirability, than endorsing feelings of sexual arousal. Thus, the effect of personality on placebo may be context specific; only when there is a match between situational factors and personality style will personality be a predictor of placebo responding.

Implications

The results of this study do not discount the role of expectancy, but rather underscore the important role of motivation in producing placebo effects. Although expectancy did not influence study variables, motivation did lead to greater task diligence, which, in turn, led to higher placebo responding. Students in the high motivation group spent more time on the rating task, smelled the samples a greater number of times, and as a result, rated their chosen sample to be more pleasing and had greater overall variability in the sample ratings. Current findings suggest a possible mechanism of change in placebo effects and have important implications for the study of placebo.

Understanding the mechanisms by which placebo is produced has implications in many clinical settings, where placebo is believed to play an important role in producing treatment effects. If greater attention to signs of improvement is the process through which placebo is produced, clinicians may be able to increase treatment effects not only

by increasing motivation to improve, but also by encouraging patients to monitor themselves for signs of improvement. Intervening at the level of this mediating variable may help clinicians to maximize placebo, thereby increasing treatment effects. Moreover, an understanding of psychological variables in placebo helps to provide a more complete picture of an individual's overall perceptual experience, which has relevance to areas of research including pain management, psychopharmacological treatment of mental disorders, and smoking cessation, to name a few.

Suggestions for Future Research

Future research should seek to further clarify the relationship of expectancy and motivation to placebo outcomes and continue to examine mediating factors such as attention. Efforts should also be made to more carefully design studies which maximally manipulate expectancy and motivation. The current study utilized a novel approach to the study of placebo, which lent itself well to the study of mechanisms, as overt behaviors related to scent assessment could be observed. Moreover, the task appeared to be very engaging to participants, an observation which was supported in informal follow-up interviews with participants and by the large effects for the motivation manipulation. This would likely be a good paradigm for the future study of placebo mechanisms, although efforts should be made to address the less than optimal manipulation of expectancy. New methods to manipulate expectations should be explored which don't rely on the traditional verbal inducement of expectations common to placebo research.

Lastly, researchers should continue to examine the multiple pathways of placebo, their potential interactions, and manifestations at the psychological, behavioral, and

physiological level. Motivation-attention models appear to be a useful paradigm through which to study placebo and future study of placebo mechanisms can be further informed by models of perception and motivation. This will provide not only a more comprehensive model of placebo, but also a better understanding of the factors and processes that shape overall perceptual and sensory experience.

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TABLES

Table 1. Current Models of Placebo Responding

Model	**Model Overview**	**Important Elements**
Lundh's (1987) Expectancy Model	Expectancies lead to greater attention, which results in evidence of the placebo's effectiveness. This evidence strengthens future responding to placebo.	Expectancy, Attention
Goal-Activation Model	Placebo effects are produced when a person holds expectancies which are compatible with motivation.	Expectancy, Motivation
Desire-Expectancy Model	The desire (motivation) to respond to placebo can be likened to approach and avoidance goals. Avoidance goals produce negative affect. Motivation and expectancies lead to greater attention which results in evidence of the placebo's effectiveness, reducing negative affect.	Expectancy, Attention, Motivation

Table 2. Demographic Variables (N = 152)

Variable	Mean or number	(SD or %)
Age	22	(6)
Gender		
Female	108	(71%)
Male	44	(29%)
Race		
Caucasian	105	(69%)
African American	20	(13%)
Asian American	11	(7%)
Hispanic American	4	(3%)
Other	12	(8%)
Year in school		
Freshman	71	(47%)
Sophomore	42	(28%)
Junior	26	(17%)
Senior	8	(5%)
Other	5	(3%)
Sexual Orientation		
Heterosexual	143	(94%)
Bisexual	5	(3%)
Homosexual	4	(3%)

Table 3. Mean, Standard Deviation, and Dispersion Statistics for Study Variables

Primary Study Variables				
	Mean	Standard Deviation	Skewness	Kurtosis
Expectancy	3.6	.56	-.69	.82
Motivation	2.8	5	.16	-.51
# sniffs	12	7.9	1.52 (SE*=.20)	2.71 (SE=.39)
Time smelled	156	79	1.13 (SE=.20)	.80 (SE=.39)
Best Scent	6.1	1.4	-.69 (SE=.20)	1.57 (SE=.39)
Variability Ratings	1.1	.80	.41 (SE=.20)	-.37 (SE=.39)
Secondary Study Variables				
	Mean	Standard Deviation	Skewness	Kurtosis
LOT	3.6	.72	-.70	.25
Social Desirability	16.7	5.1	-.11	-.32
Extraversion	29	6.1	-.53	-.35
Agreeableness	35.9	5.0	-.39	-.24
Conscientiousness	34.1	5.3	-.69	1.11
Neuroticism	22.4	6.3	.19	-.64
Openness	36.4	6.3	-.08	-.35

* Standard error of skewness and kurtosis

Table 4. ANOVA Post-Hoc Results of Mean Difference Comparisons for the Four Experimental Groups on the Self-Reported Motivation Measure

	Group 1*	Group 2	Group 3
Group 1			
Group 2	.15, p<.18 (Group 1-2)		
Group 3	.01, p<.98 (Group 1-3)	-.15, p<.18 (Group 2-3)	
Group 4	-.08, p<.47 (Group 1-4)	**-.23, p<.04 (Group 2-4)**	-.08, p<.49 (Group 3-4)

*Group 1= Hi Motivation, Lo Expectancy (n=38)
Group 2= Lo Motivation, Lo Expectancy (n=39)
Group 3= Lo Motivation, Hi Expectancy (n=38)
Group 4= Hi Motivation, Hi Expectancy (n=37)

Table 5. ANOVA Post-Hoc Results of Mean Difference Comparisons for the Four Experimental Groups on the Self-Reported Expectancy Measure

