PLACEBOS AFFECT RETROSPECTIVE AND PROSPECTIVE MEMORY PERFORMANCE BY INCREASING MONITORING

by

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Abstract

Decreasing physical pain, increasing emotional wellbeing, and improving physical health are just some of the ways placebos have affected people's physiological and psychological health (Crum & Langer, 2007; Kirsch & Sapirstein, 1999; Montgomery & Kirsch, 1997). Recently, Clifasefi, Garry, Harper, Sharman, and Sutherland (2007) demonstrated that a memory placebo called R273 could even reduce people's susceptibility to misleading information. Yet how could a substance with no physiologically active properties affect memory performance? That is the overarching question of this thesis.

In order to monitor the sources of information about the past, and in order to remember future tasks and actions, people can either use an effortful monitoring process, or they can rely on their usual, automatic and effortless memory processes. Typically, the more monitoring that people use, the better their memory performance (Johnson, Hashtroudi, & Lindsay, 1993; Einstein et al., 2005). In this thesis, over three experiments, I examined how a placebo might affect the way people monitor information, thus improving aspects of retrospective and prospective memory.

Experiment 1 examined whether R273 reduces people's susceptibility to the misinformation effect by leading them to switch from their habitual, automatic, and easy source monitoring to more deliberate and effortful source monitoring. To examine this question I used Clifasefi et al.'s (2007) sham drug procedure and then ran subjects through a three-stage misinformation experiment (Loftus, Miller, & Burns, 1978). The results of Experiments 1 suggest that R273 did not affect effortful monitoring during the post event information (PEI), but did affect effortful monitoring during the memory test.

Experiment 2 aimed to find further evidence that R273 affects people's monitoring during the memory test. To address this question, all subjects were told that they had received an inactive drug before they took part in the first two stages of the misinformation effect paradigm. Immediately before taking the memory test, however, I falsely told some people that they had actually received R273. The primary finding of Experiment 2 added support to the idea that R273 affects subjects source monitoring during the memory test: Told Drug subjects were less misled than their Told Inactive counterparts.

Finally, Experiment 3 further examined whether R273 leads people to use effortful monitoring, but did so using a prospective memory task, whose underlying memory processes align closely with those of source monitoring. The results showed that Told Drug subjects were slower to perform an ongoing and concurrent task, yet had better prospective memory performance than Told Inactive subjects. These results suggested that R273 lead Told Drug subjects' to use more effortful monitoring.

In conclusion, the results suggest that the sham cognitive enhancing placebo R273 improves people's ability to resist misleading suggestion, and perform prospective memory tasks because it leads them to use more effortful monitoring.

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I truly believed that writing this acknowledgements section would be one of the easiest parts of my PhD. Unfortunately, as I stare at the blank page and blinking cursor in front of me I realise I was wrong. I am suddenly struck by how many people have helped me get to where I am today, and how there just aren't enough words to convey how grateful I am.

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Chapter 1

Placebos and Memory

The ability of an inert substance to produce genuine physiological or psychological changes demonstrates the perplexing phenomena of the placebo effect (Kirsch, 1985; 1997; Marlatt & Rohsenow, 1980; Stewart-Williams, 2004; Stewart-Williams & Podd, 2004). Yet as puzzling as the placebo effect may be, it is robust: administered in a variety of guises placebos have been able to soothe nasty coughs, lead us to engage in behaviours we may otherwise keep to ourselves, and even aid weight loss (Cheong & Nagoshi, 1999; Crum & Langer, 2007; Eccles, 2002; 2006).

Yet the notion of using placebos for treatment, healing and enhancement is far from new. According to Shapiro and Shapiro (1997a), "the history of medicine is essentially the history of the placebo effect" (p.13). Evidence suggests that ancient civilisations—including the Assyrians, Greeks and Egyptians—possessed over 4000 "drugs" to treat a range of maladies. With only a handful of exceptions, however, the majority of these drugs were placebos (Shapiro & Shapiro, 1997a, 1997b).

In the 16th and 17th centuries the medical landscape was much the same. The English, French and German pharmacopoeias listed an extensive collection of nauseating and stomach churning treatments such as perspiration, human placenta and the saliva of a fasting man (Shapiro & Shapiro, 1997a). Even during the 1930s and 1940s, according to Spiro (1997) the use of placebos for medical treatment was still prominent. Physicians regularly administered placebos to patients in order to placate them, and this practice was not only viewed as ethical, but was encouraged. Drug

catalogues sold pills labelled as placebos and actively marketed some of them as having the ability to "perk up anyone who just read the label" p.39).

