Is It Still Working? Task Difficulty Promotes a Rapid Wear-Off Bias in Judgments of Pharmacological Products

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Is It Still Working? Task Difficulty Promotes a Rapid Wear-Off Bias in Judgments of Pharmacological Products

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Misuse of pharmacological products is a major public health concern. Seven studies provide evidence of a rapid wear-off bias in judgments of pharmacological products: consumers infer that duration of product efficacy is dependent on concurrent task difficulty, such that relatively more difficult tasks lead to faster product wear-off. This bias appears to be grounded in consumers' incorrect application of a mental model about substance wear-off based on their experiences with, and beliefs about, various physical and biological phenomena. Results indicate that the rapid wear-off bias affects consumption frequency and may thus contribute to overdosing of widely available pharmacological products. Further, manufacturers' intake instructions in an interval format (e.g., "Take one pill every 2–4 hours") are shown to signal that efficacy is task dependent and reinforce the bias. Debiasing mechanisms—interventions to reduce the rapid wear-off bias and its impact—along with implications for consumers, marketers, and public health officials, are discussed.

Misuse of pharmacological products is a significant and rapidly growing public health concern. In the United States, emergency department visits due to pharmaceutical misuse reached over 1.4 million in 2011, an increase of 87% from 2005 (SAMHSA 2013a); emergency department visits due to energy drink misuse reached over 6,000—a whopping 945% increase in the same time period (SAMHSA 2013b). Undoubtedly, inadvertent overdosing of widely available and commonly used products presents a serious problem for consumers, marketers, and public health officials alike. Accidental overdose of acetaminophen, the active ingredient in Tylenol, has alone resulted in more than 1,500 deaths in the last decade and approximately 23,000 emergency department visits every year. In fact, acetaminophen overdose is the leading cause of acute liver failure, and taking just a little more than recommended over several days—only 25% above the maximum daily dose or two additional extra-strength pills a day—can cause liver damage (Gerth and Miller 2013). Likewise, excessive consumption of caffeine, the main active ingredient in energy drinks, has been linked to numerous detrimental health-related outcomes (Reissig, Strain, and Griffiths 2009; Seifert et al. 2011). This is particularly concerning because half of the energy drink market—the fastest growing segment of the US beverage market—consists of children, adolescents, and young adults (Seifert et al. 2011). Indeed, over the past few years "the numbers of kids coming into the ER with chest pains, palpitations, even seizures—all caused by too much caffeine—has increased dramatically" (Hoffmeyer and Early 2012).

The increase in energy drink misuse is perhaps not surprising given that young adults now consume these products at all times, not solely during sports performance, and manufacturers advertise that such drinks can be used in many situations. For instance, the popular energy drink Red Bull lists "on the road, during lectures and study sessions, at

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work, while doing sports, playing video games, or going out day and night" as recommended options (Red Bull USA 2014), suggesting that it is suitable to use virtually anywhere (Elliot 2011). Given the salience of consumption contexts in marketing communications, a question arises: might consumers infer that the tasks and activities they engage in affect the workings of products they consume? And if so, could such inference contribute to overdosing of widely available pharmacological products?

Anecdotal evidence suggests that consumers may indeed believe that substances perform as a function of context and, more specifically, wear off depending on concurrent task difficulty. In a recent post on the online forum RealSelf.com (where medical professionals answer various consumer questions), one person asked: "Will the product [Dysport, a botox-like substance used to eliminate wrinkles] wear off faster since I practice Bikram Yoga? . . . It is a very strenuous activity." Fourteen licensed doctors replied to the post, all in consensus that the longevity of the product is independent of the activity one performs; they agreed that the substance "irreversibly binds to neuromuscular junctions and 'wears off' only when the body produces new ones, typically in 3–4 months." Importantly, the duration of efficacy of many pharmacological products—such as caffeinated beverages and medication containing acetaminophen (e.g., Tylenol)—is determined primarily by the dose of the active ingredient and individual-level factors such as age, disease, liver functioning, weight, and use of other medications rather than by the physical or cognitive tasks that consumers perform (Baca and Golan 2012; Benowitz 1990; Chikhani and Hardman 2011; Juliano, Ferre, and Griffiths 2009; Karan, McCance-Katz, and Zajicek 2009; Winston, Hardwick, and Jaberi 2005). The pharmacokinetics of caffeine and acetaminophen, for example, are unaffected by concurrent task difficulty (e.g., physical activity; Graham 2001; Haller et al. 2008; Loniewski et al. 2001; McLean and Graham 2002; Sawrymowicz 1997). It appears that consumers may intuit otherwise.

In the present research, we explore duration judgments of pharmacological product efficacy. We propose that consumers hold an intuitive belief that duration of pharmacological product efficacy is dependent on the difficulty level of the activities and tasks they perform, such that relatively more difficult concurrent activities and tasks lead to more rapid product wear-off. That is, similar to placebo studies (Irmak, Block, and Fitzsimons 2005; Shiv, Carmon, and Ariely 2005; Stewart-Williams and Podd 2004) in which consumers infer efficacious outcomes regardless of actual metabolic effects, we find that consumers report feeling the effects of a product for a shorter duration when tasks are perceived as difficult despite the fact that task difficulty should have no such effect. This rapid wear-off bias, we suggest, is driven by a mental model based on consumers' experiences with various physical and biological phenomena throughout their lifetimes. For example, people know that cars burn gasoline more quickly when driving uphill than downhill, difficult workouts burn calories more quickly than easy workouts, and products like stain guard sprays wear off more quickly in high traffic areas. It appears that consumers rely on their knowledge about "wear-off" in certain domains to make predictions about the workings of pharmacological substances. Thus, we suggest that although the "wear-off" intuition is correct in many contexts, it is inappropriately generalized to others—in this case, to one with serious consequences for errors.

We focus on perceived duration of pharmacological product efficacy for several reasons. As illustrated by the above examples, consumers care about duration of efficacy: it is a product attribute that can influence purchase and satisfaction. It is also an attribute, however, on which firms often do not provide precise information. Thus, one's own judgments and those of other consumers can be an important source of decisions. Further, duration judgments of pharmacological product efficacy affect intake frequency which ultimately determines the level of consumption (e.g., under- or overuse) within a given time period. As previously described, frequency of consumption is a key concern for drug adherence and can have highly detrimental consequences (Diener and Limmroth 2004; National Council on Patient Information and Education 2007; Pohler 2010). Despite the importance of perceived duration of product efficacy, research to date has not examined this variable. To the best of our knowledge, this work is the first to document a systematic consumer belief that affects such duration judgments.

THEORETICAL BACKGROUND

There is much evidence in the marketing literature that in the wake of incomplete knowledge, consumers rely on both external and internal cues to make inferences about products. For example, consumers may rely on intuitive theories, their overall evaluations, and observable attributes to infer the values of missing, or unobservable, product attributes (Kardes, Posavac, and Cronley 2004). Deval et al. (2013) show that consumers may hold several even discrepant naïve theories about product attributes and various marketplace phenomena and that consequent inferences and evaluative judgments may depend on which theory is active. However, much of inference-making research has been outside the health domain and the literature on efficacy-specific inferences—about a product's capacity to deliver a desired result—is sparse.

The limited body of research on product efficacy (i.e., of medication, functional foods and beverages) does suggest, however, that consumers may also rely on intuitive beliefs about observable product attributes to make efficacy inferences. For example, price has been shown to affect self-risk judgments and perceptions of need for a drug (Samper and Schwartz 2013), along with perceived product efficacy (e.g., pain relief; Waber et al. 2008) and actual behavioral outcomes such as task performance (Shiv et al. 2005). Similarly, the product's origin may be used to infer product efficacy. Wang, Keh, and Bolton (2010) find that Eastern medications are presumed to be more efficacious when there is high diagnosis uncertainty whereas Western medications are inferred to be more efficacious when attributing a particular cause to symptoms is easy (i.e., diagnosis certainty is high).

Other factors, such as a firm's profitability information, packaging, and negative product attributes, also affect efficacy expectations (Kramer et al. 2012; Posavac et al. 2010; Wright et al. 2013). Wright and colleagues (2013) show that negative associations between taste and quality lead consumers to experience increased efficacy (e.g., task performance) after consuming a substandard (vs. superior) tasting drink thought to enhance mental acuity. Indeed, intuitive beliefs about "no pain, no gain" yield inferences that negative personal consequences (e.g., experiencing a product's side effects) are required for experiencing health benefits, particularly for products that have been on the market for a long time (Kramer et al. 2012). Furthermore, intuitive beliefs about other product attributes, such as its perceptual properties, have also been shown to elicit various efficacy expectancies. The color of product packaging (Roullet and Droulers 2005) and the size, color, and form of medicines have been shown to affect efficacy inferences; capsules are perceived to be more efficacious than pills, and larger pills are perceived to be more efficacious than smaller ones perhaps due to a "bigger-is-better" lay theory (Buckalew and Coffield 1982; Buckalew and Ross 1991).