	Group 1*	Group 2	Group 3
Group 1			
Group 2	**.55, p<.001** **(Group 1-2)**		
Group 3	.07, p<.57 (Group 1-3)	**-.48, p<.001** **(Group 2-3)**	
Group 4	-.04, p<.77 (Group 1-4)	**-.59, p<.001** **(Group 2-4)**	-.10, p<.39 (Group 3-4)

*Group 1= Hi Motivation, Lo Expectancy
Group 2= Lo Motivation, Lo Expectancy
Group 3= Lo Motivation, Hi Expectancy
Group 4= Hi Motivation, Hi Expectancy

Table 6. F, t, and Beta values for Regression of Primary Study Values on Motivation and Expectancy Experimental Groups

	Best Scent	Variability Scent	Number Smells	Time Smelled
F-value, regression onto Motivation and Expectancy	***F*(2, 151) = 4.06, p<.02**	***F*(2, 151) = 4.14, p<.02**	***F*(2, 151) = 5.10, p<.01**	***F*(2, 151) = 4.94, p<.01**
β and t-value for Motivation	**β = .23, *t*(151) = 2.85, *p* < .01**	**β = .21, *t*(151) = 2.64, *p* < .01**	**β = .25, *t*(151) = 3.18, *p* < .01**	**β = .23, *t*(151) = 2.98, *p* < .01**
β and t-value for Expectancy	β = -.01, *t*(151) = -.11, *p* < .91	β = .09, *t*(151) = 1.12, *p* < .26	β = -.03, *t*(151) = -.33, *p* < .74	β = .08, *t*(151) = .97, *p* < .33

Table 7. Correlations Between Secondary Measures of the BFI, LOT-R, and Social Desirability Scale with Primary Study Variables

	Number Smelled	Total Time Smelled	Best Scent	Variability of Scents	Extra-version	Agreeable-ness	Conscien-tiousness	Neuro-ticism	Openness	Optimism (LOT-R)	Social Desirability
Number Smelled	1										
Total Time Smelled	**.70** (p<.01)**	1									
Best Scent	**.33** (p<.01)**	**.44 ** (p<.01)**	1								
Variability of Scents	**.20** (p<.01)**	**.24** (p<.01)**	**.61** (p<.01)**	1							
Extraversion (BFI)	-.02 (p<.80)	-.01 (p<.95)	.06 (p<.45)	.13 (p<.12)	1						
Agreeableness (BFI)	.05 (p<.52)	-.05 (p<.53)	-.05 (p<.57)	**-.21** (p<.01)**	.15 (p<.07)	1					
Conscientiousness (BFI)	-.07 (p<.39)	-.10 (p<.23)	-.10 (p<.21)	-.06 (p<.49)	**.19* (p<.02)**	**.34** (p<.01)**	1				
Neuroticism (BFI)	.01 (p<.88)	0 (p<.99)	0 (p<.99)	-.05 (p<.55)	**-.42** (p<.01)**	**-.26** (p<.01)**	**-.18* (p<.03)**	1			
Openness (BFI)	.04 (p<.62)	**.17* (p<.04)**	**.17* (p<.04)**	.08 (p<.31)	**.26** (p<.01)**	.12 (p<.16)	.09 (p<.30)	-.09 (p<.30)	1		
Optimism (LOT-R)	-.09 (p<.27)	-.12 (p<.16)	-.10 (p<.22)	-.06 (p<.47)	**.38** (p<.01)**	**.32** (p<.01)**	**.33** (p<.01)**	**-.45** (p<.01)**	.13 (p<.12)	1	
Social Desirability	.01 (p<.99)	.03 (p<.75)	**-.22* (p<.02)**	**-.23** (p<.01)**	.13 (p<.11)	**.42** (p<.01)**	**.38** (p<.01)**	**-.38** (p<.01)**	**.19* (p<.03)**	**.30** (p<.01)**	1

