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An Analysis of the Basic Processes of Formation and Change of Placebo Expectations

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Placebo effects are the measurable psychological, biological, and behavioral changes that can result from expecting a treatment to be effective. Here we argue that not all expectations are created equally and there is much to learn by clarifying the psychological processes that underlie the expectations that cause placebo effects. It is proposed that the formation and change of placebo expectations can be understood from the standpoint of a general psychological model describing the basic processes of mental change. Specifically, we use the Elaboration Likelihood Model to explain how placebo-relevant variables (e.g., doctor's lab coat, drug price, number and color of pills, patient's mood) can work to affect expectations. Clarifying the antecedent processes responsible for placebo expectations leads to new insights regarding placebo effects, including their durability, directionality, and ability to alter subsequent behaviors (e.g., treatment adherence). A key point from our approach is that expectations causing placebo effects can be formed under high or low thought. High-thought expectations should be more likely to resist change, last over time, predict placebo effects better than low-thought expectations, and have a greater likelihood to alter subsequent behaviors. We conclude by describing a variety of theoretical innovations that this new conceptualization raises and suggest novel paths for research and application.

Keywords: elaboration likelihood, expectation, nocebo, persuasion, placebo

The term placebo effect emerged during the prescientific period of medicine as a label for the beneficial changes caused by administering inactive treatments to patients (Shapiro & Shapiro, 1997). During this time, placebo effects were deemed a deceptive, yet effective, way to pacify individuals suffering from illness and disease. Placebo effects were considered unable to produce meaningful medical change. The placebo effect took on another role during the middle of the 20th century. It became a control for extraneous variance in randomized clinical trials (RCTs). Although some marveled at the magnitude of placebo effects in RCTs, the idea that placebo effects could be integrated into medical practice was incompatible with the prevailing biomedical model, which focused on the biology of health without the contamination of the human mind (Miller, Colloca, & Kaptchuk, 2009).

Over the last several decades, the concept of placebo effects has undergone a dramatic transformation—evolving into a topic of scientific inquiry in its own right. Rather than being perceived as subjective bias, placebo effects are being reconceptualized as meaningful, scientifically measurable, complex psychobiological changes that result from expectations regarding treatment effectiveness (Geers & Miller, 2014). This conceptual evolution was motivated by thousands of RCTs in which patients improved when administered inert treatments, by a broader recognition of the importance of psychological mechanisms in health outcomes, and most chiefly, by the large volume of neurobiological studies linking placebo effects to specific and detectable changes in the brain (Benedetti, 2014; Colloca, 2018; Colloca, Flaten, & Meissner, 2013; Kirsch, 1999). Placebo effects do not simply reflect subjective bias in patients or unwanted error variance to be extracted from RCTs. Rather, placebo effects represent the influence of positive treatment expectations on responses to both active and inactive treatments. Researchers are now viewing placebo effects as a vital component in successful medical care and are searching for reliable techniques to enhance these effects (e.g., Bishop et al., 2017; Kaptchuk et al., 2010; Rief et al., 2017).

Although substantial progress is being made in our understanding of placebo effects, much remains unclear. In this review, it is suggested that one missing piece is theoretical precision regarding the variables and processes that influence the main mental construct underlying placebo effects: placebo expectancy. Current research is largely focused on understanding the possible mechanisms by which placebo expectations produce outcomes (e.g., Benedetti, 2014; Colloca et al., 2013). For example, a large liter-

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ature now demonstrates that placebo treatments can reduce pain by activating endogenous opioid mechanisms in the brain (Sauro, & Greenberg, 2005). What is missing from the literature, however, is research focused on the upstream mechanisms that contribute to the formation and change of a person's placebo expectation in the first place, and especially whether an expectation is ultimately impactful in producing outcomes. Critically, here we clarify that the processes by which expectations are formed are separate from the processes by which expectations guide outcomes. That is, one can analyze the processes by which expectations are formed versus the processes by which expectations produce behavioral and evaluative outcomes. The latter has received considerably more attention in research and theory on placebo effects than the former.

In accord with prior analyses (e.g., Kirsch, 1985; Olson, Roese, & Zanna, 1996), we view expectancy as a cognition like other mental constructs, such as attitudes or goals.[1] Consequently, one can form an expectation (e.g., "this pill will reduce my pain") with low or high thought (e.g., "I believe the pill will reduce my pain just because a doctor said it" versus "I believe it because a doctor made me actively think about the compelling arguments presented"). Similarly just as there are properties of attitudes that make them more impactful on outcomes (see Petty & Krosnick, 1995), these same properties should render expectations more or less impactful. For example, expectations should have a greater influence on outcomes the more accessible they are, when they are held with confidence, and seen as important. We propose that placebo expectations, and ultimately placebo effects, can be understood using the psychological mechanisms outlined in one of the most established theories of psychological change: The Elaboration Likelihood Model (ELM) of persuasion (Petty & Briñol, 2012; Petty & Cacioppo, 1986). We will use the ELM to describe how placebo-relevant situational and personal variables (e.g., a doctor's lab coat, a patient's motivation) can work to affect expectations by low versus high thinking processes. Importantly, we propose that expectations can be formed under high or low thought and that high thought expectations are more likely to resist change, endure across time, and predict responses better than low thought expectations. Although some of the arguments made here are speculative at this point as specific research on placebo effects is lacking, this approach synthesizes two disparate literatures and offers a framework for future research on placebo expectations. Importantly, as we explain further shortly, the suggestions we make with respect to placebo expectations are well grounded in a different area of research where it has been shown that the processes by which a judgment is formed (e.g., attitudes, stereotypes) is consequential for the impact of those judgments on relevant outcomes (e.g., purchasing, discrimination).

Before getting to our analysis, it is useful to start by making some clarifications. We begin with a brief description of current research on the psychology of placebo effects, with a focus on expectations as a key mental construct. Then, we review the ELM. In that section we highlight the key mechanisms proposed in this model and explain how these mechanisms can lead to different kinds of expectations. Next, we illustrate how the ELM can be applied to not only the formation and change of placebo expectations but also to the stability and resistance of those expectations over time. Finally, we describe a variety of theoretical issues that this new conceptualization raises and we suggest novel paths for application.

A Model of Placebo Expectations and Placebo Effects

In Figure 1 we present a broad model encompassing placebo expectations and placebo effects. The model is not meant to be comprehensive but rather illustrative of the variables and processes frequently theorized to be involved in producing placebo effects. As can be seen in Figure 1, research on placebo effects can be conceptualized as a general mediational model. The model begins with treatment-related contexts and communications (e.g., direct verbal instructions from a clinical practitioner, TV ads, social media, and individual differences). These are all variables that are present in situations that can contribute to placebo expectations that ultimately cause placebo effects. To consider the psychology of placebo effects, we include Paths A and B. The processes linking variables to placebo expectations is Path A. Path B represents the processes by which expectations influence treatment responses. Finally, the unmediated path, without expectations, is Path C. The components of this model will be discussed in turn.

Situation and Person Variables: Causes of Placebo Expectations

Our analysis begins with the leftmost box in Figure 1. Placebo effects occur because variables external and internal to the person contribute to the formation of an expectation that an impending treatment causes a specific response (Kirsch, 1985). Expectations that cause placebo effects stem from a wide variety of sources, including verbal messages provided by a doctor or family members, news outlets, social media, and product packaging. These expectations can either be explicitly advocated (e.g., a doctor presents the placebo as an active treatment) or inferred from the situation (e.g., the doctor wouldn't give me this pill unless it did something). People's expectations can also be influenced by individual differences with different people having different beliefs or theories about the impact of treatments. Placebo expectations could also be influenced by cultural norms (see Olson et al., 1996) or personality variables. For example, in some cases optimists might have stronger expectations for positive outcomes than pessimists (Geers, Helfer, Kosbab, Weiland, & Landry, 2005).

Expectations may also emerge from one's prior learning experience. For instance, considerable research has found that placebo effects can arise through classical conditioning (Stewart-Williams & Podd, 2004). That is, a placebo effect can be a conditioned response (CR), with an actual treatment as an unconditioned stimulus (UCS) and the procedures or methods involved in administering the treatment or that co-occur with the treatment as a conditioned stimulus (CS). Although it has been debated whether conditioning and expectation constitute independent mechanisms of placebo effects, there is a building consensus in the human classical conditioning literature that classical conditioning effects often rely upon or are clearly strengthened when people form an expectation about the UCS (Kirsch, Lynn, Vigorito, & Miller, 2004; Lovibond & Shanks, 2002; Mitchell, De Houwer, & Lovi-

[1] The terms "expectations" and "expectancy" have been employed in different ways by scholars discussing future-oriented beliefs (Corsi & Colloca, 2017; Higgins, 1992; Thompson & Sunol, 1995). Here, we use the term "expectations" when referring to any of a wide array of particular future beliefs, and the term "expectancy" when referring to the broad mental construct (Janzen et al., 2006; Olson et al., 1996).