Importantly, this past work has focused almost exclusively on product- and firm-specific characteristics as determinants of perceived efficacy. However, people may hold naïve theories about how efficacy, and the duration thereof, "behaves" in light of other factors, such as the context in which consumption occurs. Moreover, extant research has largely studied various factors that affect inferences regarding general product efficacy. Although we do not contest that the study of general product efficacy is important, we propose that investigating other facets of efficacy may offer additional insight. Perceived product efficacy appears not to be a monolithic construct but rather to comprise several dimensions, including time to onset (Faro 2010), general efficacy (Kramer et al. 2012; Shiv et al. 2005; Wright et al. 2013), and duration of action, each with potentially unique antecedents and consequences. For example, whereas general product efficacy perceptions (i.e., "How powerful is this product?") may affect factors such as product evaluations, preference, choice, or decisions to consume a product in the first place, duration perceptions of product efficacy uniquely affect consumption frequency, or consumption quantity within a given time period. We suggest that duration judgments of product efficacy may be affected by factors that feature in people's naïve theories about duration of product efficacy and concurrent tasks. In this research, we focus on one such factor: the difficulty of the task for which the product is used.

Task Difficulty and Duration of Pharmacological Product Efficacy

Human cognition can be understood by viewing knowledge about biological, physical, and social processes as an organization of intuitive theories (Nisbett and Ross 1980). These intuitive theories often rely on knowledge about one domain to make sense of other less familiar domains. For instance, intuitive grasp of causal process in the physical environment later acts as a basis for reasoning about other domains, even when such generalizations may not be appropriate, leading people to believe in relationships which may not exist (Faro, McGill, and Hastie 2010; Griffiths and Tenenbaum 2009). We suggest that the proposed effect of task difficulty, with more difficult tasks being judged as leading to faster wear-off and shorter duration of efficacy, is an instance of such generalization. We believe that people hold a mental model according to which a substance they consume works as a counterforce to some contextual factors. As such, its efficacy is perceived not to be constant but instead determined by specific characteristics of the context—task difficulty in this case.

This mental model may have several sources or underpinnings. The first is people's naïve understanding of physical phenomena. Naïve physics entails an intuitive grasp of notions such as momentum and friction. For example, people learn or observe that an object that is parted with a causal force (e.g., a billiard ball that is hit with a cue) can have momentum and impact (e.g., make another ball move), but its force is subject to friction (McCloskey 1983). Importantly, people witness the effects of physical "action" and "counteraction" in a variety of other settings, including how automobiles burn gasoline more quickly when driving uphill (vs. downhill), how engine oil deteriorates more rapidly when vehicles perform "difficult" tasks (e.g., towing or routinely driving in severe weather conditions), and how noningested products (e.g., sunscreen, stain guard sprays, etc.) wear off—or lose their effectiveness at a faster rate —when encountering "opposition" (e.g., physical contact) from other sources. As noted, people generalize such notions from naïve physics and its daily applications to reason about other domains (Heider 1958). For instance, researchers have drawn a parallel between the notion of momentum from Newtonian physics and its psychological analogue in settings such as goal completion (e.g., writing a paper) and social relations (e.g., running a political campaign; Markman and Guenther 2007; see also Chae, Li, and Zhu 2013; Faro, McGill, and Hastie 2010). In a similar vein, if as we propose people view a substance as working to counter effects triggered by a task, task difficulty may be psychologically analogous to a physical source of friction. As a result, just as a greater source of friction would result in a quicker halt of a moving object, a product may be judged to lose its efficacy faster when faced with a difficult task.

A related source that may underlie the belief that the duration of product efficacy depends on task difficulty comes from naïve theories of biology (Siegal and Peterson 1999). Here an image of a battle is often employed in illustrations of the theory of the germ and other biological processes for children. The body's immune system or a medical substance is often shown "fighting" (sometimes literally with soldier characters) external forces such as viruses. The image of a battle suggests that the stronger the external threat or influence—or in our case the more difficult the task—the greater the challenge to the forces (internal or external) that counter it, and the faster they may lose their efficacy over time. Based on such intuitive grasp of biological processes, people may hold both accurate and inaccurate intuitions about biological processes involving "wear-off." For example, people may accurately intuit "wear-off" in the context of calorie expenditure and thirst/water loss (e.g., difficult workouts burn calories more quickly than easy workouts and people become thirsty more quickly during difficult physical tasks than easy ones). However, they may also inaccurately intuit "wear-off" in other contexts such as energy depletion (e.g., difficult cognitive tasks deplete glucose levels more rapidly than easy cognitive tasks; Kurzban 2010; Molden et al. 2012).

A final noteworthy idea linked to our prediction concerns people's expectancies that there would be resemblance in magnitude or size between a disease and the remedy to that disease (Rozin and Nemeroff 2002). Similarly, there is a general expectation that large-scale consequences arise from large causes (LeBoeuf and Norton 2010). Such reasoning may sometimes be appropriate but often is not. Big problems can have simple solutions (e.g., a simple prescription of washing hands solves many health problems; small nudges such as changing the default have a dramatic effect on donations and savings; Thaler and Sunstein 2008). And similarly, small and seemingly fragile causes can have dramatic effects (e.g., the relatively fragile HIV virus and the AIDS epidemic). Critically, this type of reasoning about problems and solutions may trigger inferences about aspects of the solution, including its duration of impact. In particular, if the problem the consumer is facing is big (i.e., difficult), it may be seen to require a big solution, and holding the size of the solution constant, the solution may be thought to wear off faster.

The sources we outlined for the mental model driving our predicted effect are theoretically interlinked. Physical and biological processes are basic types of relations that we observe and from which we generalize. Similarly, the expectation that diseases and remedies would resemble each other in magnitude is associated with primitive lay beliefs of transfer through physical contact and contagion (Rozin and Nemeroff 2002). Common to these is the idea that one force seems to counteract another force and is therefore bound to be affected by the features of the latter. This, we believe, is the core element that drives the effect of task difficulty on duration judgments of pharmacological product efficacy.

This mental model, which is based on phenomena and relationships inferred from various domains in which the relationship may hold, leads to a perceived negative correlation between task difficulty and duration of pharmacological substance efficacy: consumers will tend to judge the duration of pharmacological products' efficacy to be shorter when they perform difficult tasks rather than easy tasks. Further, we propose that people's mental model is one in which context affects the workings of the substance. Accordingly, we should see an effect of task difficulty on perceived duration of efficacy when this belief in context dependence is active but not when the belief in context dependence is challenged.

Finally, and more specifically testing the ideas of countering forces and wear-off, the effect will be pronounced for tasks that are perceived to work counter to the effect triggered by the product. When a task triggers conditions that are not perceived to work counter to the product, the predicted effect will be attenuated. For instance, consider an anxious person who is facing a difficult (or easy) task that may make him or her more anxious. The person takes a calming pill before the task. In this case, the difficulty of the task should affect duration judgments of product efficacy as we predict. If, however, the task does not make the person more anxious, its difficulty should not affect duration judgments. This is because the default mental model that we suggest underlies the effect is altered. In this case, the product and the task are not construed as working counter to each other and thus greater task difficulty should not cause faster wear-off. We test the predicted effect of task difficulty and the two moderating variables—beliefs in context dependence and substance-task relations—in our studies.

We focus on task difficulty as a contextual factor that can affect duration judgments of product efficacy for several reasons. First, it is a common variable in consumption settings. People perform some kind of activity during and after product consumption, and such activities fall on a spectrum from relatively strenuous to relatively effortless. For instance, as noted by the Red Bull example introduced earlier, energy drinks are advertised as appropriate for consumption during both strenuous activities and leisurely tasks. Task difficulty may also be interesting to examine because consumers' perceptions of task difficulty are known to be context dependent and highly malleable (Burson 2007). Thus, people's duration judgments of efficacy might be affected not only by actual but also by perceived difficulty, a possibility we test in our work. Perhaps most important, however, is the physiological fact that even if actual difficulty varies across consumption settings, the length of time a given product remains active and has impact is often not affected by such variation, especially when it comes to cognitive tasks. This suggests that, if duration judgments of product efficacy are affected by task difficulty, the resulting increased consumption for difficult tasks is unjustified. We next discuss the growing body of evidence that implicates duration of efficacy to be independent of concurrent tasks.

Task Difficulty and Metabolism of Ingested Substances

The length of time an ingested substance remains active—a function of its half-life, the amount of time over which the drug concentration decreases by one-half of its original value in the plasma—depends on physiological and pathological factors that affect (1) the volume of distribution and (2) the clearance of the substance; an increase in the volume of distribution or a decrease in clearance results in prolonged half-life (Baca and Golan 2012). Factors that affect the volume of distribution and clearance include age, weight, disease, and the level of enzymes in the liver necessary for metabolism of the substance (Baca and Golan 2012; Benowitz 1990; Chikhani and Hardman 2011; Juliano et al. 2009; Karan et al. 2009; Winston et al. 2005). Research shows that the biological half-life of caffeine, for example, varies by factors such as liver function, smoking, pregnancy, and concurrent medication (Benowitz 1990; Juliano et al. 2009); it does not depend on physical and/or cognitive activity. As such, many pharmaceutical products and the active ingredients in "functional" foods and beverages (Thomasson 2012) do not "work" as a function of concurrent tasks but depend primarily on individual-level factors.