FIGURES

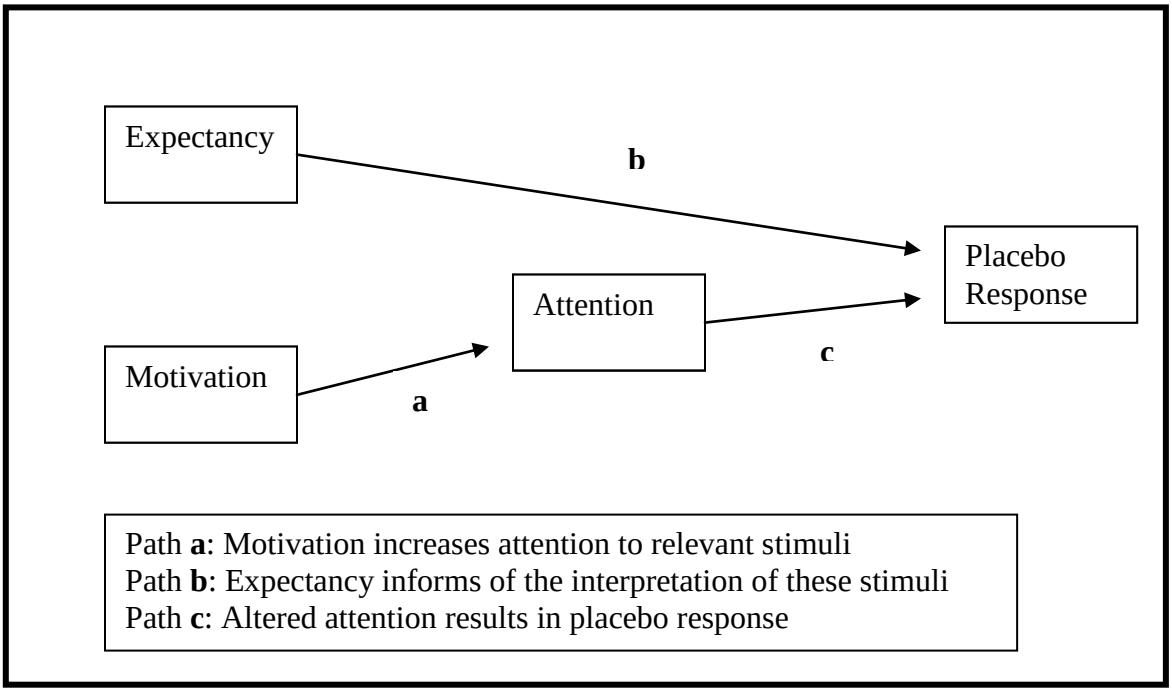
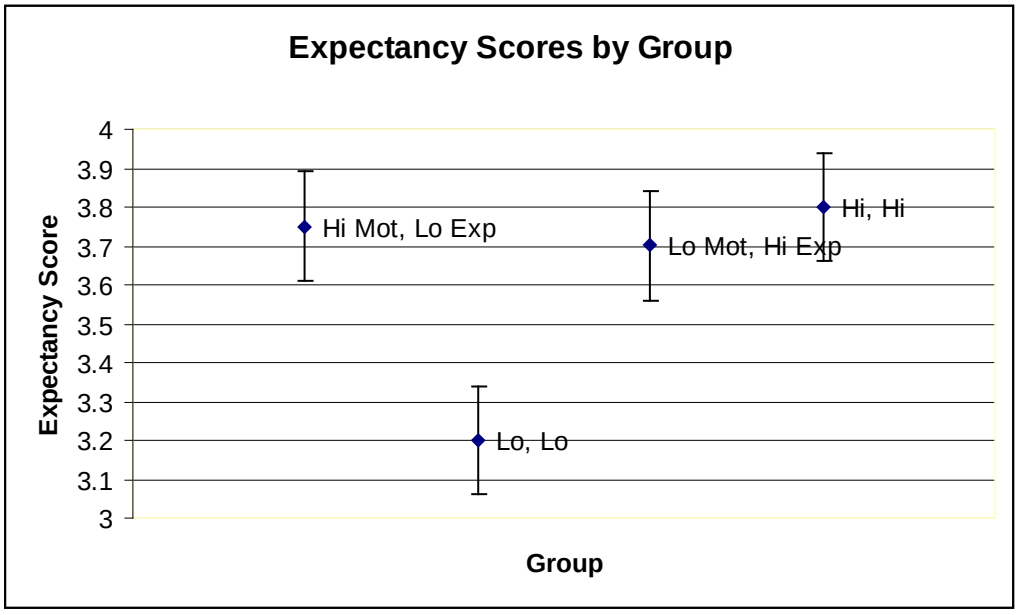
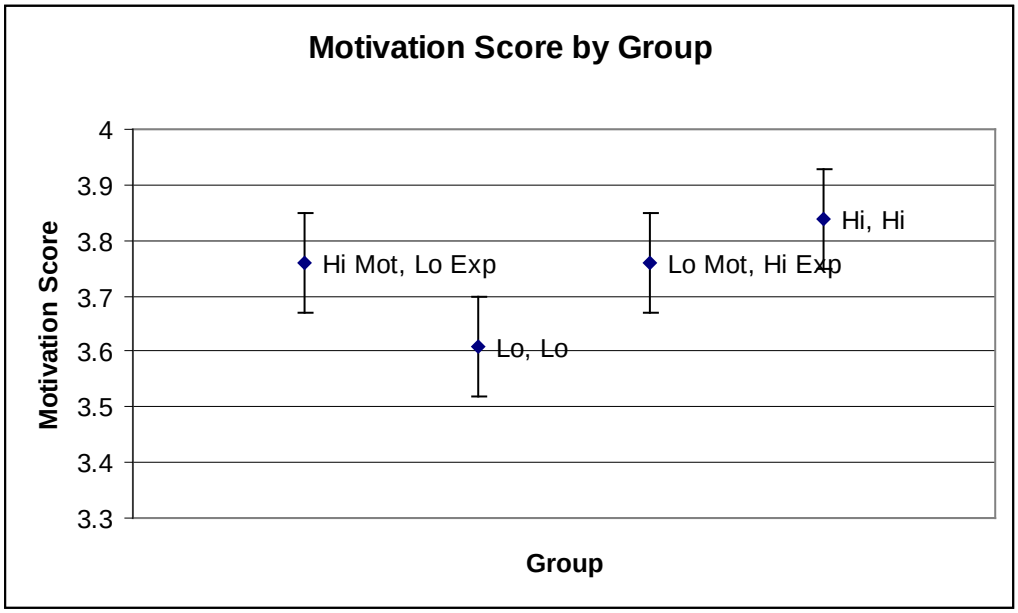