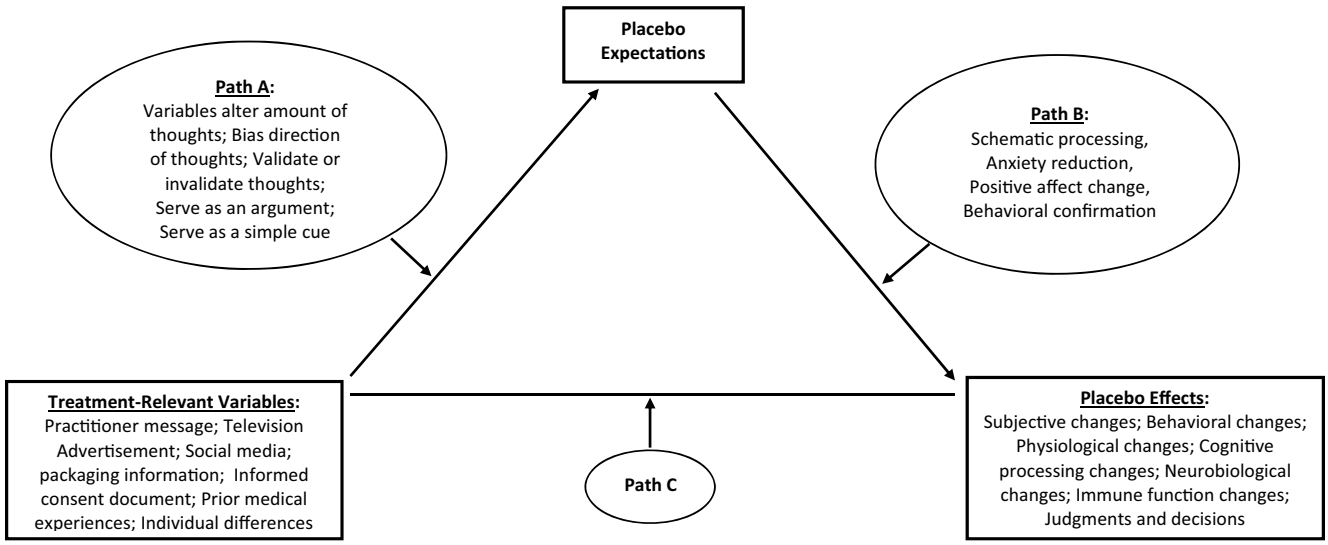

Figure 1. Conceptual model of the variables and processes relevant to placebo effects.

bond, 2009; Peterson, & Trapold, 1982; Rescorla, 1988; Savage & Ramos, 2009). Similarly, in the literature on placebo effects it has been argued that classical conditioning effects often work by altering conscious or nonconscious expectations (Colloca & Miller, 2011). For example, in placebo studies, conditioning trials have increased placebo expectations (Montgomery & Kirsch, 1997) and these expectations are highly correlated with placebo responses. Further, the direct relationship between conditioning and placebo analgesia can be rendered statistically insignificant when controlling for expectations (Kirsch et al., 2014; Montgomery & Kirsch, 1997). Taken together, the existing literature suggests that in many circumstances, conditioning produces placebo effects through conscious or nonconscious expectations, the same as for nonconditioning based placebo effects.

Placebo Expectations Cause Placebo Effects

An extensive array of work is consistent with the general hypothesis that, once formed, expectations can cause placebo effects (Figure 1, Path B). Self-reported expectations can mediate the link between a verbal treatment message and placebo effects (Shiv, Carmon, & Ariely, 2005). Further, the magnitude of placebo pain relief often closely corresponds to the amount of anticipated pain relief (Benedetti, 2014). Evidence for expectations as a causal mechanism is also found in studies with active treatments. The effectiveness of active treatments in domains such as acupuncture for pain relief, tissue transplants in Parkinson's patients, naltrexone treatment for alcohol dependence, and responses to antidepressant drug therapies, is strongly predicted by patient's prior expectations (e.g., Linde et al., 2007). In sum, ample research supports the position that placebo effects are caused by expectations.

Over the past 25 years, researchers have been examining the psychobiological pathways by which expectations lead to placebo effects (Figure 1, Path B). As these links are not the focus of the present review, and they are described extensively elsewhere, we provide only a brief overview of this expanding literature (for reviews, see Benedetti, 2014; Colloca et al., 2013; Wager & Atlas, 2015). Expectations can cause placebo effects by altering schematic processing of information, by influencing emotions, and by producing behavioral changes. First, in terms of schematic processing, placebo expectations can serve as an interpretive frame for somatic information and events, altering the processing of internal appraisals, symptom attributions, and guiding somatic attention, weighting, often in a confirmatory fashion (e.g., Ashar, Chang, & Wager, 2017; Kirsch, 1999).[2] Changes in schematic processing from expectations may be particularly influential, as somatic experience and feelings can be vague, diffuse, and open to interpretation (Pennebaker & Skelton, 1981). As such, expectations can serve as guides that shape experience and reactions to treatments.

Second, placebo expectations can produce placebo effects by changing emotional states. The belief that a treatment will lead to improvement can reduce anxiety and stress and lessen the activation of threat-related centers in the brain (Petrovic et al., 2005; Vase, Robinson, Verne, & Price, 2005). This reduction in anxiety and stress is thought to, in turn, lead to improvements in psychological and physical health (Brody & Brody, 2000; Lick & Bootzin, 1975; Lundh, 1987). Thus, sometimes expectations lead to placebo effects because expecting an effective treatment lessens anxiety which alters downstream symptom responses and perceptions. Placebo expectations could also result in placebo effects by increasing positive affect and initiating dopaminergic reward mechanisms in the brain (Benedetti, 2014; Wager & Atlas, 2015).

Third, and less frequently studied, placebo expectations may change behavior, resulting in self-fulfilling actions that contribute to placebo effects. For instance, if individuals believe a treatment

[2] Although in this review we focus on the multiple roles that variables (e.g., product packaging) can play in producing placebo expectations, one can also use the ELM to describe the multiple roles that placebo expectations can play in producing placebo effects. Just as the ELM usually focuses on the multiple roles that variables (e.g., credibility) can play in producing attitudes, one can also use the ELM to describe the multiple roles that attitudes can play in guiding behavior (Petty & Briñol, 2012).

is improving their health, they may begin to socialize more, experience social contact, and enhance social support, leading to improved immune system function and health (Stewart-Williams & Podd, 2004). In sum, by altering schematic processing, reducing anxiety, increasing positive affect, and changing behavior, placebo expectations can produce placebo effects.

Placebo Effect Outcomes

Placebo effects are the measurable psychological, biological, and behavioral changes that result from expectations that a treatment will be effective (Colloca, Jonas, Killen, Miller, & Shurtleff, 2014). Defined in this way, placebo effects occur with both active and inactive medical treatments, as individuals can have expectations for both. The standard laboratory procedure to test for placebo effects is to administer the same inert treatment to two groups of individuals, with one group receiving a treatment efficacy message (e.g., the injection will lessen your pain) and a second receiving no efficacy message. The use of inert treatments allows researchers to separate the effect of the efficacy message on responses from that of an active treatment. Hundreds of experiments using this design have revealed placebo effects in domains ranging from sham caffeine on performance, to side effects of chemotherapy, to sham surgery (Benedetti, 2014; Colloca, 2018; Colloca et al., 2013).

Placebo effects can be obtained on a wide variety of dependent measures, including subjective assessments of moods, pain, and drug cravings (e.g., Mills, Boakes, & Colagiuri, 2016; Vase et al., 2005); cognitive processing measures such as reaction time (RT) and word generation (e.g., Colagiuri, Livesey, & Harris, 2011; Weger & Loughnan, 2013); behavioral measures such as sleep latency, talking time by socially anxious individuals, and the motor performance of Parkinson patients (e.g., Benedetti et al., 2003; Brockner & Swap, 1983); and physiological measures including startle eyeblink reflex, heart rate variability, and bronchoconstriction in asthmatics (e.g., Darragh, Vanderboor, Booth, Sollers, & Consedine, 2015; Fillmore & Vogel-Sprott, 1992). Brain imaging studies find that placebo analgesics can alter activity in the same pain-processing regions of the brain (e.g., the anterior cingulate cortex) as pharmacological pain treatments (Price, Craggs, Verne, Perlstein, & Robinson, 2007; Wager et al., 2004). Finally, placebo treatments can change downstream decisions and actions, such as future purchasing behavior and decreases in the use of opioid analgesics by patients managing pain (Doering & Rief, 2012).

It is important to note that negative expectations can lead to worsening responses, a phenomenon known as "nocebo" effects. Nocebo effects result from the anticipation of unpleasant or negative, rather than pleasant or positive, treatment outcomes. In medical contexts, nocebo effects may manifest from a variety of treatment-related messages and descriptions, such as symptom listings in informed consent protocols, physician warnings about drug side effects, drug packaging labels, and direct-to-consumer treatment ads on TV (Doering & Rief, 2013; Myers, Cairns, & Singer, 1987). Similar to placebo effects, nocebo effects have been observed on self-report, physiological, and neurobiological measures (Colloca, 2017). Even though the study of placebo and nocebo effects can cover separate ground, nocebo effects are frequently regarded as an off-shoot of the study of placebo effects (Benedetti, 2014). In line with this view, unless otherwise noted, here when discussing the processes underlying placebo effects we are referring to both placebo and nocebo effects.

New Proposal: Expectations Are Formed and Altered by Processes of Change

Despite the innovative research on placebo effects over the last several decades, much about this phenomenon remains unknown. Expectation manipulations designed to elicit placebo effects produce measurable effects in some cases, but fail to produce observable outcomes other times (Geers & Miller, 2014). In cases where treatment expectations lead to observable placebo effects, sometimes the effect is of large magnitude, sometimes of small magnitude, and sometimes the direction of the effect is opposite to what might be anticipated (Petersen et al., 2014; Storms & Nisbett, 1970; Vase, Petersen, Riley, & Price, 2009). At present, it is also unclear when placebo expectations lead to brief changes versus long-lasting and durable outcomes. Further, although data exist regarding the psychological factors contributing to placebo responding (e.g., the color of an inert pill), studies of these factors have yielded some puzzling findings. For example, certain personality variables, measures of motivation, and context cues strengthen placebo effects in some studies, but in other studies they do not (e.g., Geers et al., 2005; Hyland, Whalley, & Geraghty, 2007). Finally, although there have been pioneering reviews of the placebo literature that shed light on some of the psychological processes involved in translating expectations into outcomes (e.g., Miller & Colloca, 2010; Rief & Petrie, 2016), researchers frequently discuss expectations and conditioning as the psychological causes of placebo effects without further theoretical discourse.