Notably, however, glucose metabolism has been a source of debate in the literature. It was previously suggested that tasks that require exertion of mental effort (e.g., self-control) lead to energy depletion (e.g., decrease in glucose levels; Gailliot et al. 2007). However, a growing body of research now provides evidence that does not support the energy depletion model. That is, there appears to be no increased energy utilization during tasks that require more versus less cognitive effort (Clarke and Sokoloff 1999; Gibson 2007; Gibson and Green 2002; Lennie 2003; Kurzban 2010). Even very different computational tasks have been shown to yield very similar glucose consumption by the brain (Kurzban 2010). Most recently, in a series of experiments, Molden and colleagues (2012) demonstrated that exerting cognitive effort—performing tasks that require self-control or executive function—did not increase carbohydrate metabolization or reduce blood glucose (for a conceptual replication, see Sanders et al. 2012). In fact, depletion effects are now primarily attributed to motivation (Molden et al. 2012), lay theories of willpower (Job, Dweck, and Walton 2010), and people's perception of depletion (Clarkson et al. 2010) rather than to any actual metabolic or energetic changes. Thus, emerging research supports the idea that differences in cognitive exertion do not result in different levels of resource depletion, implying that consumption of products containing glucose should be unaffected by levels of concurrent cognitive task difficulty. Nonetheless, in our four studies with actual consumption, we control for energy depletion. We use products with a 30-minute onset time to control for actual metabolic changes during the experimental sessions; duration judgments of glucose-containing product efficacy after product consumption but prior to the product's onset time must be based exclusively on intuitive beliefs about such processes. Further, we manipulate not only actual but also perceived task difficulty.

OVERVIEW OF STUDIES

Across seven studies, we provide support for the proposed rapid wear-off bias with anticipatory, online, and retrospective duration judgments of pharmacological product efficacy. In the first set of studies, we establish the basic effect. In study 1, we administer a "belief questionnaire" to tap into consumers' beliefs about "wear-off" in various domains. In studies 2a–2c, we manipulate cognitive task difficulty in both naturalistic and controlled laboratory settings and gauge duration perceptions of product efficacy via actual consumption and retrospective time judgments. In the next set of studies, we provide support for the process driving the effect and, in doing so, shed light on potential mechanisms to debias consumers. We have proposed that the effect is driven by a mental model in which duration of product efficacy is perceived not to be constant but rather context dependent. We test this by directly manipulating participants' belief in context dependence (study 3) and by allowing participants to infer context dependence through commonly used manufacturers' intake instructions (study 4). The last study (study 5) delves more deeply into the underlying psychology and tests another critical element of the proposed mental model by varying the relation between the effect of the product and the effect of the task.

STUDY 1: EXPLORING "WEAR-OFF" BELIEFS IN A VARIETY OF DOMAINS

To provide preliminary evidence that (1) consumers hold an intuitive belief about substance wear-off as a function of concurrent task difficulty and (2) this belief is related to their experiences with—and beliefs about—various physical, biological, and other phenomena, we administered a belief questionnaire at Baruch College, City University of New York.

Fifty-six volunteers (41% female, M_{age} = 21.46) rated their agreement (1 = strongly disagree, 7 = strongly agree) with 4–5 statements in each of 10 categories tapping into beliefs about pharmacological substance wear-off, substance metabolism, energy depletion, similarity in magnitude, gasoline usage, calorie expenditure, thirst/water loss, engine oil deterioration, and wear-off of nonpharmacological products including stain guard/water repellent sprays and sunscreen. Sample items are included in column 1 of table 1; a complete list of items can be found in table A1 of the appendix, available online.

When comparing the mean responses for each category to the scales' midpoints, we find that with the exception of "similarity in magnitude" which failed to reach statistical significance, people hold strong and positive beliefs about each of the aforementioned phenomena (all $p < .05$; see col. 2 of table 1). Thus, it appears that people subscribe to a belief that concurrent task difficulty counteracts the workings of a consumed substance and that such substances are metabolized more rapidly in the wake of relatively difficult (vs. easy) tasks. Furthermore, in line with our theorizing, we find that all of the beliefs—including similarity in magnitude—are positively and significantly correlated with the wear-off belief proposed in the present research (all $p < .05$; see col. 3 of table 1). A complete correlation table can be found in table A2 of the appendix, available online. In the next set of studies, we explore how the intuitive belief

TABLE 1

STUDY 1: "WEAR-OFF" BELIEFS IN A VARIETY OF DOMAINS

Belief category (sample items)	*M* (SD) Comparison to scale midpoint	Pearson correlation (*r*)[a]
Pharmacological substance wear-off (α = .71) ("Substances [e.g., medicine, energy enhancers] wear off faster when a person performs challenging mental activities")	4.32 (1.14) $t = 2.08, p < .05$	1
Substance metabolism (α = .93) ("The body metabolizes substances faster when a person performs difficult tasks, including mental tasks")	4.48 (1.37) $t = 2.57, p = .01$	.61 $p < .001$
Energy depletion (α = .83) ("Difficult cognitive tasks deplete energy at a faster rate than easy cognitive tasks")	5.17 (1.10) $t = 7.90, p < .001$	.51 $p < .001$
Similarity in magnitude (α = .85) ("Difficult tasks require big solutions")	4.03 (1.40) $t = .14, p > .10$	.30 $p < .05$
Gasoline usage (α = .91) ("An automobile moving uphill burns gasoline more quickly than an automobile moving downhill")	5.18 (1.33) $t = 6.64, p < .001$	.29 $p < .05$
Calorie expenditure (α = .83) ("A difficult workout burns calories at a faster rate than an easy workout")	5.93 (.97) $t = 14.85, p < .001$	.39 $p < .005$
Thirst/water loss (α = .92) ("I become thirsty more quickly when working on a hard physical task than on an easy one")	5.94 (1.02) $t = 14.18, p < .001$	.40 $p < .005$
Engine oil deterioration (α = .93) ("Engine oil deteriorates more quickly when a vehicle regularly performs activities like carrying heavy objects or towing")	5.08 (1.17) $t = 6.90, p < .001$	.56 $p < .001$
Stain guard/water repellent wear-off (α = .89) ("Stain guard sprays [e.g., protector sprays used on carpets and fabrics, like furniture/upholestery, to repel stains] wear off more quickly in high traffic areas")	5.29 (1.05) $t = 9.27, p < .001$	.34 $p = .01$
Sunscreen wear-off (α = .89) ("In the summertime, sunscreen wears off at a faster rate when performing a difficult physical task than a relatively easy one")	5.11 (1.17) $t = 7.10, p < .001$	.36 $p < .01$

[a]Correlations with the "pharmacological substance wear-off" belief proposed in the present research.

about task-dependent substance wear-off manifests in duration judgments of pharmacological product efficacy and consumption frequency.

STUDIES 2A–2C: MANIPULATING COGNITIVE TASK DIFFICULTY

Study 2a: Cognitive Task in a Naturalistic Setting

In study 2a, we sought to explore whether the intuitive wear-off belief arises spontaneously and, if so, to gauge whether it manifests in actual consumption behavior. We used a naturalistic context for this study—a classroom—and manipulated task difficulty by staging an audio malfunction.

Method. Thirty-six undergraduate students at Baruch College, City University of New York (50% female, M_{age} = 22.00) taking the same marketing course but at different times (i.e., sessions) served as the sample in this study. These students were informed that they would receive course credit in return for their participation. We used a two level, single factor—easy versus difficult—between-subjects design.

All students were told that the primary purpose of the study was to evaluate a YouTube video entitled "Mark Zuckerberg's Profile: Bloomberg Game Changers" for potential incorporation into the marketing curriculum in future semesters. They were informed that they would see a 20-minute clip of this video and that it was important that they pay close attention to its content. In addition, we told participants that we were also interested in their evaluations of a product: Jelly Belly® Extreme Sport Beans®, caffeinated jelly beans formulated with carbohydrates, electrolytes, and vitamins B and C. Intake instructions that specify that the product should be consumed 30 minutes prior to activity were concealed with small labels on the back of the packets.

Participants were given a description of the product. They were told that the product is a short-term energy enhancer and though it is marketed as a source of energy during physical exercise (e.g., sports performance), the active ingredients stimulate energy in general, including mental energy. They read: "Mental energy helps sensory receptors process stimuli coming in through the five senses (e.g., sight, hearing, smell, etc.). Please eat the Sport Beans® as you wish during the video." Thus, we allowed participants to consume the product spontaneously—without directing attention to product wear-off—while they performed their "primary" task of watching the video. We did, however, include the aforementioned description of the product and its purpose; we wanted to establish that the product can be used during tasks such as those that participants were about to encounter, since such efficacious products are generally consumed for specific activities in the real world.

To manipulate difficulty, we staged an audio malfunction. Prior to the beginning of each session, we adjusted the audio system such that those in the easy condition were exposed to a relatively high, "normal" volume used in classrooms, whereas those in the difficult condition were exposed to a low, considerably more difficult to hear volume. Before beginning the video, those in the "difficult classroom" were told: "IT just came to check the audio system. Unfortunately, the audio system is malfunctioning. It might be difficult for you to hear. Please do your best to pay attention and follow what the characters are saying." Those in the "easy classroom" were told, "IT just came to check the audio system. The audio system is working perfectly, so it should be easy to hear. Please pay attention and follow what the characters are saying." After a 20-minute clip of the video, we distributed surveys.

In this study, we were interested in several variables related to duration of product efficacy. One of our main dependent variables was the quantity of Sport Beans® consumed during the length of the video. We collected the packet of Sport Beans® from each student and counted the number of Sport Beans® remaining. In addition, we asked, "For how many minutes did each Sport Bean® provide energy?" We also asked perceived frequency of consumption ("How often did you feel like you were consuming the Sport Beans®?"; 1 = Not often at all, 7 = Very often; note that unless otherwise specified, all items in this article were assessed on a similar 7-point scale with appropriately modified descriptors).