Figure 1. Proposed Model of Placebo Responding



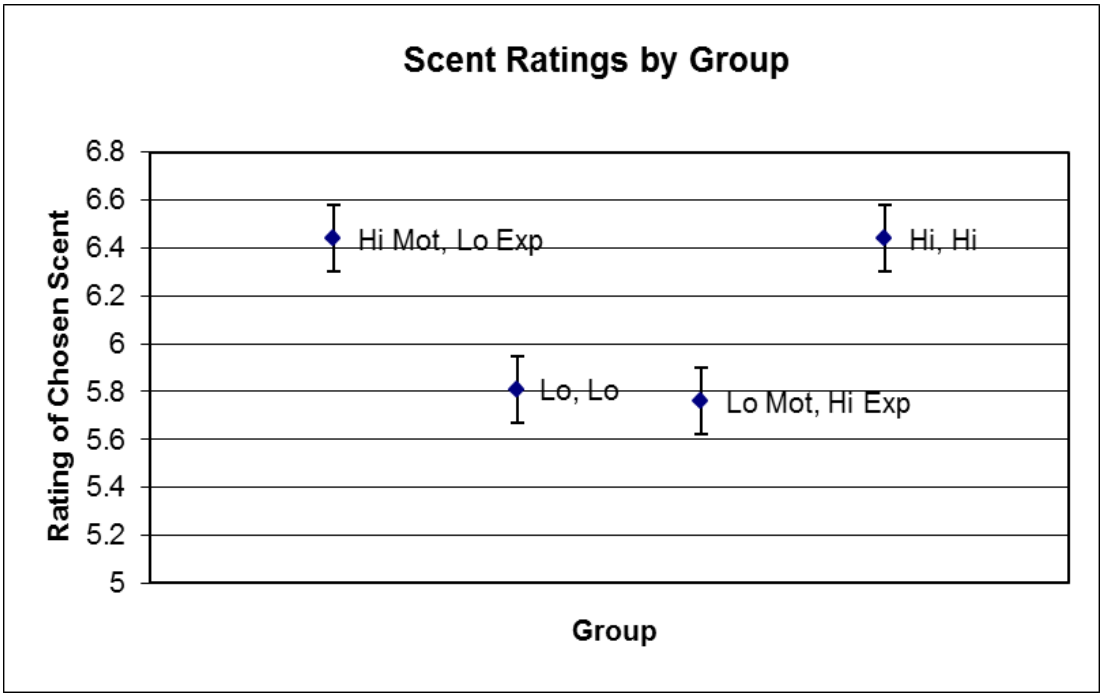
*error bars represent 95% confidence levels

Figure 2. Expectancy Scores by Experimental Group



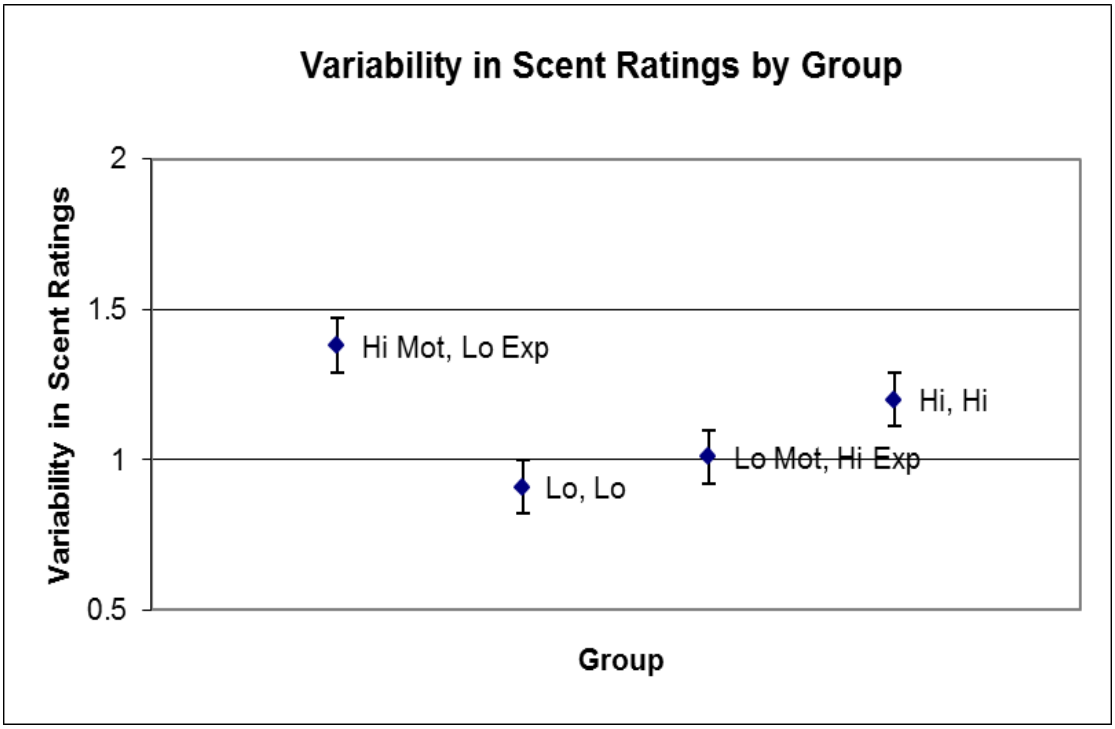
*error bars represent 95% confidence levels

Figure 3. Motivation Score by Experimental Group



*error bars represent 95% confidence levels

Figure 4. Rating of the Placebo Outcome 'Best Scent' by Experimental Group



*error bars represent 95% confidence levels

Figure 5. Rating of the Placebo Outcome 'Variability in Scent Rating' by Experimental Group

APPENDICES

Appendix A

Please answer the following questions:

I am currently involved in a committed relationship _____ Yes _____ No

What is your gender (check one)? _____ Male _____ Female

What is your age? _____

What best describes your racial or ethnic background (check one)?
_____ 1. African American _____ 2. Caucasian American _____ 3. Native American
_____ 4. Asian American _____ 5. Hispanic American _____ 6. Other (please specify)

What best describes your sexual orientation (check one)?
_____ 1. Heterosexual _____ 2. Homosexual _____ 3. Bisexual
_____ 4. Other (please specify)

What year are you currently in school (check one)?
_____ 1. Freshman _____ 2. Sophomore _____ 3. Junior _____ 4. Senior
_____ 5. Graduate _____ 6. Other (please specify)

The Big Five Personality Inventory

Instructions: Here are a number of characteristics that may or may not apply to you. For example, do you agree that you are someone who likes to spend time with others? Please choose a number for each statement to indicate the extent to which you agree or disagree with this statement.

How well do the following statements describe your personality?