We suggest that one reason for the present challenges in the placebo literature can be traced to a shortage of theoretical and research attention given to the variables and processes underlying the development of placebo expectations. Currently, much of this literature examines the link between expectations and placebo effects (Figure 1, Path B). Although that work is of extreme importance, the "upstream" antecedent variables and processes that determine placebo expectations and the impact of these variables and processes on placebo outcomes are typically neglected. Put simply, researchers tend to assume that once a person is told, for example, that a pill will reduce their pain, this creates an expectation and the only issue is, how this expectation produces an outcome (Path B in Figure 1). In stark contrast to this view, we argue that not all expectations are created equal and there is much to learn by focusing on the processes by which expectations are formed (Path A in Figure 1). Stated differently, for placebo effects, expectations serve as the critical mediating psychological construct (see Figure 1). As in any mediational model, an understanding of the influence of the causal variable (e.g., a treatment message) depends upon not only the mediational Path B (e.g., from expectation to placebo effect), but also on the initial mediational Path A (e.g., from the treatment message to an expectation).

Thus, our focus here is on the mechanisms that contribute to placebo expectations rather than on the mechanisms by which expectations produce outcomes. We pay special attention to the issue of whether the processes underlying expectation formation produce expectations that are consequential and impactful. Our discussion draws on work in the literature on persuasion and attitude strength (Petty & Krosnick, 1995), and therefore we con-

sider whether expectations formed are strong (relatively consequential) or weak (relatively inconsequential). As we describe shortly, knowing the antecedent processes responsible for placebo expectations can lead to new insights regarding not only the direction of placebo effects, but also their durability, resistance, and likelihood to alter subsequent thinking and behaviors. To illustrate this, imagine two doctors prescribe the same placebo treatment to their patients. In one case, the variables and processes align to develop a positive and durable expectation. In the other case, a positive and transient expectation could form, or, a durable negative expectation could arise instead. Importantly, as in this example, the treatment message could be identical, however because of the different processes by which the initial input (doctor's message) becomes an expectation, the resulting placebo expectation and subsequent placebo effect could vary in direction, magnitude, and stability (also see Vase, Nørskov, Petersen, & Price, 2011).

The aim of the present article is to explore the concept of placebo expectancy through the lens of a well-established theoretical model explaining psychological change: The ELM (Petty & Briñol, 2012; Petty & Cacioppo, 1986). The ELM was developed to clarify the effects of persuasive communications on evaluative judgment, and it is now a framework widely used for understanding psychological change broadly defined. By focusing on the basic psychological mechanisms underlying change in mental constructs, such as attitudes, beliefs, and goals, the ELM has been useful in organizing numerous variables, outcomes, and theories across different areas of inquiry (Petty & Briñol, 2006). Here, we propose that the formation of placebo expectations, like other mental constructs, depends upon the operation of a finite set of processes described in the ELM. Further, these processes have predictable relationships with communication variables. If we conceptualize expectations as the outcome of the processes outlined in the ELM, the model can be useful as a basis for and shed light on a variety of aspects relevant to understanding expectations and their relations to placebo effects. That is, the ELM has the potential to enhance understanding of expectation formation and change within the domain of placebo effects, and to offer practical steps that doctors and others might take to amplify the placebo component of medical treatments and interventions.

Because the ELM was first developed as a model of persuasion, it is worth noting here that we are not the first to consider applying a persuasion framework to account for placebo effects (e.g., Wickless & Kirsch, 1989). For example, in an influential book, *Persuasion and Healing,* Frank (1961) proposed that all psychotherapies contain a common set of ritualistic elements that are likely to improve the morale of patients and provide hope and relief from distress. Briefly described, from this point of view, beneficial effects in psychotherapy can arise from the persuasive influences of actions and features making up the clinical encounter such as the perceived expertise of the therapist. Another connection to the literature on persuasive communication was made by Liberman (1962), when he discussed how the classic "Yale" model of persuasion could help explain placebo effects. The Yale model was an early and influential approach to persuasion, derived from the established principles of learning theory (Hovland, Janis, & Kelley, 1953). This model, for example, would argue that treatment messages would be more effective the better they were learned such as when they were repeated many times. Notably, both of these earlier conceptualizations held that one single variable (e.g., repetitive ritual) leads to a single outcome (e.g., positive attitude toward healing). Although the single effect and single process assumptions like that offered by the Yale approach provided a valuable beginning to the empirical study of persuasion, complications surfaced as the data accumulated (for a discussion, see Briñol & Petty, 2012). First, a single variable (e.g., a positive mood, a confident speaker) was found to increase persuasion in some cases, but not in other cases. Second, the building evidence-base did not support the view that there was any single mechanism of persuasion (e.g., message learning). Third, researchers continued to struggle with the finding that attitude change seemed to be relatively enduring and impactful (e.g., guiding behavior) in some cases, but in other cases, attitude change was inconsequential and temporary. As we describe shortly, contemporary theories such as the ELM evolved specifically to account for these multiple effects, processes, and consequences and offer new directions for understanding phenomena, such as placebo effects.

In summary, here we propose that expectations are formed and changed by the same processes as other mental constructs, such as attitudes, and thus can be understood by the same principles. The most important insight of the ELM (and many subsequent dual process and dual system theories of judgment, see Petty & Briñol, 2008) is that mental constructs, such as expectancies, can be based upon relatively high or low thought. This is important because in the ELM, expectations formed through high levels of thought are postulated to be of greater consequence (e.g., greater stability, predictive of outcomes, and resistant to change) than those formed with low levels of thought. Further, the ELM separates the processes by which expectations are formed from the processes by which expectations produce outcomes. Thus, in understanding how different variables produce placebo effects, there are two components: the processes by which expectations are formed, and the processes through which expectations produce their outcomes.[3] In what follows, we use the ELM to describe how variables (e.g., a doctor's lab coat, the price of the drug, a patient's mood) can work to affect expectations by low versus high thinking processes which should result in expectations that are more or less consequential.

The ELM as a General Model of Psychological Change

In the 1980s, several multiprocess theories in social psychology broadly and in the field of persuasion specifically, were developed (Sherman, Gawronski, & Trope, 2014). Most notably, the ELM (Petty & Cacioppo, 1986) and the heuristic-systematic model of persuasion (HSM; Chaiken, Liberman, & Eagly, 1989) explained the various processes responsible for the ways variables change evaluations across diverse situations. The ELM was originally proposed to bring coherence to several decades of persuasion research. Over that period, data gathered indicating that variables can lead to multiple and contradictory effects, and further, these effects seemed to be produced by a diverse group of processes. Given the parallel of these past controversies with some of the

[3] As noted in footnote 2, the same processes can be relevant for understanding both the antecedents and the consequences of expectations, though we focus only on the former here.

current controversies relating to expectations and placebo effects, the ELM could be useful in understanding some of the unresolved issues within the placebo literature. Further, in considering the ELM as an explanatory framework for placebo expectations, it is valuable to note that multiprocess models like the ELM are broad and nearly any mental change from personal and social variables can be accommodated. This includes, for example, changes in personal identity, changes in mood and affective responses, changes in internal evaluations like self-esteem, and many others (see Petty & Briñol, 2006). In light of these previous applications, we argue that a valuable feature of the ELM is its potential to provide an understanding of how placebo expectations are formed and changed.

Main Postulates of the ELM

The ELM (Petty & Cacioppo, 1986) makes a number of propositions that we describe next (for more detailed descriptions, see Petty & Briñol, 2012; Petty & Wegener, 1998). First, the model highlights the fact that changing judgments can be accomplished either with a relatively low level of thought or a relatively high level of thought. Stated differently, the "elaboration continuum" ranges from low to high. Importantly, the ELM maintains that numerous specific processes that cause mental change operate across the elaboration continuum. For instance, at the lower end of the elaboration continuum where less thought is required, processes such as classical conditioning (Zanna, Kiesler, & Pilkonis, 1970) and mental heuristics (e.g., a doctor said it so it must be right; Chaiken, 1980) operate. In contrast, active information integration, intentional decision making, and metacognitive judgments tend to involve a higher degree of thought and they operate at the upper end of the continuum (Briñol & Petty, 2009). In the ELM, the operation of processes along the low end of the elaboration continuum are collectively described as following the *peripheral route* to persuasion whereas the operation of processes along the high end of the elaboration continuum are collectively described as following the *central route* to persuasion. This is important because, rather than a single process underlying the development of placebo expectations, the model suggests there are many potential processes (e.g., deliberative attribution, conditioning) that vary in the extent of elaboration required. Also, note that central route and peripheral route are simply labels used as a heuristic to simplify conceptually the end points of the continuum and to draw parallels between the relatively low thinking processes of change versus the relatively high thinking processes of change. For example, classical conditioning requires relatively little thought and operates at the low end of the continuum as does the use of persuasion heuristics. Although the latter may require a little bit more thought, both operate at the lower end of the continuum.

Second, the ELM states that whether the central route or the peripheral route to persuasion is followed is determined by the motivation and ability an individual possesses to process information when the critical stimulus (e.g., a message) is encountered. For example, eliminating distractions, increasing message repetition, enhancing one's relevant knowledge, and increasing the clarity of a message, can all improve the ability one has to process a message and lead to more thoughtful influence. In the realm of placebo effects, the ability to process a treatment message could be affected by the clarity and complexity of information presentation. If the treatment information is overly complex, it may be difficult for individuals to effectively elaborate on a treatment-relevant message.

In addition to one's ability, variables relevant to the motivation to process a message also determine if the peripheral or central route is employed. For instance, by raising the personal relevance of a message, people scrutinize the available evidence more carefully and if it is found to be compelling (high quality), greater judgmental change results, but if the evidence is deemed to be weak (low quality arguments), less judgmental change ensues than when thinking is low (Petty & Cacioppo, 1979). In contrast, when there is relatively low motivation to think, the ELM holds that argument quality has less influence than simple persuasive cues which require less cognitive effort to process, such as whether an advocacy is endorsed by attractive rather than unattractive people (e.g., Haugtvedt, Petty, & Cacioppo, 1992).