In line with our cover story that we were interested in general evaluations of the product, we administered a 10-item general efficacy scale ($\alpha = .95$, e.g., "How effective is this product?"). Table A3 of the appendix, available online, contains the complete list of items. To gauge another potential consequence—how much product participants would ask for in the future—we asked, "If you were to watch this video again, how many Sport Beans® would you request?"

We also asked participants to indicate their willingness to pay for the product by checking a box representing the quantity, ranging from $0.00 to $5.00 in $0.50 intervals. In addition, we inquired about purchase likelihood ("How likely are you to purchase Sport Beans® in the future?"), likelihood of using this product over another ("How likely are you to use Sport Beans® instead of another short-term energy enhancer in the future?"), perceived taste ("How tasty are the Sport Beans®?"), perceived attractiveness of the product and the package ("How attractive are the Sport Beans®?"; "How attractive is the packaging?") and how much they "like" the product.

Participants were then asked a two-item task evaluation scale ("How educational was the video?", "How useful was the video?", $\alpha = .84$), their affect toward the video ("How would you describe the video you watched?" 1 = Dull, 7 = Exciting, "How would you describe the video you watched?" 1 = Unpleasant, 7 = Pleasant, $\alpha = .64$) and how tired, energized, and alert they felt. We also asked several questions regarding perceived difficulty in hearing, which were combined into a composite measure and served a manipulation check ($\alpha = .87$): "How difficult was the video to understand?", "How difficult was it to understand the speakers?", "How difficult was it to hear the video?", and "How difficult was it to understand the content of the video?" In addition, we asked perceived difficulty in seeing ($\alpha = .72$): "How difficult was it to see the video?" (1 = Not difficult at all, 7 = Very difficult) and "How would you describe the video you watched?" (1 = Easy to watch, 7 = Difficult to watch). We asked participants to indicate their level of attention, motivation, involvement, engagement, and commitment to the task. Finally, they provided demographic information, supplied information on general use of energy-enhancing products, and responded to an open-ended question regarding what they thought the study was about.

Results. When asked the purpose of this study, no participants indicated awareness that the audio manipulation was intentional. Two students did not open the packet and consume any Sport Beans® during their session and were excluded from the analyses. An ANOVA on the composite perceived difficulty measure revealed a significant main effect of task difficulty, such that those in the difficult audio condition found it significantly more difficult to understand/process the video than those in the easy audio condition ($M_{difficult} = 4.90$ vs. $M_{easy} = 1.86$; $F(1, 32) = 63.14$, $p < .001$).

An ANCOVA on the actual consumption measure controlling for age, gender, and how often the participant uses energy enhancers revealed a significant main effect of task difficulty ($F(1, 29) = 4.30$, $p < .05$; note that these covariates are included in all analyses involving measures of actual consumption [i.e., intake frequency in studies 2a, 2b, and 3] since these variables were hypothesized to potentially affect consumption quantity). Those in the difficult audio condition consumed significantly more Sport Beans® ($M_{difficult} = 7.04$) during the video than those in easy audio condition ($M_{easy} = 3.01$). None of the covariates were significant (all $F < 1$) and hence were not included in subsequent analyses.

An ANOVA on the log transformed duration estimate revealed a marginally significant main effect of task difficulty, such that perceived duration of product efficacy was lower for those in the difficult audio condition than for those in the easy audio condition ($M_{difficult} = 4.22$ vs. $M_{easy} = 8.19$; $F(1, 32) = 3.10$, $p < .10$; means reported in minutes for ease of interpretation). Similarly, participants reported consuming Sport Beans® more frequently in the difficult condition than in the easy condition ($M_{difficult} = 3.72$ vs. $M_{easy} = 2.38$; $F(1, 32) = 4.12$, $p = .05$).

We asked participants how many Sport Beans® they would request if they were to watch this video again. One participant left this measure blank and, hence, was not included in the analysis. An ANOVA revealed that participants in the difficult audio condition would request significantly more Sport Beans® than those in the easy audio condition ($M_{difficult}$ = 7.11 vs. M_{easy} = 2.33; $F(1, 31) = 5.01$, $p < .05$).

We find no difference in perceived general efficacy between the difficult and easy audio conditions ($M_{difficult}$ = 3.37 vs. M_{easy} = 3.35; $F < 1$). Likewise, we find no difference in willingness to pay for a packet of Sport Beans® ($M_{difficult}$ = $1.17 vs. M_{easy} = $1.19; $F < 1$) and in purchase likelihood ($M_{difficult}$ = 1.89 vs. M_{easy} = 2.06; $F < 1$). Furthermore, we also find no significant difference in how likely participants are to use this product over another short-term energy enhancer ($M_{difficult}$ = 1.83 vs. M_{easy} = 2.69; $F(1, 32) = 2.47$, $p = .13$), perceived taste ($M_{difficult}$ = 4.33 vs. M_{easy} = 3.50; $F(1, 32) = 1.52$, $p = .23$), or attractiveness of the product ($M_{difficult}$ = 4.39 vs. M_{easy} = 3.88; $F < 1$) and the package ($M_{difficult}$ = 4.11 vs. M_{easy} = 3.88; $F < 1$). Interestingly, however, those in the difficult condition actually report liking the product more than those in the easy audio condition ($M_{difficult}$ = 4.11 vs. M_{easy} = 3.06; $F(1, 32) = 4.34$, $p < .05$).

There were no differences in the composite task evaluations measure or affect toward the video (all $F < 1$), how difficult participants thought it was to watch the video (p = .30), or how tired, energized, and alert they felt (all $F < 1$). Last, ANOVAs on attention paid to the task, engagement, involvement, motivation, and commitment to understanding the video revealed no significant effect of task difficulty (all $p > .38$).

Discussion. The results of study 2a demonstrate that the intuitive wear-off belief manifests in duration estimates and actual consumption: participants in the difficult task condition consumed the product more frequently than those in the easy task condition. Furthermore, we find no differences across conditions in perceptions of general product efficacy. It is perhaps thus not surprising that we also do not find differences in willingness to pay for the product and purchase likelihood. As such, it appears that task difficulty does not affect perceptions of product (in)effectiveness, in general, but rather uniquely affects duration perceptions of efficacy and intake frequency.

Study 2b: Cognitive Task in a Controlled Lab Setting

We conceptually replicate the aforementioned findings in study 2b (see the appendix, available online, for complete methodology and results). We administered a reading task in which we asked participants to identify vowels in passages with a degraded (vs. standard) font in the difficult (vs. easy) condition (Novemsky et al. 2007). Participants were given a packet of Sport Beans® and immediately before beginning the task, they were instructed to eat one and to press the [SPACE BAR] key. They were told to eat another Sport Bean® whenever they felt the effects wearing off and to press [SPACE BAR] each time they did so. DirectRT software was used to record how long participants worked on the task and how many Sport Beans® they consumed during the experiment.

Results of study 2b show that duration perceptions of product efficacy—measured by actual consumption and also by a four-item retrospective duration of product efficacy scale (e.g., "For how long did each Sport Bean® increase your mental acuity?")—were shorter in the difficult task condition than in the easy task condition. Furthermore, a factor analysis revealed that perceived duration of efficacy and perceived general efficacy indeed represent separate constructs; only the former, but not the latter, is affected by concurrent task difficulty. As speculated in the theoretical development, and empirically shown in studies 2a and 2b, there may be situations in which judgments of general product efficacy are equivalent across consumers, but judgments of efficacy duration differ.

Additionally, in study 2b we rule out affect experienced during the task (e.g., positive and negative mood, alertness, and fatigue) and general time-based inferences as potential alternative explanations for greater consumption in the difficult (vs. easy) condition. One additional potential explanation for greater consumption in the difficult (vs. easy) conditions, however, is that participants consumed more of the product because they felt that they did not have enough of the substance to cope with the task rather than experiencing faster product wear-off per se (e.g., "The Sport Bean® *didn't wear off*, but I probably need another one since the task is hard"). To further disentangle the subtle distinction between experiencing product wear-off and simply needing more, we conducted a follow-up experiment in which we control for total consumption. By having all participants consume a fixed amount of Sport Beans®, we aimed to test that the effect concerns rapid wear-off (i.e., shorter duration of product efficacy) rather than mere need for additional quantity.

Study 2c: Cognitive Task with Fixed Consumption

Method. Forty-eight participants at the Baruch College, City University of New York (50% female, M_{age} = 22.52) were recruited for the study in return for course credit. We used the same task materials as in study 2b; half of the participants were randomly assigned to the difficult task condition, in which they identified vowels in passages with a degraded font, whereas the other half performed the same task in a standard, easy-to-read font. However, rather than allowing consumption throughout the length of the task, each participant was given only five Sport Beans® and instructed to eat all of them before he/she began working on the task. In this way, we were able to control for the total amount available and consumed by each participant. If participants judge the duration of a fixed product quantity to be shorter while performing a more difficult task, this would show that the effect we examine indeed concerns product wear-off and duration of efficacy. This would also indicate that duration perceptions of product efficacy, rather than mere need for additional product, drives the greater overall consumption observed in previous studies.