I see myself as someone who …	**Disagree strongly**	**Disagree a little**	**Neither agree nor disagree**	**Agree a little**	**Agree strongly**
Is talkative	(1)	(2)	(3)	(4)	(5)
Tends to find fault with others	(1)	(2)	(3)	(4)	(5)
Does a thorough job	(1)	(2)	(3)	(4)	(5)
Is depressed, blue	(1)	(2)	(3)	(4)	(5)
Is original, comes up with new ideas	(1)	(2)	(3)	(4)	(5)
Is reserved	(1)	(2)	(3)	(4)	(5)
Is helpful and unselfish with others	(1)	(2)	(3)	(4)	(5)
Can be somewhat careless	(1)	(2)	(3)	(4)	(5)
Is relaxed, handles stress well	(1)	(2)	(3)	(4)	(5)
Is curious about many different things	(1)	(2)	(3)	(4)	(5)
Is full of energy	(1)	(2)	(3)	(4)	(5)
Starts quarrels easily with others	(1)	(2)	(3)	(4)	(5)
Is a reliable worker	(1)	(2)	(3)	(4)	(5)
Can be tense	(1)	(2)	(3)	(4)	(5)
Is ingenious, a deep thinker	(1)	(2)	(3)	(4)	(5)

I see myself as someone who …	**Disagree strongly**	**Disagree a little**	**Neither agree nor disagree**	**Agree a little**	**Agree strongly**
Generates a lot of enthusiasm	(1)	(2)	(3)	(4)	(5)
Has a forgiving nature	(1)	(2)	(3)	(4)	(5)
Tends to be disorganized	(1)	(2)	(3)	(4)	(5)
Worries a lot	(1)	(2)	(3)	(4)	(5)
Has an active imagination	(1)	(2)	(3)	(4)	(5)
Tends to be quiet	(1)	(2)	(3)	(4)	(5)
Is generally trusting	(1)	(2)	(3)	(4)	(5)
Tends to be lazy	(1)	(2)	(3)	(4)	(5)
Is emotionally stable, not easily upset	(1)	(2)	(3)	(4)	(5)
Is inventive	(1)	(2)	(3)	(4)	(5)
Has an assertive personality	(1)	(2)	(3)	(4)	(5)
Can be cold and aloof	(1)	(2)	(3)	(4)	(5)
Perseveres until the task is finished	(1)	(2)	(3)	(4)	(5)
Can be moody	(1)	(2)	(3)	(4)	(5)
Values artistic, aesthetic experiences	(1)	(2)	(3)	(4)	(5)
Is sometimes shy, inhibited	(1)	(2)	(3)	(4)	(5)
Is considerate and kind to almost everyone	(1)	(2)	(3)	(4)	(5)
Does things efficiently	(1)	(2)	(3)	(4)	(5)
Remains calm in tense situations	(1)	(2)	(3)	(4)	(5)

I see myself as someone who …	**Disagree strongly**	**Disagree a little**	**Neither agree nor disagree**	**Agree a little**	**Agree strongly**
Prefers work that is routine	(1)	(2)	(3)	(4)	(5)
Is outgoing, sociable	(1)	(2)	(3)	(4)	(5)
Is sometimes rude to others	(1)	(2)	(3)	(4)	(5)
Makes plans and follows through with them	(1)	(2)	(3)	(4)	(5)
Gets nervous easily	(1)	(2)	(3)	(4)	(5)
Likes to reflect, play with ideas	(1)	(2)	(3)	(4)	(5)
Has few artistic interests	(1)	(2)	(3)	(4)	(5)
Likes to cooperate with others	(1)	(2)	(3)	(4)	(5)
Is easily distracted	(1)	(2)	(3)	(4)	(5)
Is sophisticated in art, music, or literature	(1)	(2)	(3)	(4)	(5)

The Life Orientation Test- Revised

Please indicate the extent to which you agree or disagree with each of the following items. Try not to let your answer to one question influence your answers on other questions. Also, try to be as accurate and honest as you can in answering. There are no right or wrong answers.

	Strongly Disagree	**Disagree**	**Neither Agree nor Disagree**	**Agree**	**Strongly Agree**
In uncertain times, I usually expect the best.	(1)	(2)	(3)	(4)	(5)
It's easy for me to relax.	(1)	(2)	(3)	(4)	(5)
If something can go wrong for me, it will.	(1)	(2)	(3)	(4)	(5)
I'm always optimistic about my future.	(1)	(2)	(3)	(4)	(5)
I enjoy my friends a lot.	(1)	(2)	(3)	(4)	(5)
It's important to me to keep busy.	(1)	(2)	(3)	(4)	(5)
I hardly ever expect things to go my way.	(1)	(2)	(3)	(4)	(5)
I don't get upset too easily.	(1)	(2)	(3)	(4)	(5)
I rarely count on good things happening to me.	(1)	(2)	(3)	(4)	(5)
Overall, I expect more good things to happen to me than bad.	(1)	(2)	(3)	(4)	(5)

Relationship Attitudes

Indicate the degree to which you agree or disagree with the following statements.

	Strongly Disagree	**Disagree**	**Neither Agree nor Disagree**	**Agree**	**Strongly Agree**
A person can't have a satisfactory and satisfying sex life without being in love with his partner.	(1)	(2)	(3)	(4)	(5)
Two people should not engage in sexual intercourse until they are married.	(1)	(2)	(3)	(4)	(5)
It makes me uncomfortable when other people express emotion.	(1)	(2)	(3)	(4)	(5)
It shows strength to express emotions openly.	(1)	(2)	(3)	(4)	(5)
For me, expressing emotions is an important part of settling disputes	(1)	(2)	(3)	(4)	(5)
I avoid conflict.	(1)	(2)	(3)	(4)	(5)
I like when other people challenge my opinion.	(1)	(2)	(3)	(4)	(5)
It annoys me when I know someone else is upset with me but refuses to discuss it.	(1)	(2)	(3)	(4)	(5)
In a relationship, it is important for me to feel emotionally supported by my partner.	(1)	(2)	(3)	(4)	(5)
When in a relationship, I often need a lot of space.	(1)	(2)	(3)	(4)	(5)
Communication is very important to me in a relationship.	(1)	(2)	(3)	(4)	(5)

Social Desirability Scale

Listed below are a number of statements concerning personal attitudes and traits. Read each item and decide whether the statement is true or false as it pertains to you personally. It's best to go with your first judgment and not spend too long mulling over any one question. Please circle 'True' or 'False.'