The third thing the ELM does is to postulate that it matters whether change occurs as the result of a relatively low or high amount of thought. This is because the degree of thought behind an evaluation determines how consequential that judgment is. That is, the more an attitude is based upon thinking, the more it tends to resist efforts at change, persevere over time, and be consequential for other behaviors and judgments (Petty & Krosnick, 1995). Even when an attitude or expectation formed is initially equivalent under high and low thinking conditions, the consequences will be different.

Fourth, in addition to the concept of elaboration, the ELM includes another important concept named *self-validation* (Briñol & Petty, 2009). Distinct from the previously discussed mechanisms of judgment change that concern primary or first-order cognition (i.e., direction and amount of thoughts), this self-validation process centers on secondary or metacognition (Briñol & DeMarree, 2012). A novel contribution of self-validation is that generating thoughts is not sufficient for them to have an influence on judgment under high thinking conditions. Rather, one must also feel sufficiently good about one's thoughts (affective validation) or hold sufficient confidence in the thoughts for them to impact judgment. Disliked thoughts or thoughts that are not deemed valid are mentally discarded. Numerous aspects of a source (e.g., credibility, attractiveness), a message (e.g., length, internal consistency), a recipient (e.g., body posture, transitory affect), and a situation (e.g., source-recipient synchrony, consensus) can influence evaluative judgments by affecting thought-validation once message-relevant thoughts have been generated (see Briñol & Petty, 2009, for a review).

Fifth, validation is not the only process of a metacognitive nature that is relevant to the ELM. There are also judgmental correction processes. In general, people are motivated to be accurate in their judgments, so under high elaboration conditions, people may notice a particular bias in their thinking (e.g., "Do I think this medicine will work just because I am happy today?") and try to correct for this perceived bias. Just as increased confidence in thoughts can cause greater reliance on them, greater doubt or perception of bias can cause one to discard thoughts. In some cases, people might be so dubious of their thoughts that they deem the opposite to be true. When this occurs, doubt can result in reversal effects with positive thoughts generating less positive attitudes and expectations than negative thoughts. If individuals doubt their thoughts because they are concerned the thoughts arose from some biasing aspect of the situation (e.g., a visually appealing

package) or perhaps a prejudice they hold, they may attempt to correct for the potentially biasing thoughts. Such correction is expected to occur from the mechanisms specified by the *flexible correction model* (FCM, see Wegener & Petty, 1997, for a review). That is, people may estimate the direction and magnitude of the perceived bias on their judgment or expectation and try to correct for the bias. If individuals overcorrect for this bias, the likelihood of reverse effects of variables increases (Wilson & Brekke, 1994).

The final, and arguably the most useful, thing that the ELM does is to organize the numerous mental processes by which relevant communication variables (e.g., credibility of a message source, quality of the message, personality factors) influence judgments and evaluations into a fixed set that operate at different places along the elaboration continuum. For example, the ELM postulates that one of the things that variables (e.g., how attractive a message source is perceived) can do is change how much thinking a message recipient is doing—altering their location on the elaboration continuum (e.g., people may be more interested in processing a message from an attractive vs. an unattractive source). If circumstances exist, however, already limiting a message recipient to the low end of the elaboration continuum, then that same variable can take the role of a simple cue, altering judgments and expectations in the same direction as its valence (e.g., a message from an attractive communicator would result in a positive change in judgment regardless of the arguments used). When an individual is situated closer to the high end of the elaboration continuum, then there are three ways a variable may affect judgments. A variable may function as an argument (e.g., can the attractiveness of the source provide information as to the merit of the message that is being presented?), a variable could change the valence of one's conscious thoughts (e.g., attractive sources can increase the likelihood of generating positive thoughts about a message), and the variable can change structural features of the thoughts that are created (e.g., exposure to an attractive source could increase one's thought confidence or make the thought more likable, resulting in greater reliance on those thoughts). Depending on the conditions, any communication variables (e.g., communicator trustworthiness) may operate by any of the five processes just described.

At this time, a sizable volume of research demonstrates that many communication variables have this complexity of effects and mechanisms depending on the ability and motivation for recipients to think when presented a message (see Petty & Briñol, 2012). In this review, we cover numerous examples of the multiple roles variables can assume, including a source's credibility, a recipients' emotional state, and their doctor's physical appearance. At this point, it is useful to highlight that prior placebo research has identified many factors from the source, message, and recipient that could alter placebo expectations through these five processes (e.g., De Craen, Roos, De Vries, & Kleijnen, 1996; Di Blasi, Harkness, Ernst, Georgiou, & Kleijnen, 2001; Faasse, Cundy, Gamble, & Petrie, 2013; Howe, Goyer, & Crum, 2017; Kaptchuk et al., 2006). These factors include the properties of the health care practitioner (e.g., white lab coat, wearing eye glasses, belief in treatment efficacy, motivation for treatment success), properties of the patient (e.g., current illness, age, motivation), features of the patient–practitioner interactions (e.g., gestures, similarity match between doctor and patient), properties of the treatment (e.g., cost, size, and color of pills), and properties of the administration procedure (e.g., injection, lotion, difficulty).

In the following sections, we illustrate the processes described in the ELM and explain how they can inform our understanding of placebo expectations. It should be noted at the outset that most placebo studies have relied on experimental designs that were not specifically devised to test issues related to the processes underlying placebo expectations. As such, as of yet, few studies directly test the many possible ELM predictions. However, existing data can be reinterpreted from this framework and studies that have key similarities to standard placebo effect paradigms can be used to gauge some predictions. We return to these topics later to highlight novel directions for future research.

Part II: Fundamental Processes of Expectation Formation and Change

In this section, we apply the five processes specified by the ELM to the mechanisms of change underlying placebo expectations. That is, according to the ELM, expectations, like other mental constructs (attitudes), result from different mental processes depending on one's desire and ability to think in any given situation. In the ELM, variables (e.g., a doctor's lab coat; the patient's mood) that influence expectations can do so by: affecting the amount of issue-relevant thinking, determining the type of thinking (i.e., biasing thinking), influencing what people think about their own thoughts (metacognition), serving as pieces of evidence or arguments, and functioning as simple cues that produce influence without much issue-relevant thought. The ELM describes the antecedents and consequences of these five processes, offering testable predictions regarding for whom and when each process is most likely to operate in changing expectations.

Expectations Can Be Affected by the Amount of Thinking

The first of the five fundamental processes we describe for how variables can influence expectations is by changing how extensively a recipient thinks about a message. Indeed, one of the most important and fundamental ways variables can influence expectations is by altering the amount of thinking in which people engage when forming their expectation. This effect is most likely to occur when thinking is not already constrained to be high or low by other variables such as when there is neither high distraction which reduces the ability to think (Petty, Wells, & Brock, 1976) nor high personal relevance which increases the motivation to think (Petty & Cacioppo, 1979). The more motivated and able people are to think about a message, the more their expectation should be determined by their valenced thoughts in response to the message (Petty, Ostrom, & Brock, 1981). Increased thinking can result in more expectation change (e.g., from no expectation to some expectation) if the arguments presented for the future belief are of high quality and people therefore generate more favorable thoughts as thinking is increased. Alternatively, increased thinking can result in less expectation change if the arguments presented are low in quality and people therefore generate more unfavorable thoughts as thinking about those arguments is increased. If the arguments are very weak, people could even develop an opposite expectation to that advocated.

As noted earlier, whether people take the central or peripheral route to persuasion rests on their motivation and ability to think

when the persuasive event occurs. Perhaps the strongest determinant of the motivation to think about a message is how *personally relevant* the communication is perceived to be. Motivation and interest in a medical treatment could vary as a result of many factors, such as illness type (e.g., treating a minor ailment or debilitating disease), personal involvement in treatment selection (e.g., choice or no choice over treatments), and sample population (e.g., volunteer in a research trial vs. patient in clinical practice). Each of these factors could affect the extent of message processing that determines placebo expectations.

The importance of personal relevance for attitude change was demonstrated in an early and representative experiment by Petty, Cacioppo, and Schumann (1983). These researchers manipulated personal relevance level in a mock advertisement for the "Edge razor" by telling participants that they would get a razor for being in the experiment (high relevance) or a tube of toothpaste (low relevance). Following this manipulation, participants viewed an advertisement for the Edge razor that was based on high quality (e.g., "In direct comparison tests, the Edge blade gave twice as many close shaves as its nearest competitor") or low quality (e.g., "In direct comparison tests, the Edge blade gave no more nicks or cuts than its competition") arguments. In addition, the individual endorsing the razor in the advertisement was also manipulated, such that the endorser was either a famous celebrity or a nonfamous citizen. Petty et al. (1983) found a larger argument quality effect (i.e., greater attitude change from high as compared to low quality arguments) if the advertisement for the razor had high personal relevance as opposed to low personal relevance. In contrast, the low relevance participants, but not the high relevance participants, were more persuaded by the celebrity endorser than the noncelebrity endorser. These findings support the proposal of the ELM that the route to persuasion followed by low and high thinking individuals differ. Under conditions of high relevance, issue-relevant arguments were more influential, whereas under conditions of low relevance, peripheral cues were more influential. We argue that the same should be true for the formation of expectancy beliefs.

One relevant study illustrating that the amount of thinking is important for predicting whether expectations are formed (or the extremity of the expectation created) used a paradigm designed to serve as a laboratory analog of placebo effects (Geers et al., 2013; Study 4). In this paradigm, participants sit at a computer terminal and are exposed to aversive audio stimuli over noise-cancelling headsets. Prior to the main stimulus presentation, one group of participants is presented with a color on their computer screen that they are told will reduce the level of discomfort they experience from the aversive audio stimuli. Because color in actuality has no direct influence on discomfort ratings in this paradigm, reduced discomfort in the efficacy message condition compared with the no-message condition serves as an estimate of the effect of a placebo expectation.