After participants finished performing the task, they were asked to complete the four-item retrospective duration of product efficacy scale used in study 2b ($\alpha = .84$): "For how long did the Sport Beans® increase your mental acuity?", "How long-lasting is the product?", "How quickly did the effects of the Sport Beans® wear off?" (reverse coded), and "For how much time did the Sport Beans® enhance your performance?" They also completed scales to gauge perceived task difficulty ($\alpha = .91$), motivation, involvement, engagement, commitment, attention, perceived performance, and confidence in performance on the task. Finally, they provided demographic information and general use of energy-enhancing products.

Results. As expected, an ANOVA revealed a main effect of task difficulty such that participants rated working on the passages with adjusted font as more difficult ($M_{\text{difficult}} = 5.44$) than working on the passages with standard font ($M_{\text{easy}} = 2.24$; $F(1, 46) = 79.62$, $p < .001$).

Importantly, an ANOVA revealed a significant main effect of task difficulty on retrospective duration judgments of product efficacy ($F(1, 46) = 6.70$, $p = .01$). That is, duration judgments were shorter in the difficult font condition ($M_{\text{difficult}} = 2.52$) than in the easy, standard font condition ($M_{\text{easy}} = 3.40$). Age, gender, and how often the participant uses energy enhancers were not significant covariates when included in the model (all $F < 1$).

Furthermore, there were no differences in self-reported motivation, involvement, engagement, commitment, and attention (all $p > .16$). However, perceived performance was lower in the difficult font condition than in the easy font condition ($M_{\text{difficult}} = 4.54$ vs. $M_{\text{easy}} = 5.54$; $F(1, 46) = 6.58$, $p = .01$) and confidence in performance was marginally lower in the difficult font condition than in the easy font condition ($M_{\text{difficult}} = 4.63$ vs. $M_{\text{easy}} = 5.38$; $F(1, 46) = 3.73$, $p = .06$). Given that participants consumed a fixed (vs. different) amount of product, unlike in our previous two studies, analysis of actual task performance (number of vowels identified) across conditions would provide additional insight into the consequences of experienced product wear-off. One participant did not complete the task correctly and was excluded for this analysis. We divided the task (text that participants worked on) into three sections of approximately equal length (sec. 1 = 14 paragraphs; sec. 2 = 16 paragraphs; sec. 3 = 14 paragraphs), using each subsequent section as a proxy for time (e.g., time period 1, 2, and 3). While the difference in performance was marginally significant for section 1 ($M_{\text{difficult}} = 79.63\%$ vs. $M_{\text{easy}} = 86.19\%$; $F(1, 45) = 3.01$, $p = .09$), the difference was significant for section 2 ($M_{\text{difficult}} = 75.09\%$ vs. $M_{\text{easy}} = 87.44\%$; $F(1, 45) = 5.20$, $p < .05$) and for section 3 ($M_{\text{difficult}} = 70.56\%$ vs. $M_{\text{easy}} = 84.63\%$; $F(1, 45) = 5.64$, $p < .05$). In other words, the difference in task performance between those in the difficult and easy conditions increased over time, in line with the finding that those in the difficult condition reported experiencing product wear-off more quickly as the task progressed. This suggests that the rapid wear-off bias can also manifest in differential performance on a task.

Discussion. The results of this follow-up study suggest that, as hypothesized, consumers hold an intuitive belief that pharmacological products lose their effectiveness at a faster rate depending on concurrent task difficulty and report experiencing shorter duration of product efficacy in the wake of a difficult cognitive task. Thus, it appears that consumption frequency in studies 2a and 2b is driven by a naïve theory about product wear-off rather than by inferences about the overall quantity of a substance needed to perform a task. Overall, the first set of experiments provides support for the rapid wear-off bias and rules out several alternative accounts. The goal of the next set of experiments is twofold: to provide support for the process driving this effect and, in doing so, to shed light on potential mechanisms to debias consumers.

STUDY 3: DEBIASING CONSUMERS BY MANIPULATING THE BELIEF IN CONTEXT DEPENDENCE

The purpose of study 3 was to provide evidence that the effect we have shown is indeed contingent on the belief that duration of pharmacological product efficacy is context dependent. To do so, we directly manipulate the strength of the belief (e.g., Igou 2004; Mukhopadhyay and Johar 2005; Mukhopadhyay and Yeung 2010; Tsai and Zhao 2011). According to our account, the effect should persist when reinforcing the intuitive belief that duration of efficacy is "malleable" but should be attenuated when providing the counterbelief that duration of efficacy is "fixed."

In this study we also wanted to show that duration judgments of product efficacy are affected by mere perceptions of task difficulty, rather than by actual task difficulty. We thus kept the task completely constant across conditions: all participants performed the same reading comprehension task from a GMAT examination. We manipulated perceived difficulty by framing the upcoming task as difficult or as easy.

Method

Participants and Design. One hundred and ninety-seven participants at the London Business School (56% female, $M_{\text{age}} = 26.76$) completed the experiment in return for a payment of 5 British pounds (equivalent of about US\$8). Participants were randomly assigned to one of four conditions based on a 2 (perceived task difficulty: difficult vs. easy) × 2 (efficacy belief: malleable vs. fixed) between-subjects design.

Stimuli and Procedure. As in the previous studies, Jelly Belly® Sport Beans® served as the target product. We used a similar procedure to study 2b (detailed in the appendix, available online): before beginning the task, participants were instructed to open the packet of Sport Beans®, eat one, and press the [SPACE BAR]. The instructions also stated that to ensure a fair product evaluation, participants should continue eating the Sport Beans® as needed to experience the effects of the product throughout the entire study; they were told to eat another Sport Bean® whenever they felt the effects wearing off and to press [SPACE BAR] each time they did so. Participants were asked to work on the task in its entirety and to indicate completion by pressing the "S" key. DirectRT was used to record the key presses. Ostensibly to minimize distraction, we instructed participants to remove all mobile devices and watches during the experiment; we did so to ensure that participants relied on their own experience and impressions to make judgments about duration of product efficacy rather than relying on any external source.

Each task booklet contained 21 reading comprehension questions based on six reading passages (about social, physical, or biological sciences) taken from a Practice GMAT study guide. However, we included a "practice" reading comprehension passage with several questions before the 21 actual GMAT questions. Although seemingly part of the overall task, the "practice" passage was actually a manipulation of the efficacy belief. All participants read that many people believe that the amount of time a substance has an effect depends on the situation and context (e.g., allergy sufferers often report that the beneficial effects of their medication wear off more quickly with changes in humidity). Those in the malleable condition then read that researchers and medical professionals have evidence that supports such beliefs: the actual effectiveness of medication and other ingested products is typically malleable and that the ingredients found in such products remain active in the system for some time period but that time period depends on the context or the activities people engage in after consuming the product. Those in the fixed condition read that researchers and medical professionals have evidence that does not support such beliefs: the actual effectiveness of medication and other products is typically of fixed time length and that ingredients found in such products remain active in the system for a specific time period, regardless of the context or the activities people engage in after consuming the product. At the end of both passages, we included a concluding line that summarized the finding.

After participants answered the "practice questions" about this first passage, they then moved on to the actual task. At the top of the page, we included our difficulty manipulation. Those in the difficult condition saw: "Difficulty Rating: High" with a picture of four mountain-shaped icons shaded in with the notation "(4 out of 5)." Those in the easy condition saw: "Difficult Rating: Low" with a picture of two mountain-shaped icons shaded in with the notation "(2 out of 5)." The actual passages and questions were identical across conditions.

Measures. We measured perceived duration of product efficacy in two ways. First, we assessed the time participants spent on the task (the duration between the first [SPACE BAR] click and "S," indicating task completion) divided by the number of Sport Beans® consumed during that interval (as recorded by the [SPACE BAR] clicks). Second, we used the retrospective duration of product efficacy scale employed in studies 2b and 2c ($\alpha = .79$). Participants answered four items gauging the difficulty of the task as a manipulation check (e.g., "How difficult was it to do the tasks"; $\alpha = .87$) and indicated how motivated they were to be accurate, how well they thought they performed the task, how confident they were in their performance, and whether they remembered to eat the Sport Beans® when needed. They then provided demographic information and general use of energy-enhancing products.

Results

We excluded participants who consumed only the first, mandatory Sport Bean® ($n = 8$) given that we cannot accurately interpret perceived duration of product efficacy. That is, for these participants, we could not ascertain whether the product "stopped working" prior to task completion but subjects chose not to take another for various reasons, or if the Sport Bean® was still "working" after task completion. We also excluded participants who had missing data/incomprehensible key presses ($n = 5$) and participants whose responses were 3+ SD from the mean of the perceived duration of product efficacy measure ($n = 7$). We had 177 data points for subsequent analyses.

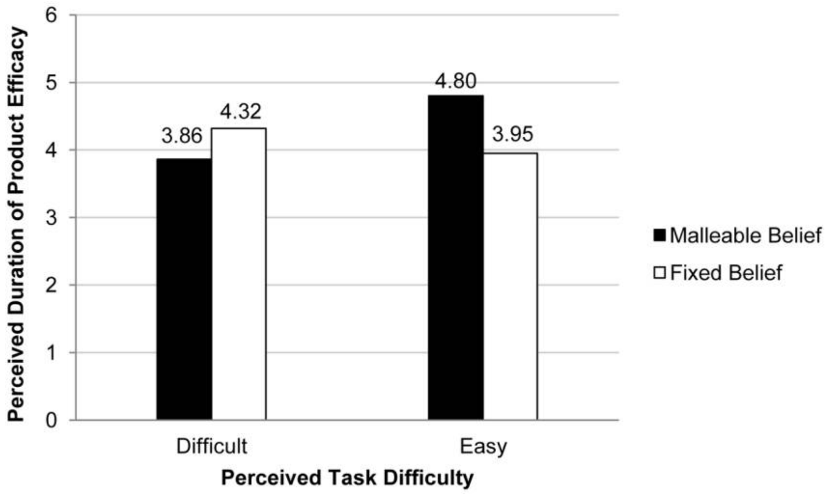
Manipulation Check. An ANOVA revealed a main effect of task difficulty such that participants in the difficult condition rated the GMAT questions as more difficult ($M_{difficult} = 5.05$) than those in the easy condition ($M_{easy} = 4.57$; $F(1, 173) = 5.89$, $p < .05$). Neither the main effect of efficacy belief nor the interaction was significant.