Before voting I thoroughly investigate the qualifications of all the candidates.	True False
I never hesitate to go out of my way to help someone in trouble.	True False
It is sometimes hard for me to go on with my work if I am not encouraged.	True False
I have never intensely disliked anyone.	True False
On occasions I have had doubts about my ability to succeed in life.	True False
I sometimes feel resentful when I don't get my way.	True False
I am always careful about my manner of dress.	True False
My table manners at home are as good as when I eat out in a restaurant.	True False
If I could get into a movie without paying and be sure I was not seen I would probably do it.	True False
On a few occasions, I have given up something because I thought too little of my ability.	True False
I like to gossip at times.	True False
There have been times when I felt like rebelling against people in authority even though I knew they were right.	True False
No matter who I'm talking to, I'm always a good listener.	True False
I can remember "playing sick" to get out of something.	True False
There have been occasions when I have taken advantage of someone.	True False
I'm always willing to admit it when I make a mistake.	True False
I always try to practice what I preach.	True False
I don't find it particularly difficult to get along with loudmouthed, obnoxious people.	True False
I sometimes try to get even rather than forgive and forget.	True False
When I don't know something I don't mind at all admitting it.	True False
I am always courteous, even to people who are disagreeable.	True False
At times I have really insisted on having things my own way.	True False
There have been occasions when I felt like smashing things.	True False
I would never think of letting someone else be punished for my wrong-doings.	True False
I never resent being asked to return a favor.	True False
I have never been irked when people expressed ideas very different from my own.	True False
I never make a long trip without checking the safety of my car.	True False
There have been times when I was quite jealous of the good fortune of others.	True False
I have almost never felt the urge to tell someone off.	True False
I am sometimes irritated by people who ask favors of me.	True False
I have never felt that I was punished without cause.	True False
I sometimes think when people have a misfortune they only got what they deserved.	True False
I have never deliberately said something that hurt someone's feelings.	True False

Appendix B

Using the following scale, please indicate the degree to which you agree or disagree with the following statements. Write the number corresponding to your level of agreement or disagreement on the space following each statement.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
1	2	3	4	5

At this point in my life, I am interested in dating. _____

I would like the opportunity to get to know more members of the opposite sex. ____

I think that everyone has their own unique scent. _____

I believe that humans can detect the pheromones, or scent, of others. _____

I believe that a person's scent influences attraction. _____

I don't think that a person's scent is an important component in physical attraction. _____

If I met the right person, I would be interested in pursuing a romantic relationship with them. ____

There is much scientific evidence to show that scent influences attraction. _____

In the past, I have noticed that a person's scent has increased my attraction to that person .____

I have heard a lot about pheromones before this study. ____

I believe that scent plays a role in the physical chemistry between two people. _____

The following statements assess your opinions regarding **this study.** Using the following scale, please indicate the degree to which you agree or disagree with each statement. Write the number corresponding to your level of agreement or disagreement on the space following each statement.

Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
1	2	3	4	5

In this study,……..

I think that I will have no difficulty in rating the pheromone samples. ____

I hope that I notice differences among the different scents. _____

I want to respond positively to the scent of my match. _____

I am looking forward to rating the different scents. _____

When I am rating the scents, I plan to give it my best effort. _____

It really wouldn't bother me if I didn't notice any differences among the different scents. _____

I would be interested in participating in more research studies like this one. _____

I would be disappointed if I didn't notice differences among the scents. _____

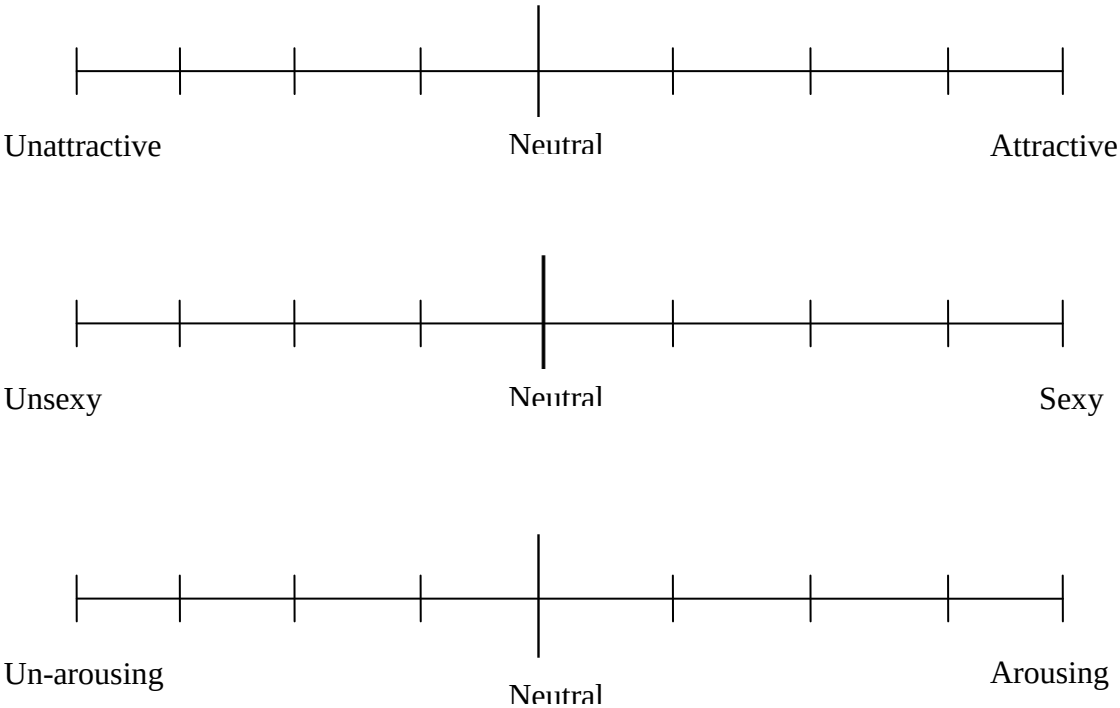
It really wouldn't bother me if I didn't find my match's scent to be most pleasing. _____