In one study employing this paradigm (Geers et al., 2013; Study 4), participants were all induced with the motivation to gain control and were either assigned a "placebo" treatment (i.e., they were given a specific screen color) or were given the opportunity to select between two "placebo" treatments (i.e., they had choice between two different colors to have on their computer screen). In this study, participants displayed a larger placebo effect (i.e., less discomfort) when given the opportunity to choose their treatment. Notably, in the choice condition, this effect was mediated by participants' conscious thoughts about being able to exert control over their treatment selection. This mediation did not occur for participants in the no-choice condition. In other words, there was a greater placebo effect under high choice due to the thoughtfully mediated formation of the placebo expectation. If we assume that individuals deciding between the two treatments were more likely to take the central route to persuasion than the peripheral route (i.e., active choice led to more thinking), then the results are consistent with the notion that the type of thoughts generated about the treatment message enhanced the expectation and thereby caused a placebo effect for those taking the central route to persuasion as compared to participants not engaging in higher elaboration.

Amount of Thinking Can Produce the Same Expectation With Different Consequences

The first process discussed above by which variables can influence expectations (amount of thinking) is important because it influences the impact and durability of change. In terms of placebo expectations, the ELM approach is particularly valuable as the model offers predictions regarding the differential stability, longevity, and behavioral consequences of placebo expectations that might appear similar on the surface (e.g., the same extremity of expectation). Specifically, the ELM proposes that when placebo expectations are formed through the use of high-elaboration processes, they should be more persistent and resistant than those form through low-elaboration processes (Petty, Haugtvedt, & Smith, 1995). We suggest that this insight allows for new predictions about placebo effects. For instance, currently, there is little theory or research by which to answer questions such as, "How likely is this placebo expectation to endure over time?" and "When will placebo treatments lead to changes in subsequent behavior, such as a reduction in drug usage by patients?" The ELM predicts that expectations formed through high rather than low levels of thinking will be more durable and more likely to produce placebo effects over time. Similarly, expectations created via high levels of thinking should have a greater likelihood of altering subsequent treatment-related behavior. In other words, the expectation that a treatment will, for example, reduce pain, will persist over time with a greater likelihood when the underlying process of expectation formation involved high (vs. low) thinking. An important qualification to this general proposition, however, exists with conditioning and persistence over time, as is discussed in a subsequent section.

Support for the influence of elaboration on the consequences of cognitive constructs, such as attitudes, has been provided in many studies, such as one conducted by Haugtvedt and Strathman (1990). In this study, participants viewed high-quality, cogent advertisements for a bicycle and half of the participants were told the bicycle would soon be available (high relevance), whereas the other half did not receive this additional information. Participants reported on their attitudes toward the bicycle immediately after viewing the ads and then again 2 days later. The initial attitudes of the two groups did not differ. However, consistent with the ELM, the attitudes of the high relevance participants were more favorable toward the bicycle 2 days later.

Other studies that provide converging evidence that differential consequences are associated with different attitude change mechanisms are in the area of prejudice (Cárdaba, Briñol, Horcajo, & Petty, 2014). In one study, these investigators gave participants a persuasive appeal containing compelling arguments in favor of a minority group or a control persuasive appeal. The degree of thinking was varied by altering participants' ability or motivation to think about the messages. The study found that even when the reduction in prejudice by the message was equivalent under low and high thinking conditions, there were noticeable advantages of high elaboration prejudice reduction. Specifically, although both low and high thinking groups displayed a reduction in the extremity of prejudiced attitudes, the reductions found in the high thinking group were more persistent and resistant to subsequent attacks than equivalent changes found in the low thinking group.

One study providing data regarding this strength hypothesis in a domain related to placebo effects was conducted by Helfer, Elhai, and Geers (2015). Although this experiment did not involve the administration of a placebo treatment, it did test whether an expectation manipulation induced changes in mood in response to exercise, and thus contains similarities to expectations induced changes from a treatment. In this study, participants in one condition were provided with information stating that exercise elevates mood states. A control condition instead provided information pertaining to the various attributes of a stationary exercise bike. Crossing this expectation manipulation was an elaboration manipulation. Specifically, participants either elaborated or did not elaborate on the information the experimenter provided. In the high-elaboration no expectation condition, participants just wrote what parts of the information received were familiar to them, whereas in the high-elaboration expectation condition participants were asked to write personal examples justifying the idea that exercise improves mood. Following this manipulation, participants in all conditions engaged in a bout of light-intensity exercise for 10 min on a stationary bicycle in the research laboratory. At the end of the session, participants were recruited for a 2-week follow-up study in which their exercise and exercise experience were recorded. The results demonstrated that all participants given the expectation that exercising leads to positive moods, initially exhibited more positive postexercise affect than the no-expectation participants in the experimental session. Thus, the data revealed that in the short-term, expectations formed through low and high elaboration produced comparable changes in feelings (similar to a placebo effect). Importantly, during the follow-up portion of the experiment over the subsequent two weeks, only those who initially elaborated on the expectation information showed continued positive affect after exercising. Thus, the finding show that message elaboration extended the duration of the expectation manipulation on feeling changes.

The above results yield preliminary evidence that elaboration level can influence the duration of expectations on changes in feelings. Further studies could examine this elaboration effect in placebo paradigms, preferably incorporating non-self-report dependent variables. Also, future studies can test other ways that elaboration leads to expectations of greater consequence. For example, people who elaborate on compelling treatment messages may form a more lasting expectation that is likely to alter outcome variables such as the purchasing of drugs, treatment compliance, and the recommendation of treatments to others. Placebo expectations formed with a high amount of thought may also be less influenced by somatic sensations and feelings that are not in alignment with a placebo expectation.

Type or Direction of Thinking

In addition to affecting the amount of thinking, a second mechanism by which variables can influence expectations is by affecting the direction (valence) of the thinking. This mechanism is most likely to operate when thinking is already set to be high by other variables in the situation (e.g., high personal relevance of the message; Petty & Cacioppo, 1979). Considerable research has examined the direction of thinking by altering whether thinking is supportive or derogatory of the information provided in a message (Cacioppo, Harkins, & Petty, 1981). Variables can enable or motivate message recipients to increase the likelihood of generating favorable thoughts or increase the likelihood of generating unfavorable thoughts. For example, optimists are more likely to generate favorable thoughts to a message whereas pessimists are more likely to do the opposite (Geers, Handley, & McLarney, 2003). Thus, when thinking is high, optimists are more likely to generate favorable thoughts to a suggestion about the effects of a placebo than pessimists. This is potentially important because the degree of expectation change is predicted to vary with the valence and number of thoughts that come to mind when elaboration is high. Not only variables of the recipient can bias the direction of the thoughts, but also variables relevant to the communicating source. For example, aspects of the communicator such as a smiling face, a powerful posture, a white coat, or a fast voice can motivate or enable people to increase the likelihood of generating either favorable or unfavorable thoughts to a message. Research has shown that people who are exposed to a smiling speaker are more likely to generate favorable thoughts to a message, whereas people exposed to a frowning speaker are more likely to do the opposite (e.g., Calanchini, Moons, & Mackie, 2016).

A common outcome in the persuasion literature is that, unlike changes that occur through low thinking processes, attitude changes occurring under high thinking conditions are mediated by the content of participants' thoughts. As an illustration of this, consider an example of emotion and persuasion. In one study exploring the various functions of emotions under low and high elaboration, Petty and colleagues (1993) showed how individual differences in the propensity to think (measured continuously, using the need for cognition scale; Cacioppo & Petty, 1982) can exhibit similar outcomes for emotions that are mediated differently. Participants viewed a series of commercials, the critical one being for a pen. Participants' incidental emotion was manipulated in one of the studies by embedding the commercial in a TV program that invoked either a positive or a neutral affective state. Both low and high need for cognition (NC) participants developed more favorable attitudes toward the pen when they were made to feel happy by the TV program. However, the effect of emotion on attitudes was mediated by the favorability of the thoughts they generated in response to the message for those high in NC (i.e., emotion biased thought production), but not for those low in NC (i.e., a direct effect of emotion was obtained, independent of thought production). Thus, happiness led to the generation of more positive thoughts exclusively among high thinkers. Therefore, here

we see the same attitude emerged through different processes of high and low thinking.

As placebo expectations can arise from both relatively high and low degrees of thinking, we would anticipate similar divergences in mediational processes. For example, placebo expectations changed through an affective heuristic should differ in mediational processes from placebo expectations changed through the conscious evaluation of explicitly delivered treatment instructions. Perhaps even more important for the practical consideration of placebo effects, high and low thinking processes should lead to differential downstream consequences following expectation change. As explained earlier, attitudes created through high elaboration tend to be more enduring over time, more resistant to change in the face of new evidence, and more influential on thinking and behavior than attitudes created in low thinking conditions (Petty & Krosnick, 1995). If similar processes are at play with placebo expectations as with attitudes, then placebo expectations formed through high elaboration should be more consequential, altering factors such as the reliability of placebo effects, the duration of placebo effects, and intentions to continue using a medical treatment.

Metacognition: Validation

Third, variables can influence expectations by affecting how individuals perceive their own thoughts. That is, in addition to affecting the number and valence of thoughts when the amount of thinking is set to be high, variables can alter how much we like our thoughts, trust them, or how biasing they are perceived to be. Confidence in thoughts is a key factor because thoughts held with greater confidence are more likely to be trusted when judging (Petty, Briñol, & Tormala, 2002). If people doubt the validity of their thoughts, however, their impact tends to be attenuated.