Duration of Product Efficacy. There was no difference in time spent (in minutes) on the task between the difficult and easy conditions ($M_{difficult} = 23.51$ vs. $M_{easy} = 24.71$; $F(1, 175) = 1.08$, $p = .30$). Age, gender, how often the participant uses energy enhancers and whether the participant remembered to eat the Sport Beans® when needed during the experiment were included as covariates; as predicted, an ANCOVA revealed a significant interaction between perceived task difficulty and efficacy belief ($F(1, 169) = 3.90$, $p < .05$). Contrast analysis indicated that in the malleable belief condition, perceived duration of product efficacy (in minutes) was shorter when the task was perceived as difficult ($M_{difficult} = 3.86$) than when it was perceived as easy ($M_{easy} = 4.80$; $F(1, 169) = 4.03$, $p < .05$; see fig. 1). However, in the fixed belief condition, there was no difference in perceived duration of product efficacy between the difficult and easy conditions ($F < 1$). Only age was a significant covariate and was retained in subsequent analyses ($F(1, 169) = 6.93$, $p < .01$). No other effects were significant.

Furthermore, an ANCOVA on the retrospective duration measure revealed a nonsignificant interaction of task difficulty and efficacy belief ($F(1, 172) = 2.02$, $p = .16$). Despite the

FIGURE 1

STUDY 3: THE EFFECTS OF EFFICACY BELIEF AND PERCEIVED TASK DIFFICULTY ON PERCEIVED DURATION OF PRODUCT EFFICACY



overall interaction not reaching significance, contrast analysis supports our theorizing. In the malleable belief condition, duration judgments were shorter when the task was perceived as difficult than when it was perceived as easy ($M_{difficult}$ = 2.82 vs. M_{easy} = 3.38; $F(1, 172) = 4.58$, $p < .05$), but in the fixed belief condition, there was no difference in duration judgments of product efficacy between the difficulty conditions ($M_{difficult}$ = 2.81 vs. M_{easy} = 2.84; $F < 1$). The difference between malleable and fixed efficacy beliefs was significant in the easy task condition ($F(1, 172) = 4.23$, $p < .05$) but not in the difficult task condition ($F < 1$). Age was not a significant covariate ($F < 1$).

Motivation, Perceived Performance, and Confidence. ANCOVAs revealed nonsignificant main effects of perceived difficulty and efficacy belief (all $F < 1$) and a nonsignificant interaction on the motivation measure ($F(1, 172) = 1.99$, $p = .16$), on the perceived performance measure ($F < 1$), and on the confidence measure ($F < 1$). Age was a significant covariate only for the motivation measure ($F(1, 172) = 4.58$, $p < .05$).

Discussion

In study 3, we show that consumers exhibit the rapid wear-off bias when the intuitive belief (i.e., belief in efficacy context dependence) is salient: duration judgments of product efficacy are shorter when consumers perceive performing a difficult task than an easy task. This replicates the pattern of results in the previous experiments and shows that mere perceptions of task difficulty drive the emanating duration inferences since we held the actual task constant. Further, and importantly, we show that the rapid wear-off bias is attenuated when the counterbelief (i.e., belief in efficacy context independence) is salient: the effect of task difficulty on duration judgments of product efficacy no longer persists. Thus, the counterbelief served as a debiasing mechanism. In this study, we directly manipulated participants' beliefs about whether the duration of efficacy depends on the context. In the next study, we allow participants to infer whether duration of efficacy may be malleable or fixed by varying intake instructions.

STUDY 4: DEBIASING CONSUMERS BY MANIPULATING INTAKE INSTRUCTIONS

Manufacturers often provide product intake instructions either in an absolute format (e.g., "Take one pill every 3 hours") or in an interval format (e.g., "Take one pill every 2–4 hours"). While the provision of intake instructions is done primarily to prevent overdosing, the presentation mode might yield differential duration inferences of product efficacy. Research suggests that people make inferences depending on the format in which information is conveyed. For example, prior research has shown that people respond differently to gain-framed and loss-framed messages (Cox, Cox, and Zimet 2006), frequency versus probability terms (Siegrist 1997), and verbal versus numerical information (Berry, Knapp, and Raynor 2002). We theorized that when a manufacturer's suggested intake frequency is expressed in interval terms (e.g. "Take one pill every 2–4 hours"), consumers might interpret this information as a signal that duration of product efficacy is malleable and context dependent. Consumers may show our focal effect and infer, for example, that duration of efficacy is closer to the lower end of the range when they perform difficult tasks and closer to the higher end when they perform relatively simple tasks.

However, when a manufacturer's suggested intake frequency is expressed in absolute terms (e.g. "Take one pill every 3 hours"), this information might elicit the fixed duration of efficacy belief and, in turn, not affect duration estimates depending on the nature of concurrent tasks. Thus, the goal of study 4 was to replicate the results of the previous study through a manipulation that taps a common manufacturer practice; that is, to identify a condition in which the proposed intuitive duration of product efficacy belief may be accentuated (or attenuated) in the marketplace. We chose a well-known OTC medication as the target stimulus: Advil®.

Method

Participants, Design, and Stimuli. One hundred and seventy participants at Baruch College, City University of New York (47% female, $M_{age} = 21.25$) volunteered to complete the questionnaire. They were randomly assigned to one of four conditions based on a 2 (task difficulty: difficult vs. easy) × 2 (suggested intake: interval vs. absolute) between-subjects design. All participants read a short scenario in which they were asked to imagine an upcoming day: "Imagine that you wake up in the morning with a strong, painful headache. It is the end of the semester and you have a full 10-hour day of classes ahead of you: from 9:00 AM to 7:00 PM. There is no way that you can be absent because you have to take exams in several classes."

Those in the difficult condition read: "You anticipate that all of these exams will be very difficult; the course material is very challenging." Those in the easy condition read: "You anticipate that all of these exams will be very easy; the course material is very simple." Participants in both the difficult and easy conditions then read: "You decide to take medication (see below) to help you get through the day. You take one pill before leaving home, and bring the bottle with you to school." Below the scenario was a statement about the manufacturer's suggested consumption instructions. Those in the interval (i.e., malleable duration of efficacy) condition read: "The intake instructions state: 'Take one pill orally every 2–4 hours, as needed.'" Those in the absolute (i.e., fixed duration of efficacy) condition read: "The intake instructions state: 'Take one pill orally every 3 hours, as needed.'" An image of the product was featured below the aforementioned text, followed by survey questions.

Measures. The main dependent variable for this study was a duration estimate of product efficacy. Participants indicated their response to the following question: "In hours and minutes, how long do you think each pill will work for you?" Furthermore, we asked participants to indicate how many pills they anticipate taking at school. They also indicated how much effort they would put into the exams to gauge motivation, how well they thought they would perform on the exams to gauge confidence, and how painful they imagined their headache to be. As a manipulation check, we asked, "How difficult did you imagine your exams to be?"

Results

Manipulation Check. An ANOVA revealed a main effect of task difficulty on the perceived difficulty measure ($F(1, 166) = 26.02$, $p < .001$), confirming our manipulation. That is, participants who were asked to imagine a day filled with difficult exams rated imagining the exams as significantly more difficult ($M_{difficult} = 5.81$) than those who were asked to imagine a day filled with easy exams ($M_{easy} = 4.77$). Neither the main effect of suggested intake instructions nor the interaction was significant.

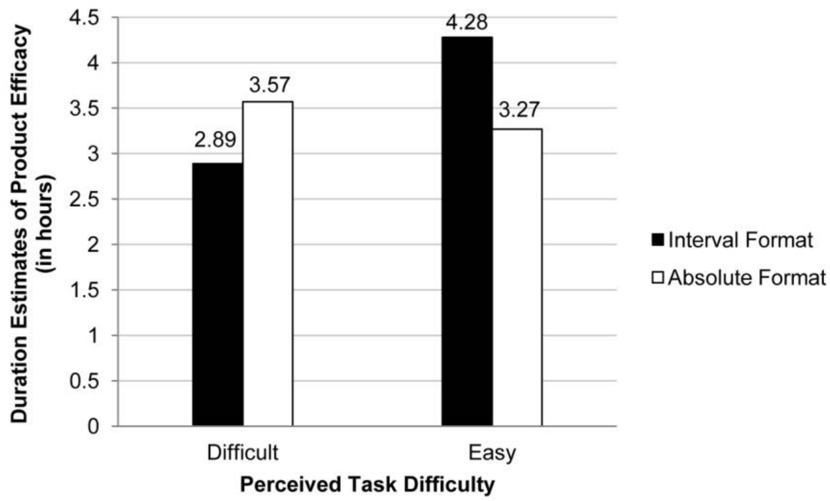
Duration of Product Efficacy. Duration judgments of product efficacy were measured by estimates, in hours and minutes, of how long each pill would work for participants. As predicted, an ANOVA on the log transformed duration measure revealed a significant interaction between perceived difficulty and suggested intake instructions ($F(1, 166) = 5.74$, $p < .05$). Contrast analysis indicated that when participants were given the suggested intake instructions in an interval format, duration estimates of product efficacy were shorter when the task was expected to be difficult ($M_{difficult} = 2.89$) than when it was expected to be easy ($M_{easy} = 4.28$; $F(1, 166) = 7.07$, $p < .01$; means reported in hours for ease of interpretation; see fig. 2). However, when participants were given the instructions in an absolute format, there was no difference in duration estimates of product efficacy between the difficult and easy conditions ($M_{difficult} = 3.57$ vs. $M_{easy} = 3.27$; $F < 1$). In the difficult task condition, the difference between the interval and absolute format conditions was significant ($F(1, 166) = 3.89$, $p = .05$). No other effects were significant.