I am not very interested in this study. _____

I don't think that I will notice differences among the different scents. _____

I hope that I find the scent of my match to be most pleasing. _____

Scent Ratings



Appendix C

Lo Expectancy, Hi Motivation Prompt:

1) As you read online, this study is examining attraction and dating: specifically, how pheromones influence these variables. Have you heard about pheromones before? ……. Pheromones are chemicals secreted by all animals, including humans. *Although some scientists claim pheromones play an important role in attraction, most research has not supported this claim. It seems that human beings are not able to detect pheromones and that pheromones really don't do much of anything in humans. In most studies like this, most people aren't able to smell the pheromone sample. Because of this, it does not appear that pheromones play any role in attraction. Does it make sense to you how pheromones don't appear to influence attraction? ……..* **In this study, you will be evaluating the pheromone samples of members of the opposite sex who have submitted these samples to us throughout the course of the study. Based on the results of the personality and values questionnaire you filled out, we have selected a compatible match from a member of the opposite sex. We are interested in studying those individuals who are compatible on both physical and emotional dimensions. If you rate your match's pheromone sample to be the most pleasing, you will have the opportunity to participate in the second stage of this study in which you and this other person will meet and we will perform further pheromone tests; this part would be optional.**

Lo Expectancy, Lo Motivation Prompt:

2) As you read online, this study is examining attraction and dating: specifically, how pheromones influence these variables. Have you heard about pheromones before? ……. Pheromones are chemicals secreted by all animals, including humans. *Although some scientists claim pheromones play an important role in attraction, most research has not supported this claim. It seems that human beings are not able to detect pheromones and that pheromones really don't do much of anything in humans. In most studies like this, most people aren't able to smell the pheromone sample. Because of this, it does not appear that pheromones play any role in attraction. Does it make sense to you how pheromones don't appear to influence attraction? ……..* **In this study, we want to examine this further. You will be evaluating the pheromone samples of members of the opposite sex. Based on the results of the personality and values questionnaire you filled out, we have selected a compatible match from a member of the opposite sex. You will be evaluating their pheromone sample along with the samples from three randomly selected males/females. We are interested to see if you rate your match's sample as most pleasing. The identities of these people will remain anonymous. This study is for educational purposes only.**

Hi Expectancy, Lo Motivation Prompt:
3) As you read online, this study is examining attraction and dating: specifically, how pheromones influence these variables. Have you heard about pheromones before? ……. Pheromones are chemicals secreted by all animals, including humans. *In studies like this one, most people are able to detect different pheromone scents and there is much research which suggests that pheromones are an important component of attraction. Moreover, research has found that those couples who have both physical chemistry, which has been linked to pheromones, and emotional and personality compatibility, have the most satisfying relationships. Does it make sense to you how the scent of pheromones can increase your attraction to someone?*..... **In this study, you will be evaluating the pheromone samples of members of the opposite sex who have submitted these samples to us throughout the course of the study. Based on the results of the personality and values questionnaire you filled out, we have selected a compatible match from a member of the opposite sex. You will be evaluating their pheromone sample along with the samples from three randomly selected males/females. We are interested to see if you rate your match's sample as most pleasing. The identities of these people will remain anonymous. This study is for educational purposes only.**

Hi Expectancy, Hi Motivation Prompt:
4) As you read online, this study is examining attraction and dating: specifically, how pheromones influence these variables. Have you heard about pheromones before? ……. Pheromones are chemicals secreted by all animals, including humans. *In studies like this one, most people are able to detect different pheromone scents and there is much research which suggests that pheromones are an important component of attraction. Moreover, research has found that those couples who have both physical chemistry, which has been linked to pheromones, and emotional and personality compatibility, have the most satisfying relationships. Does it make sense to you how the scent of pheromones can increase your attraction to someone?*..... **In this study, you will be evaluating the pheromone samples of members of the opposite sex who have submitted these samples to us throughout the course of the study. Based on the results of the personality and values questionnaire you filled out, we have selected a compatible match from a member of the opposite sex. We are interested in studying those individuals who are compatible on both physical and emotional dimensions. If you rate your match's pheromone sample to be the most pleasing, you will have the opportunity to participate in the second stage of this study in which you and this other person will meet and we will perform further pheromone tests; this part would be optional.**

Pheromone Rating Task Prompt (for all 4 experimental groups):

Here are four pheromone samples collected from males/females who have participated in this study at some point. One of these samples is from a male/female who has been matched to you using the results of your personality and values quiz and three are random samples. Rate each of the samples on the following dimensions (show the rating scales to the subjects). You will need to introspect, or look inside yourself, to examine how you are feeling. When you begin, place the mask over your nose and mouth; you do not actually have to put the mask on. Please take as much or as little time as you need in smelling each sample; you can smell each as many times as you want. Remember that you may not notice differences in the samples and that's o.k. if you do not. The important thing is that you are honest in your answers. If you do not notice a scent, please mark 'neutral' on the rating scale *(show them 'neutral on the scale.)* Please tell me when you are done.