In an illustration of this process, Tormala, Briñol, and Petty (2007) showed that source credibility can increase the perceived validity of thoughts about pain relief products. In one experiment in this series, either high-quality of low-quality arguments promoting a new brand of pain reliever were given to participants. In the cogent arguments condition, the ad stated that the new product works faster than other aspirins, and lasts longer than other aspirins. In the specious arguments condition, the ad stated that the new consumer product lasts about as long as other aspirins, has very few harmful side effects, contains only small amounts of caffeine and sodium, and recently received a score of 6 of 10 in quality and efficiency testing. This manipulation was designed to create positive or negative thoughts toward the product. Source credibility was then manipulated following exposure to the ad. High credibility participants were told that the information about the product was taken from a pamphlet from a federal agency that conducts research on medical products. Low credibility participants were led to believe that the information was taken from a class report written by a local high school first-year student.

In line with the self-validation hypothesis, this research showed that source credibility information following a message validated the thoughts generated initially toward the product. Specifically, when the message was cogent and produced primarily favorable thoughts, high source credibility enhanced confidence in the favorable thoughts that were generated, leading to more persuasion. When the message was specious and elicited predominantly unfavorable thoughts, however, high source credibility enhanced confidence in those unfavorable thoughts, leading to less (rather than more) persuasion.

Because placebo effects often require individuals to hold on to an expectation in the face of incoming internal and external cues that may not support the expectation, variables altering validation should be critical in many cases. For example, consider a patient in a hospital setting who sees a fellow patient taking an identical treatment. If the observed patient responds negatively, this would reduce confidence in the expectation and undercut the placebo effect component of the treatment. In subsequent sections, we will provide additional examples of how validity processes can be informative in interpreting and generating placebo research.

Metacognition: Correction

If people perceive that their thoughts are contaminated by a biasing factor, they can correct for such an unwanted influence (correction processes; Petty & Wegener, 1998; Wilson & Brekke, 1994). This calibration of thoughts is more likely to take place when the amount of thinking is high because it is only in these situations that people have enough motivation and ability to consider how biased their expectations are.

For example, in a study by Petty, Wegener, and White (1998), undergraduate students received a proposal from a high or low attractive source that contained either cogent or specious arguments in favor of changing a campus policy. After reading the message, participants either immediately completed attitude measures, or were asked not to let any biases toward the message source influence their judgments of the proposal. The simple likability manipulation had little effect when no correction instruction was given. However, when a correction instruction was given, attitudes were actually more favorable when the message was presented by a dislikeable rather than a likable source, suggesting an overcorrection for the perceived biasing influence of the likable source. Such explicit corrections typically require a relatively high degree of thinking. That said, if certain corrections are practiced repeatedly, however, they may become less effortful (see Wegener & Petty, 1997), and even automatic (for an example, see Maddux, Barden, Brewer, & Petty, 2005).

Correction processes are relevant to placebo research. For example, if a patient is carefully considering the arguments for why a dubious supplement could reduce pain, the patient may realize that her own personal desire for an end to the pain may be biasing her interpretation of the supplement (Handley et al., 2013). As such, the patient may try to *correct* for this bias toward the supplement to remain impartial. According to the Flexible Correction Model, if people are thinking carefully and wish to reduce a bias, they will try to estimate the magnitude and direction of it and adjust their judgments accordingly. In this example, if a patient engages in this process, she may end up with a more unfavorable expectation of the supplement effects than she would have had without the correction. This could even lead to a reversal of the placebo effect if the person overestimates the bias. Several placebo studies provide data consistent with this correction perspective, suggesting that when individuals are more likely to notice that their symptoms are not consistent with a treatment expectation (Ross & Olson, 1981) or are more concerned about being biased (Handley et al., 2013), reversals of placebo effects are more likely.

For example, reverse placebo effects are more likely to occur for individuals who are more responsive to internal versus external cues (e.g., Duncan & Laird, 1980; Heatherton, Polivy, & Herman, 1989), or are high in private body consciousness (Brockner & Swap, 1983), and reversals can be obtained through experimental manipulations that increase subjective self-awareness (e.g., Gibbons, Carver, Scheier, & Hormuth, 1979; Gibbons & Gaeddert, 1984). Further, reverse placebo effects are more likely when individuals have a clear preexisting internal benchmark that provides them a comparison standard when assessing whether the anticipated symptom change resulted from a placebo treatment (Snyder, Schulz, & Jones, 1974).

Serving as Arguments

Next, when the amount of thinking is high, variables can serve as arguments. When thinking is high, people evaluate the relevance of *all* of the information that comes to mind in the situation so as to ascertain the merits of the expectation under consideration. That is, people assess message, source, and recipient information as possible arguments or reasons for creating an expectation.

For example, whereas an attractive source might increase persuasion under low elaboration conditions purely because people have a positive association with attractive individuals, under high elaboration, people scrutinize whether the attractiveness of the source is relevant to the advocacy. Under high thinking conditions, an attractive source will have relatively little impact on persuasion when people view the attractiveness as irrelevant to the merits of the advocacy. However, when attractiveness is relevant, such as when the source is advertising a beauty product, then attractive sources can be more persuasive than unattractive sources by serving as a cogent argument (e.g., Petty & Cacioppo, 1984). For example, if the practitioner administering the treatment would express feeling good after taking a particular brand of pain killers, then the patient could use that information about feelings as an argument to generate expectations about the treatment under high thinking conditions.

Use of Cues

A final role for variables occurs under relatively low thinking conditions (e.g., high distraction, low personal relevance). In these situations, variables can affect expectation change by functioning as a simple cue, influencing the selection of cues, or by having an impact on what cues would be more effective. For instance, when the situation provides little reason to engage in extensive message processing, individuals are more likely to be influenced by a celebrity endorsing a product than by an average citizen endorsing the same product (Petty et al., 1983).

There is some research to suggest that simple cues can be effective at changing placebo expectations. For example, the influence of placebo expectations can be increased by incidental cues in the environment, such as supraliminal goal primes (Geers, Weiland, Kosbab, Landry, & Helfer, 2005). Also, simple conditioning procedures above and below conscious awareness can cause placebo effects. Other variables such as the number of pills required in the treatment or the credentials of the doctor administering the treatment can also operate as cues for people to generate expectations about treatment efficacy. Although in these studies placebo expectations are typically not measured, as discussed previously, there is substantial data implicating expectations as mediator of such effects.

Summary

In sum, the ELM postulates that variables can affect expectations through the key five processes of mental change just described. That is, any of the innumerable ways that the context and practitioner-patient interaction differ can (a) change one's placement on the elaboration continuum, (b) work as simple cues, (c) alter the valence of thoughts that arise, (d) serve as an argument, and (e) influence the liking and/or confidence in the thoughts created. As noted, the ELM specifies that some of these processes are most likely to operate when thinking is low, some operate when thinking is high, and others operate when thinking is unconstrained to be either high or low. The ELM also articulates the consequences associated with high versus low elaboration expectation change (e.g., degree of resistance to counterpersuasion).

Multiple Roles: The Case of Source Credibility

To illustrate the organizational and predictive value of the ELM's multiprocess framework, consider the credibility of the source who presents information about a placebo treatment (e.g., doctor vs. neighbor). Traditionally, credible sources were expected to be more persuasive because individuals hold to the heuristic that, "if an expert says it, it must be true" (Chaiken, 1980). In line with this perspective, initial research on source credibility effects found this result was more prominent when individuals are not very motivated or able to think carefully (Petty, Cacioppo, & Goldman, 1981). Further studies, however, found that source credibility does not always function as a simple heuristic and does not always increase persuasion. For instance, if thinking is not already constrained to be low or high, credibility can alter the favorability of attitudes by changing the amount of thinking people engage in. If individuals are uncertain whether a message warrants or requires scrutiny, they can rely on the credibility of the source as a guide—for example, increasing how much they think about a message from a highly educated source than a source lacking advanced education (e.g., Heesacker, Petty, & Cacioppo, 1983). Moreover, if high credibility motivates people to elaborate more on a message but that message has specious arguments, then high credibility can actually lead to a *reduction in* persuasion, an outcome that is contrary to the effect it had when serving as a simple heuristic. Likewise, an expert source can increase persuasion if the arguments in a message are cogent but decrease it if the arguments are specious (e.g., Heesacker et al., 1983).

When the ability and motivation to process are high, such as times when recipients are not distracted (Petty et al., 1976) and a message has high personal relevance (Petty & Cacioppo, 1979), people are more likely to think carefully about a message. Yet, source credibility can bias that thinking. Chaiken and Maheswaran (1994) discovered that when a persuasive message was personally relevant but the arguments presented were somewhat ambiguous (i.e., neither cogent or specious), an expert (vs. nonexpert) source generated more attitude change by biasing the direction of participant's thoughts (i.e., people interpreted the ambiguous arguments in a more positive way when the source was credible). Importantly,

as noted, other studies indicate that when people consider their thoughts to be biased by the source, they may adjust their judgments in a direction opposite to the implication of the thoughts (*correction processes*; Petty et al., 1998; Wegener & Petty, 1997). Lastly, source credibility can also affect the confidence that people have in their message-relevant thoughts and thereby affect persuasion. In a study by Tormala et al. (2007), source credibility influenced thought confidence only when information revealing the source followed, rather than preceded the message. When source information preceded the message under high thinking conditions, it biased the valence of thoughts, as found in earlier research (Chaiken & Maheswaran, 1994).

Multiple Roles: The Case of Doctor's White Coat

This same multiprocess schema can be applied to the construct of placebo expectations. Prior research has found that numerous factors from the source, message, recipient, and context alter placebo effects. But, it has remained unclear how and when these assorted variables alter placebo expectations and thereby alter placebo effects. The multiprocess perspective of the ELM clarifies that these variables can alter placebo effects by influencing the process by which placebo expectations are formed. As an illustration of the multiple roles that any one communication factor can take in altering placebo expectations, consider the familiar medical symbol of a white lab coat. White lab coats can influence patient perceptions and judgments and are highly recognizable signs of credibility in the medical profession (Landry, Dornelles, Hayek, & Deichmann, 2013). From the perspective of the ELM, this seemingly straightforward variable could alter placebo expectations in five different ways as documented above in the literature on source credibility.