Anticipated Future Consumption. Participants were asked to indicate how many pills they anticipate taking at school. An ANOVA revealed a marginally significant interaction between perceived difficulty and suggested intake instructions ($F(1, 166) = 3.34$, $p = .07$). Contrast analysis showed that when participants were given the 2–4-hour interval (i.e., the malleable condition), they anticipated taking more pills when the task was expected to be difficult ($M_{difficult} = 2.30$) than when it was expected to be easy ($M_{easy} = 1.66$; $F(1, 166) = 4.86$, $p < .05$). However, when participants were given a specific duration of product efficacy (i.e. the fixed condition), there was no difference in the number of pills they anticipated taking between the difficult and easy conditions ($M_{difficult} = 1.93$ vs. $M_{easy} = 2.05$; $F < 1$). No other effects were significant.

Other Task-Related Measures. ANOVAs revealed a nonsignificant interaction between task difficulty and intake instructions on the motivation measure ($F < 1$) and on the confidence measure ($F(1, 166) = 1.97$, $p = .16$). There was also no difference between conditions in how painful participants imagined their headache to be ($F < 1$).

FIGURE 2

STUDY 4: THE EFFECTS OF THE MANUFACTURER'S SUGGESTED INTAKE FORMAT AND TASK DIFFICULTY ON DURATION ESTIMATES OF PRODUCT EFFICACY



Discussion

In study 4, we corroborate our findings that consumers infer duration of pharmacological product efficacy to be shorter (vs. longer) when they expect to perform a concurrent task that is difficult (vs. easy). Using a non-energy-enhancing product (i.e., medication), we show that this intuition is prevalent across different product categories. We also identify an environmental cue by which the intuitive belief in context dependence can be accentuated (or attenuated): product intake instructions. We find that the interval format elicits the rapid wear-off bias whereas the absolute format attenuates it.

Together, studies 3 and 4 demonstrate conditions under which the effect of task difficulty is likely to arise and potential mechanisms to debias consumers. The observed effect of task difficulty persists when consumers are cued to the notion that duration of product efficacy may be context dependent. Marketing-related factors like advertisements that emphasize usage during activities that vary in level of difficulty (e.g., strenuous activity vs. leisure) may reinforce the intuitive belief. Likewise, consumption instructions presented in an interval format may also reinforce the rapid wear-off bias. When the notion of context dependence is put into question, however, the rapid wear-off bias is attenuated. Thus, providing explicit information about duration of product efficacy via advertisements and product labeling, and providing consumption instructions in an absolute format may be potential means of mitigating the effect and debiasing consumers.

We have so far demonstrated that context dependence is a central element of our proposed mental model. Another critical element of the mental model is the notion that one force (the substance consumed) is opposing another (the task) and as a result, is wearing off. To test this aspect of the model, in the next study we manipulate the relationship between the effect of the substance and the effect of the task, making them work counter to each other or not. We expected the effect of task difficulty on duration judgments to persist when the respective effects of the substance and task work counter to each other, but to be muted when they do not.

STUDY 5: MANIPULATING (COUNTER)ACTION

In this study, we use another product—Similasan, a homeopathic anti-anxiety medication sold in major US drugstores—and delve more deeply into the underlying psychology driving our effects. We hypothesized that if the task performed after product consumption is construed as working in opposition to the product (i.e., the task itself is stressful), then we would observe the effect documented in our previous studies. However, if the task performed after consumption of this product is not construed as working in opposition to the product (i.e., the task itself is calming), the effect of task difficulty would be attenuated.

Method

Participants, Design, and Stimuli. Seventy-seven participants at Baruch College, City University of New York (64% female, $M_{age} = 22.82$) were recruited for the study in return for course credit. They were randomly assigned to one of four conditions based on a 2 (task difficulty: difficult vs. easy) × 2 (type of task: stressful vs. calming) between-subjects design. All participants read a short scenario: "Imagine that you are an actor. Today, you wake up in the morning feeling anxious. You have been experiencing anxiety and restlessness lately and decide to take some medicine before work. You have play rehearsal all day (9:00 am–5:00 pm)."

Then, those in the stressful task condition read, "You find rehearsing your lines to be stressful" whereas those in the calming task condition read, "You find rehearsing your lines to be calming." We then manipulated task difficulty; those in the difficult task condition read, "In this particular role, your lines are very difficult" whereas those in the easy task condition read, "In this particular role, your lines are very easy." Subsequently, all participants read, "You decide to take some medicine before rehearsal. Similasan is a homeopathic remedy that soothes and calms anxiety. The usage directions say to dispense 7 drops, place in the mouth, and allow to dissolve without swallowing. You consume the 7 drops." An image of the product—"Similasan Anxiety Relief"—was featured below the text.

Measures. The main dependent variable for study 5 was anticipated duration of product efficacy, measured by the four-item scale used in the previous studies but slightly modified for the target product ($\alpha = .70$): "For how long do you think this product will relieve your anxiety?", "After you take the first seven drops of Similasan, how long do you think you will be stress and anxiety-free?", "How long-lasting do you think this product will be?" and "How quickly do you think the effects of the drops will wear off?" (reverse coded).

Afterward, participants completed several manipulation checks. They rated perceived stressfulness of the task on two items, "How much stress and anxiety did you imagine having from rehearsing?" and "How stressful did you imagine rehearsing to be?" ($\alpha = .89$). They also completed items gauging perceived task difficulty: "How difficult did you imagine your lines in the play to be?" and "How challenging did you imagine your lines in the play to be?" ($\alpha = .90$). Last, participants indicated how familiar they were with the product, how often they consume products that reduce stress and anxiety, how much they would be willing to pay for the given product, and they provided demographic information.

Results

Manipulation Checks. An ANOVA revealed a significant main effect of the task difficultly manipulation on imagined task difficulty ($F(1, 73) = 15.68, p < .001$). Participants in the difficult condition imagined the task to be significantly more difficult than those in the easy task condition ($M_{difficult} = 5.13$ vs. $M_{easy} = 3.80$). There was neither an effect of type of task, nor an interaction effect, on this variable (all $p > .23$). Similarly, there was a significant effect of type of task on imagined task stressfulness ($F(1, 73) = 6.76, p = .01$). Participants in the stressful condition imagined the task to be significantly more stressful than those in the calming condition ($M_{stressful} = 5.33$ vs. $M_{calming} = 4.46$). However, there was neither an effect of the task difficulty manipulation, nor an interaction effect, on this variable (all $p > .16$).

Duration of Product Efficacy. An ANOVA on the perceived duration of product efficacy scale revealed a significant main effect of task difficulty ($F(1, 73) = 15.44, p < .001$), a significant main effect of type of task ($F(1, 73) = 6.14, p < .05$), and a significant interaction between the two variables ($F(1, 73) = 4.34, p < .05$). Contrast analysis indicated that when participants imagined the task to work counter to the product (i.e., in the stressful task condition), perceived duration was shorter when the task was expected to be difficult ($M_{difficult} = 3.04$) than when it was expected to be easy ($M_{easy} = 4.24$; $F(1, 73) = 18.30, p < .001$; see fig. 3). However, when participants did not imagine the task to work counter to the product (i.e., in the calming task condition), the effect of task difficulty was attenuated, with the means no longer being significantly different ($M_{difficult} = 3.95$ vs. $M_{easy} = 4.32$; $F(1, 73) = 1.68, p = .20$). Further contrast analysis revealed a significant difference between the stressful and calming task conditions in the difficult task condition ($M_{stressful} = 3.04$ vs. $M_{calming} = 3.95$; $F(1, 73) = 10.54, p < .005$), but not in the easy task condition ($M_{stressful} = 4.24$ vs. $M_{calming} = 4.32$; $F < 1$).

Other Measures. There were no main or interaction effects on familiarity with the given product, or usage of products that reduce stress and anxiety (all $p > .18$). Furthermore, there were neither main effects of task difficulty and type of task, nor an interaction, on willingness to pay for the product (all $F < 1$).