VITA

VITA

Carrie J. Aigner

EDUCATION

2006-2011	Ph.D. (2011) Clinical Psychology Department of Psychology Indiana University Purdue University Indianapolis APA Accredited Program
2006-2008	Master of Science in Clinical Psychology Department of Psychology Indiana University Purdue University Indianapolis Indianapolis, IN
2005	Non-degree student of Psychology University of Wisconsin-Milwaukee
2000-2004	B.B.A. in Finance, with Distinction University of Wisconsin-Madison

CURRENT CLINICAL AND RESEARCH INTERESTS

- Behavioral medicine, chronic pain
- Role of expectancies, motivation in enhancing psychological and medical treatment effects

HONORS AND AWARDS

2009-2010	Teaching Fellowship Indiana University Purdue University Indianapolis

2009	School of Science Travel Award Indiana University Purdue University Indianapolis
2006	Indiana University Travel Award Indiana University Purdue University Indianapolis
2006-2007	University Fellowship Indiana University Purdue University Indianapolis
2004	Outstanding Business Student of 2004 University of Wisconsin-Madison
2003	Holts, Smith, and Yates Women in Finance Scholarship University of Wisconsin-Madison

CLINICAL EXPERIENCE

2010 **Psychology Intern**, **Behavioral Medicine**, Southwest Consortium, Albuquerque, NM

- Conducted neuropsychological, decisional capacity, organ transplant, and pre-surgical evaluations
- Led groups for pain management, smoking cessation, mindfulness, and weight loss
- Participated in weekly interdisciplinary treatment meetings
- Provided psychotherapy for patients with acute and chronic medical illness

2009 **Practicum Student**, Indiana University Hospital, Indianapolis, IN

- Provided psychotherapy for adult clients with a wide range of psychological disorders and chronic medical illness
- Conducted diagnostic interviews, prepared treatment plans, and wrote integrated reports

2008 **Practicum Student**, Riley Hospital Pain Center; Riley Hospital Child and Adolescent Psychiatric Clinic, Indianapolis, IN

- Provided biofeedback, relaxation training, and psychotherapy for pain management in a pain clinic
- Provided cognitive-behavioral therapy for children with anxiety and depression

2008 **Practicum Student**, Larue Carter Hospital, Indianapolis, IN

- Co-facilitated psychoeducation and psychosocial rehabilitation groups in an inpatient psychiatric hospital
- Provided individual psychotherapy

2007 **Practicum Student**, Indiana University Neuropsychological Center, Indianapolis, IN

- Conducted full neuropsychological batteries for assessment of traumatic brain injury, dementia, organ transplant, and learning disability
- Wrote integrated neuropsychological reports

RESEARCH EXPERIENCE

2006-2008 **University Fellow**, IUPUI Department of Psychology
Conducted longitudinal research examining the role of expectancies, motivation and effort in student success and student ratings of course satisfaction.

2005 **Research Assistant**, University of Wisconsin-Milwaukee
Collected measures of self-reported stress, well-being, and EEG and blood pressure ratings for experimental research examining the physiological responses to betrayal and forgiveness.

MASTER AND DISSERTATION PROJECTS

2009-2011 Dissertation Title: *The Role of Expectancy and Motivation in the Placebo Effect*
Examined the mechanisms through which placebo responses are produced in an experimental study of 165 students. Found that motivation for the placebo substance to work led to greater attention to signs of change, which in turn, produced greater placebo response.

2006-2008 Thesis Title: *Do Expectations Explain the Effects of Expressive Writing?*
In an experimental study of 170 college students, examined the role of treatment expectancies in reducing illness, a treatment effect associated with the emotional disclosure of traumatic events.

TEACHING EXPERIENCE

2010-2011 **Distance Learning Instructor**, IUPUI Department of Psychology
Introduction to Psychology, online course, 2 semesters

2007-2010	**Lecturer**, IUPUI Department of Psychology Social Psychology, 2 semesters Introduction to Psychology, 4 semesters
2007-2009	**Preparing Future Faculty**, IUPUI Attended seminars and workshops addressing pedagogical theory and skills. Received ongoing supervision and evaluation of teaching by a senior faculty member.
2006	**Teaching Assistant**, IUPUI Department of Psychology Abnormal Psychology, 1 semester Drugs and Addiction, 1 semester Social Psychology, 1 semester

GUEST LECTURES

2011	*Motivation and Placebo* Research Symposium, Raymond Murphy VA, Albuquerque, NM
2009	*Mechanisms Involved in Placebo* Clinical Psychology Brown Bag, IUPUI

PRESENTATIONS

Aigner, C. & Svanum, S. (2009). *The Influence of Student Motivation and Course Performance on Student Evaluations of Teaching*. Poster presented at the Association for Psychological Science Annual Conference, San Francisco, CA.

Svanum, S. & Aigner, C. (2008). *Student grade success influences course satisfaction*. Poster presented at the Association for Psychological Science Annual Conference, Chicago, IL.

PUBLICATIONS

Svanum, S. & Aigner, C. (in press). The influence of course effort, mastery and performance goals, grade expectancies, and course grades on student ratings of course satisfaction. *British Journal of Educational Psychology*.

WORKSHOPS ATTENDED

2010	**Motivational Interviewing**, two day training Eric Levensky, Ph.D. Albuquerque, NM
2010	**Gathering of Healers**, four day retreat Training in indigenous healing practices with the goal of integrating these ideas into team building, conflict resolution, and clinical practice Albuquerque, NM
2010	**Evidence-Based Practice**, one day workshop Barbara Walker, Ph.D. Indianapolis, IN
2008	**Motivational Interviewing**, two day training John M. Wryobeck, Ph.D. Indianapolis, IN

PROFESSIONAL MEMBERSHIPS

2010-2011	**Society of Behavioral Medicine** Student Member
2007-2009	**Association for Psychological Science** Student Member