First, a white lab coat can serve as a simple cue when individuals are relatively unable or unmotivated to think about the message a practitioner provides. For example, perhaps a patient is mentally taxed by anxiety over an existing medical condition or considers herself at low risk for an ailment and is thus not motivated to attend to the information being delivered by the practitioner. As noted previously, when individuals are taking this peripheral route to persuasion, low thinking processes, such as the generation of an inference of credibility, (e.g., "this person is believable, so this treatment is effective") should dominate. In such low thinking situations, the white lab coat signals credibility and raises expectations of treatment benefits. Notably, if the practitioner's message was that a treatment would also induce negative consequences this same credibility cue could result in larger nocebo expectations. Importantly, because low levels of elaboration were used in this case, any placebo or nocebo expectations observed would be anticipated to be short in duration and relatively low in resistance to contradictory information (e.g., physiological sensations that contradict the treatment expectation).

Second, when the likelihood of thinking is more moderate, the presence of a white lab coat can affect the extent of elaboration. Consider a situation in which a patient has the ability to devote a great deal of thinking toward the medical instructions of a practitioner—but is only moderately motivated to do so or is somewhat distracted. For example, the patient may be momentarily occupied by thinking about his job and as a result is not fully attentive to his medical professional. Here, the white lab coat, as an indicator of credibility and authority, could prompt the patient to engage in more thinking. Increased thought may improve the effectiveness of a positive treatment message if the message provides good reasons for effectiveness of the recommended treatment. If the treatment message was of poor quality, however, this increased message processing would result in a weaker placebo expectation and thus less placebo responding. Again, the opposite pattern would be expected if the treatment message was for more negative (nocebo) outcomes.

Third, when thinking is high, the white lab coat can be examined as an argument. That is, patients could ask themselves if the lab coat is a useful indicator that the treatment being given is effective. For example, consider a patient trying to determine whether an administered treatment is efficacious or not. To help make this decision, she could decide that the white coat means the practitioner has received important medical training and such a person would only prescribe an effective treatment. Thus, this patient uses this piece of information as evidence to bolster the perceived efficacy of the treatment. Alternatively, if the patient was seeing a nontraditional healer who does not wear a white lab coat, this could result in a reduction in a patient's expectation for treatment efficacy. Finally, it is important to consider that when variables are used as arguments, they also have the potential to weaken persuasion. For example, research suggests that some individuals possess negative opinions of standard medical practices and are very skeptical of modern medical treatments (Brownlee, 2007). For such individuals, the white lab coat could serve as an argument that the treatment is a traditional one and is not very innovative. This inference would undercut the placebo expectation and thus placebo effects. This latter possibility highlights the value of simultaneously considering source and recipient factors in a treatment context.[4]

Fourth, source credibility variables, such as the white lab coat, can serve another role at high levels of elaboration—biasing the message processing patients use when thinking about the advocated treatment. For example, patients may interpret arguments in a more favorable way when they stem from a credible source, such as a practitioner dressed in a white lab coat. Generating a larger number of favorable thoughts tends to increase persuasion. Prior research reveals that indicators of source credibility are likely to influence judgment through biased processing especially when the information in the persuasive message is more moderate or ambiguous in quality (Chaiken & Maheswaran, 1994). In medical contexts, this leads to the prediction that source credibility variables will be more likely to influence placebo expectations when patients are presented with treatment efficacy messages that are open to multiple interpretations and they are also processing the message to a large extent.

Fifth, and finally, patients who think extensively about a treatment message can vary in thought confidence. In the present example, a patient may have thoughts that a treatment sounds

[4] The white lab coat is always relevant to the effectiveness of a placebo, so it can be an argument or a cue. Other factors such as the doctor's physical attractiveness could serve as a peripheral cue under low thinking conditions, but are less likely to serve as a piece of evidence if evaluated as an argument under high thinking (except in the case of forming expectations about the efficacy of a beauty treatment). Thus, cue effects and argument effects for any one variable are not always the same.

effective. If, however, the patient is not confident in these thoughts, the thoughts should have little influence on their placebo expectation. Source credibility variables, such as the white lab coat, can instill greater confidence in the thoughts about treatments. This metacognitive process can enhance placebo expectations and thereby placebo effects. This role is especially likely to occur if patients notice the lab coat while or after favorable thoughts have already been generated rather than before. Indeed, to enhance validation effects, the physician can don the lab coat after the message is provided.

In sum, source characteristics—such as the credibility implied by a white lab coat—can enhance or undermine placebo expectations through any of the above five roles by changing the success of the treatment message. Importantly, whether a relatively low or high amount of thinking is employed determines the impact of source variables on the long-term consequences of persuasion attempts. For the cases when patients generate placebo expectations through greater amounts of thought, the expectations should result in placebo effects that are more influential and durable.

To further illustrate this point, next consider the variable of the packaging in which a treatment is presented. Under conditions of unconstrained elaboration in which amount of thinking is free to vary, something as apparently trivial as the looks of the package in which pills are delivered can influence whether a person thinks carefully or not about the arguments that accompany the delivery. An attractive presentation would be expected to increase elaboration and therefore increase placebo expectations only when the doctor provides compelling arguments in explaining why it will work. However, the same luxury appearance would increase elaboration but reduce placebo expectations if the doctor presents specious arguments about the scientific merits of the pain killer because people would be more likely to realize the flaws. Thus, the same variable (luxury package) can increase elaboration leading to either an increase or decrease of placebo expectations as a function of argument quality when other variables in the situation have not already compelled or inhibited elaboration. It is clear that a luxury package would capture our attention and trigger our interests most of the time. However, an attractive package might also reduce elaboration for some people under certain conditions (e.g., when the attractive package has so much going on that is too distracting or people reason that luxury items are not for them). In such instances, the distraction introduced by the package would reduce placebo expectations for strong, high-quality arguments while increasing placebo effects for weak, low-quality arguments.

Of course, the attractiveness of the packaging could also serve in the other roles we have mentioned (e.g., serving as a simple cue when thinking is low). Interestingly, under high thinking conditions, treatment packaging may be expected to have no influence on placebo expectations as an argument. Unlike a doctor's white lab coat, the attractiveness of the packaging may not serve as a useful piece of evidence as an argument for a treatment's effectiveness (unless luxury packaging was associated with high quality). Finally, people might even correct their judgments in a negative way if they come to believe that the attractive package was inappropriately biasing their judgment.

In this section, we provided two illustrations of the ELM, explaining how the wide array of factors in medical contexts can alter placebo expectations depending on the circumstances. This means that positively valenced factors (e.g., source credibility) can sometimes be associated with increased persuasion, but at other times these very same aspects can be associated with decreased persuasion.

The ELM and Traditional Psychological Explanations of Placebo Effects

With the ELM described and the links between it and placebo effects now illustrated, in this section we discuss how this framework connects to and expands on prior placebo effect formulations.

Existing work on placebo effects has focused predominantly on clarifying the link between expectations and placebo effects, emphasizing confirmatory information processing and the neurobiological pathways connecting expectations to placebo outcomes. The approach described here complements existing research by articulating the antecedent processes and the variables acting on these processes that underlie placebo expectations. The specification of these mental operations provides new insights into issues such as when placebo effects may not manifest and when they are likely to be stable in the face of attacks and endure over time.

The current approach also addresses a conceptual ambiguity in the placebo literature. Specifically, in some cases, expectations have been described as the psychological *process* underlying placebo effects. Although our analysis aligns with formulations that focus on the importance of expectations in causing placebo effects, it does not construe expectations as a mental process per se. Instead, expectations are regarded here as mental constructs, like attitudes, that are influenced by a variety of processes that vary in level of elaboration, and have important downstream consequences. That is, we argue that it is unsatisfying to focus on expectations per se as the process that underlies placebo effects because not all expectations are the same. Specifically, the manner in which they are formed can determine the extremity of the expectation and the consequences that the expectation has.

Relatedly, in the placebo literature, classical conditioning has sometimes been conceptualized as a distinct and even contrasting mechanism from expectations (for a discussion, see Stewart-Williams & Podd, 2004). The ELM provides guidance as to how conditioning and expectations relate. From the perspective of the ELM, conditioning can be considered a low elaboration process that influences placebo expectations. This resolution arises when we consider that psychological change (in this instance placebo expectations) can occur through both high and low degrees of thought. As classical conditioning tends to require relatively lower levels of thought, it operates at the lower end of what is referred to as the elaboration continuum. Other processes, such as careful attributions and intentional decision-making, tend to require a higher degree of thought, and influence placebo expectations along the upper end of this continuum. The ELM suggests that the processes underlying placebo expectations are not confined to only one location on the elaboration continuum and stem from different amounts of thinking—depending on the circumstance.

In an influential article closely related to the present concerns, Stewart-Williams and Podd (2004) reviewed the placebo literature and proposed a resolution to the debate over expectation and conditioning accounts of placebo effects. Stewart-Williams and Podd theorized that placebo effects stemming from verbal treatment messages are mediated by conscious expectations, whereas

placebo effects produced by conditioning procedures can be either mediated by conscious expectations or occur through nonconscious learned associations. The ELM account is compatible with this approach in positing that the same outcome (e.g., placebo expectations) can emerge from processes that require high and low amounts of thinking. Importantly, however, the ELM does not link expectations exclusively with high thinking conscious processes. Expectations, like other mental constructs, can operate at a conscious as well as a more automatic level. This point may help address one inconsistency in the placebo literature. In some studies, conscious expectations mediate the effect of treatment messages on placebo effects, whereas in other studies they do not mediate. From the perspective of the ELM, if conscious expectation reports do not mediate the link between a treatment message and a placebo effect, it is possible that nonconscious or automatic expectations can be the mechanism responsible for the placebo effect (Jensen et al., 2012).