Discussion

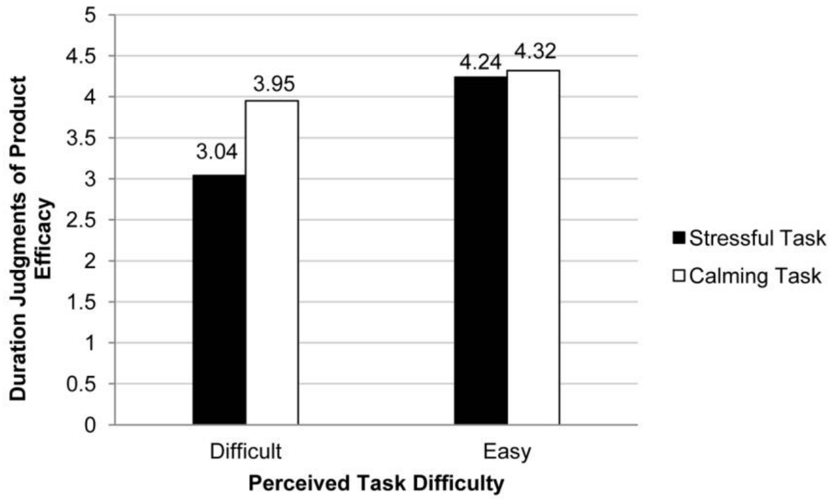
In this study, we provide further support for the underlying psychology of the documented effect of task difficulty on perceived duration of product efficacy. In line with the mental model that we have proposed, the concurrent task must be construed as working in opposition to the product. If, instead, the task is seen as working in the "same direction" as the product—thereby lessening the perceived counteraction—we find that duration perceptions of product efficacy do not vary significantly as a function of the task's difficulty level.

GENERAL DISCUSSION

Across seven studies, we show that perceived duration of pharmacological product efficacy—anticipatory, online, and retrospective—is based on the difficulty of activities consumers perform during and after product consumption. In study 1, we show that consumers hold an intuitive belief that consumed substances wear off as a function of concurrent task difficulty and that this belief is related to their experiences with—and beliefs about—various physical, biological, and other phenomena. In studies 2a–2c we provide evidence of the rapid wear-off bias: consumers report feeling the effects of a product for a shorter duration—and increase consumption frequency—when a concurrent cognitive task

FIGURE 3

STUDY 5: THE EFFECTS OF TYPE OF TASK AND TASK DIFFICULTY ON DURATION JUDGMENTS OF PRODUCT EFFICACY



is relatively difficult (vs. easy). We find evidence of this bias in a naturalistic setting (study 2a) and replicate the effects in a controlled laboratory experiment (study 2b, detailed in the appendix, available online). In study 2c, we demonstrate that task difficulty indeed affects perceptions of how quickly a product wears off rather than mere need for more product. The next three studies provide support for the process driving this effect. As theorized, the effect is driven by a mental model in which duration of product efficacy is perceived to be context dependent. We tested this by directly manipulating participants' belief in context dependence (study 3) and by allowing participants to infer context dependence through commonly used manufacturers' intake instructions (study 4). The last study (study 5) delved more deeply into the underlying psychology and tested another element of the proposed mental model: substance-task relations. We find that the effect of task difficulty obtains only when there is perceived opposition between the task and the product, and is attenuated when there is no perceived counteraction.

Theoretical and Substantive Contributions

Our findings make several theoretical contributions. Prior research has focused almost exclusively on general product efficacy (e.g., Kramer et al. 2012; Shiv et al. 2005; Wright et al. 2013). In the present research, we introduce a previously unexplored variable: perceived duration of product efficacy. We find that consumers hold an intuitive belief that duration of efficacy is dependent on the difficulty level of the tasks they perform, such that relatively more difficult concurrent tasks lead to shorter duration. By demonstrating that concurrent tasks affect duration judgments, we identify a critical input in consumers' product inference making. Furthermore, we suggest that this work adds to extant research on placebo and placebo-like effects. Researchers from diverse fields have documented the extraordinary effects of expectancies on well-being and performance for both traditional (inert) placebos (Stewart-Williams and Podd 2004) and products containing active ingredients which should not yield differential efficacy (e.g., energy drink efficacy depending on price; Shiv et al. 2005). In the present research, we uniquely document a condition when substances' efficacy appears to come to a halt.

This research has implications for actual consumption behavior. Given that duration estimates of product efficacy ultimately relate to intake frequency, excessive consumption or inadequate intake of beneficial products may result in negative and potentially injurious health effects for consumers in both the short and long term. While we do not study over- or underconsumption per se, biased duration judgments of efficacy may affect misuse of pharmacological products. The World Health Organization (WHO) estimates that globally only about half of consumers take their medicines as prescribed, translating into 125,000 annual deaths in the United States alone (Loden and Schooler 2000). Moreover, almost half of US adults take at least one over-the-counter (OTC) medication on a regular basis, and research has shown that nearly a quarter are likely to overdose unintentionally due to a misunderstanding of the active ingredients and proper instructions (Wolf, Di Francesco, and McCarthy 2012). Indeed, misuse of pharmacological products among consumers of all ages is a major public health concern; teenagers are routinely misusing pain relievers, caffeine medicines, and diet pills. They are largely ignorant about the complications, such as liver or kidney failure and cardiac risks, associated with large doses of medicines containing acetaminophen and ibuprofen (Cohen 2013). News reports have highlighted that the several cups of coffee a person might have throughout the day may be "nothing compared to what some teenagers are consuming to deal with schoolwork" (Fox and Carroll 2012). Given that people consume a variety of pharmacological products to "deal with" a variety of tasks—a case where context is particularly salient—it becomes crucial to educate consumers about efficacy-context independence for many activities (e.g., schoolwork) to limit overuse. Interventions to mitigate the rapid wear-off bias are thus key; studies 3 and 4 of the present research offer evidence-based prescriptions for debiasing consumers.

We suggest that this research also has significant implications for pharmaceutical marketers and food and beverage companies entering the market of "functional foods" (Thomasson 2012). Successful performance in this domain requires that consumers realize the expected benefits of a product; ensuring proper consumption frequency becomes crucial. Both verbal and visual cues about consumption contexts that accompany product-specific information in marketing communications are likely to elicit the rapid wear-off bias. As such, we propose that product labeling that elicits accurate duration expectations of product efficacy (e.g., absolute vs. interval format intake instructions), along with advertising claims that convey duration of efficacy "fixedness" and reinforce the driving factors of efficacy (e.g., individual-level factors) may be beneficial for such firms.

Directions for Future Research

The purpose of the present research was to study a previously unexplored dimension of efficacy: perceived duration of product efficacy. Perceived duration of efficacy has unique antecedents (i.e., consumption context, namely, concurrent task difficulty and the moderators we identified) and consequences (i.e., consumption frequency). Indeed, the results of study 2a and 2b—which provide support for our conceptualization of duration of efficacy as distinct from general efficacy—reinforce that perceived duration of product efficacy is important to both acknowledge and measure. We find a situation in which judgments of general product efficacy are equivalent across consumers but perceptions of duration differ. Although beyond the scope of the present research, an exploration of conditions under which perceptions of general efficacy and duration perceptions of efficacy covary, and conditions under which they diverge, would contribute to our understanding of consumers' perceptions of pharmacological product efficacy. That is, a fruitful avenue for future research would be to delineate situations when perceived duration of efficacy and general efficacy exhibit similar (vs. different) patterns and to investigate the relationship between these and other efficacy dimensions (e.g., time to onset; Faro 2010).

We believe that future research would also benefit from the identification of other antecedents of duration judgments of product efficacy. Would previously documented antecedents of general efficacy, such as marketing variables, also affect duration judgments of product efficacy? Might a discounted energy drink (Shiv et al. 2005) affect not only general efficacy expectancies but also expectancies of efficacy duration? Further, future research may also address moderating factors of our effect, including product experience, expertise, and individual differences such as people's implicit theories about willpower (Job, Dweck, and Walton 2010). It would also be interesting to delineate which pharmacological products—perhaps those that vary in their results' visibility or tangibility (e.g., energy boost vs. elimination of an observable rash)—and which nonpharmacological products are more (vs. less) likely to yield the documented effect. Finally, research has shown that people's evaluations of experiences differ depending on whether tasks are continuous or partitioned (Ariely and Zauberman 2000, 2003; Nelson and Meyvis 2008). Would people make different duration estimates of efficacy if explicitly given breaks during the task, or if they consumed the product only during breaks? Extension of the current work as tasks progress over a longer period of time, either segmented or continuously, would provide insight into the larger research question.

Whereas many factors that affect perceived efficacy are at least in part controllable by marketers, such as a product's price and perceptual properties, the consumption context is rarely, if ever, one such factor. Consequently, educating consumers—via advertisement, product labeling, or public policy initiatives including public service announcements—about the driving factors of duration of product efficacy becomes crucial. We suggest that accurate information about, and use of, pharmacological products benefits many constituents of the value chain, from marketers to end users. For the former, consumers' satisfaction from witnessing the beneficial effects of the product inevitably corresponds to downstream effects such as increased sales, brand loyalty, and positive word of mouth. For the latter, making valid duration judgments of efficacy allows for proper consumption frequency which, in turn, directly affects health and well-being.

DATA COLLECTION INFORMATION

The data for studies 1, 2a–2c, 4, and 5 were collected at Baruch College, City University of New York, between spring 2011 and spring 2014. These data were collected primarily by the first author in the marketing lab at the university; the second author visited the laboratory on several occasions to supervise the data collection. Study 3 was collected during the summer of 2011 at the London Business School by a research assistant under the supervision of the third author. These data were analyzed independently by the first author and jointly by the first and second authors.

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