Additionally, unlike the formulation of Stewart-Williams and Podd (2004), the ELM does not focus exclusively on conditioning when investigating how placebo expectations emerge when thinking is low. Low thinking processes can go beyond mere associations, including rule-based operations and promotional inferences of attribution and misattribution (Petty & Briñol, 2006, for a discussion). For example, in the case of emotion, in addition to classical conditioning, a number of other specific processes have been offered to explain effects when thinking is low, including use of emotion-based heuristics (e.g., "I feel good, so I must like it"; Schwarz & Clore, 1983), misattribution of one's emotional state to an attitude object (Zillmann, 1971), and direct affective transmission (e.g., Murphy & Zajonc, 1993). In these accounts (including classical conditioning), although the emotion can occur as a result of a variable that is incidental to the persuasive content of the message or object of evaluation (e.g., a foul odor in the room, smiling), when elaboration is low, the emotion nonetheless influences evaluation toward the associated target consistent with its valence. Furthermore, although the different accounts of low effort emotional impact vary in many respects, they converge on the notion that the impact of emotion does not necessitate much in the way of cognitive capacity of motivation, and the effect is consistent with the emotion's valence. Importantly, as explained earlier, the ELM also identifies high thinking mechanisms by which emotions can influence judgments.

Finally, an important note is in order regarding conditioning and the consequences of placebo expectations. As previously described, placebo expectations based on high elaboration processes are expected to be more consequential (e.g., alter future judgments) than those based on low elaboration processes. However, prior research has found that repeated pairings of a cue and stimulus, such as through conditioning, can lead to more persistent attitudes (e.g., Haugtvedt, Schumann, Schneier, & Warren, 1994). Thus, conditioning, a low elaboration process, may be associated with placebo expectation persistence, in least in some circumstances. Although conditioning may produce placebo expectations of a longer duration, expectations formed through conditioning are less likely to exhibit other consequences that follow from high elaboration (Petty & Wegener, 1998). For example, research finds that conditioning provides little aid in resisting counterinfluence since individuals have no way to justify an expectation based simply on a cue. Indeed, conditioned attitudes can be changed through verbal persuasion. In an illustration, Petty and colleagues (Petty, Tormala, Briñol, & Jarvis, 2006) first conditioned attitudes about a fictitious person to be positive or negative and then gave participants verbal information about whether the person to whom they had conditioned attitudes shared their opinions on important issues or not. This verbal similarity information was successful in modifying the initially conditioned attitudes to be more neutral. This point regarding conditioning and persistence is particularly notable, as it highlights that the specific consequences of an attitude or expectation sometimes varies because of the process involved (Petty & Krosnick, 1995).

Conclusions

Placebo effects have become an innovative topic of scientific inquiry that provides great interest for both researchers and medical practitioners. Substantial effort is currently underway to understand the pathways linking placebo expectations to placebo effects. In this article, we highlight the advantage of also focusing efforts on the variables and processes underlying placebo expectations. We suggest that knowing the antecedent processes responsible for placebo expectations can lead to new insights regarding the durability and directionality of placebo effects. Further, it should also prove informative regarding the likelihood that the placebo effect will alter subsequent behaviors (e.g., treatment adherence) and other consequences such as the extent to which the changes observed will generalize and spread to other domains.

In this review we have introduced a multiprocess perspective from the persuasion literature to help clarify when placebo expectations are most likely to form and what kind of psychological process is responsible. We propose that the success or failure of treatment-relevant information in producing placebo expectations depends upon the specific variables and most importantly upon the processes by which those variables operate according to the framework outlined in the ELM. As described, the model suggests that placebo expectations can arise from both low and high amounts of thinking and that ability and motivation are key to determining the amount of thinking that takes place. The ELM suggests that placebo expectations created though greater elaboration tend to be more durable, resilient against opposing information, and predictive of future actions than placebo expectations formed with low-elaboration processes. The model also emphasizes the metacognitive processes of validation and correction which can alter the direction of the thoughts that determine placebo expectations.

Key to the ELM is the notion that communication variable can alter placebo expectations in one of five ways. Variables can (a) change a person's placement along the elaboration continuum (which determines whether the central or peripheral route operates), (b) function as simple cues (peripheral route operates), (c) modify the positivity of thoughts that are generated (central route operates), (d) be used as an argument (central route operates), and (e) alter the confidence with which thoughts are held (central route operates). To illustrate these different roles of communication variables in placebo contexts, we have presented examples relevant to the source of message (e.g., credibility, white coat), the message (e.g., luxury looking packaging), and the recipient (e.g., emotion, body symptoms). The same principles can be applied to many other relevant factors such as, cost of pills, the similarity of

a doctor to the patient, or the patient's level of treatment familiarity.

We propose that the ELM provides many insights that can be harnessed to understand and influence the connection between expectations and placebo effects. First, to enhance placebo effects one could increase the amount of elaboration behind placebo expectations. That could be achieved by reducing distractions when considering compelling, high-quality treatment efficacy messages or by making the situation more personally relevant or even asking the patient to provide their own arguments as to why the treatment might work. If placebo expectations are thoughtfully processed, they are more likely to translate into placebo effects and to sustain over time. Second, one would want to reduce doubts regarding placebo expectations. There are many ways to reduce doubts (and increase confidence) ranging from making it easy to come up with reasons to support the placebo expectations, learning about others who are benefiting from a treatment, or having people sit down in a confident posture. Finally, one could reduce the awareness of the potential bias of a placebo expectation and reduce the motivation to decontaminate unwanted biasing factors. These are just a few of the many placebo enhancement strategies that can be derived from the ELM. Importantly, a recent development in the placebo literature is the creation of expectation-enhancement interventions so as to amplify the placebo component of standard medical treatments (Rief et al., 2017). Future expectation interventions might consider using the ELM framework to gain the most from changing expectations.

In this review we have focused primarily on examples relevant to standard placebo situations (such as placebo in the context of active drugs). However, the present perspective offers potential insights on many other issues of high relevance to the placebo literature, such as open-label placebo effects. For instance, in open-label placebo studies, participants are explicitly informed that they have been administered a placebo and are additionally told that placebos can have beneficial effects. The objective of this procedure is to evoke placebo effects without the use of deceptive instructions that are not permitted by medical codes of conduct. In several open-label experiments, participants have improved from placebo treatments even when they were made aware that the treatments were inert (e.g., Charlesworth et al., 2017; Kaptchuk et al., 2010). Recent research has found that, similar to standard placebo effects, open-label placebo effects can be a consequence of expectations (Wei et al., 2018). Open-label placebos effects have also been found to be stronger when individuals are provided high quality arguments (Locher et al., 2017). As such, we propose that the ELM provides a useful framework for understanding and perhaps even amplifying the expectations responsible for the results of open-label studies. For example, open-label placebo interventions likely contain many features, including two-sided messages and motivated belief change. These factors have been clarified in the persuasion literature with the ELM and studies could use these previous findings to amplify the effectiveness of open-label placebos.

The ELM may also help in understanding variations in placebo effects attributable to sociodemographic variables because it anticipates that recipient factors can play different roles depending on the circumstances. With respect to the existing literature, some data suggest that children display a larger placebo effect than adults, and that men are more responsive to a verbally given placebo expectation than women (e.g., Haltia et al., 2008; Vambheim & Flaten, 2017; Weimer et al., 2013). These age and gender effects, however, differ across studies, and it is currently unclear when the effects will emerge (Averbuch, & Katzper, 2001; Weimer, Colloca, & Enck, 2015). Research on the ELM, particularly regarding matching effects, may assist in clarifying these mixed results. Persuasion studies have found that greater attitude change can occur when variables, such as characteristics of the recipient (e.g., patient age) and message source (e.g., experimenter age), align (for a review, see Briñol & Petty, 2018). For example, matching the gender of the message source to that of the recipient can either increase or decrease the persuasiveness of the message depending on the mechanism involved (see Fleming & Petty, 2000). This is because the ELM postulates that such matching effects occur through the same five fundamental processes previously described. That is, matching can influence attitudes by serving as a peripheral cue when elaboration is low, by biasing thoughts, serving as an argument, or affecting thought validation when elaboration is high, and by affecting the amount of information processing when elaboration is not constrained by other variables. With respect to this latter role, if gender matching increases processing of the message, then if the message had strong arguments, gender matching would increase persuasion over mismatching but if the message had weak arguments, gender matching would reduce persuasion.

There is existing evidence for such matching effects with sociodemographic differences in placebo research. For example, several studies have found that placebo effects are more likely to occur when the participant gender and the gender of the experimenter, an observer in the room, or confederate modeling symptoms, match (Faasse, Grey, Jordan, Garland, & Petrie, 2015; Lorber, Mazzoni, & Kirsch, 2007; Mazzoni, Foan, Hyland, & Kirsch, 2010; Weimer et al., 2012). However, these studies have not identified the specific process by which matching had its impact, and the ELM can be useful in uncovering this. Matching can also occur between the aspects of the recipient and the message. For example, women, who tend to report greater sensitivity to pain stimuli (Fillingim, King, Ribeiro-Dasilva, Rahim-Williams, & Riley, 2009; Fowler, Rasinski, Geers, Helfer, & France, 2011), are more responsive to (nocebo) expectations for increased pain than men (Vambheim & Flaten, 2017). In contrast, men are often more responsive to placebo expectations for lower pain than women. As with gender matching, the ELM specifies multiple mechanisms by which this can be brought about.

In conclusion, we have attempted to integrate a dominant theory of psychological change with the literature on placebo effects by describing the processes and variables that can influence placebo expectations. Finally, although we have limited our focus here to placebo expectations, there is no reason that this approach could not be expanded to explain other types of expectation effects, including expectations in consumer marketing and social interactions. Thus, in the future, the ideas presented here could be further developed to provide a more comprehensive analysis of expectation change and the consequences of expectancy broadly defined.

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