Today, according to a recent survey by Tilburt, Emanuel, Kaptchuk and Curlin (2008), physicians still regularly administer placebos to their patients: a survey of 679 physicians found that approximately 50% administer placebos on a regular basis while 62% believe that the practice of administering placebos is ethical. However, placebos now play a part in more than just a medical setting. They have established themselves as vital agents of control in clinical drug trials and are recognised as complex psychological phenomena worthy of study in their own right (Kirsch, 1999; Marlatt & Rohsenow, 1980; Price, Finniss & Benedetti, 2008). For example, two comprehensive meta-analytic studies by Kirsch and colleagues show that placebos are powerful agents in reducing depression (Kirsch & Sapirstein, 1999; Kirsch et al., 2008). In the most recent of these studies, Kirsch et al. (2008) conducted a meta-analysis on a class of selective serotonin reuptake inhibitors (SSRIs)—the new generation of antidepressants. Under the Freedom of Information Act, Kirsch et al. obtained data on all clinical trials between 1987 and 1999 submitted to the Food and Drug Administration (FDA), including some that were previously unpublished due to inconclusive or null results. Overall, Kirsch et al. found that the benefit of the antidepressants over placebos did not meet the necessary criteria of clinical significance as laid out by the UK's National Institute of Clinical Excellence (either a three point difference in depression score on the Hamilton Rating Scale for Depression, or a standardised mean difference in effectiveness between placebo and antidepressant treatments of at least .50).

Thus, recent research suggests that the placebo effect is a modern day, real-world phenomenon. As such, the majority of psychological research on the placebo

effect has addressed why a substance that possesses no active or physiological powers can alter and affect such a vast range of behaviours.

Theoretical Underpinnings: What causes the placebo effect?

While many theories attempt to account for the placebo effect—most beyond the scope of this thesis—the two leading explanations in the placebo literature are *conditioning theory* and *expectancy theory* (Ader, 1997; Kirsch, 1997; 1999, Stewart-Williams & Podd, 2004).

Conditioning Theory

The conditioning account of the placebo effect draws heavily on some of the basic premises of classical conditioning, and provides compelling evidence as to how placebos produce physiological responses in humans and animals, which mimic those of an active drug.

The central tenet of classical conditioning is that people and animals demonstrate reflexive unconditioned responses (UR) to certain unconditioned stimuli (US). For example, some people may suffer skin irritation (UR) when they eat peanuts (US). Yet if an UR and US are repeatedly paired, otherwise neutral stimuli—such as the packaging that the peanuts come in—can also become associated with the UR and US. Subsequently, neutral stimuli become conditioned stimuli (CS) when they are able to produce responses that mimic those of the UR (irritation). The response produced by the CS is the conditioned response (CR). Thus, early accounts of classical conditioning viewed it as occurring through the continuous parings of stimuli that were presented together at the same time (temporal contiguity), and the strength of the effect was thought to be a function of the number of times the CS and the US were paired (Stewart-Williams & Podd, 2004).

In classical conditioning terms, the placebo effect occurs because people learn to associate the pharmacologically active treatment (the US) and its pharmacological effects (the UR) with neutral stimuli. For example, it has been suggested that features of active medical treatments such as pill casing, taste, or even the sight of a syringe may become paired with the US (Ader, 1997; Stewart-Williams & Podd, 2004; Wickramasekera, 1980). If a strong association between the US and the neutral stimuli is formed, the neutral stimuli may elicit a similar response to the active medication.

Much of the classical conditioning research on the placebo effect comes from the animal literature (Ader, 1997; Stewart-Williams & Podd, 2004). A range of studies from the 1970s and 1980s show that under placebo administration, animals display behavioural and physiological changes that mimic the effects of active drugs (Pihl & Altmas, 1971; Ader & Cohen, 1975; Numan et al., 1975; Michel & Tirelli, 2002). For example, Ader and Cohen (1975) paired a sugar solution with an immunosuppressant. After a number of pairings, the sugar solution alone decreased the rat's immune responses. Similarly, Numan et al. (1975) repeatedly injected rats with morphine but paired the morphine injections with a tone. When they stopped giving morphine to the rats, the rats experienced withdrawal symptoms. Yet, Numan et al. found that presenting the tone reduced their withdrawal symptoms.

Likewise, research using human subjects suggests that conditioning might explain why people who take placebos report less pain, fewer symptoms of schizophrenia, and the stimulating effects of caffeine (Voudouri, Peck, & Coleman, 1985; Greenberg & Roth, 1966; Knowles, 1963). For example, in a series of studies by Voudouris and colleagues, people learned to respond to a placebo analgesic (Voudouris et al., 1985; 1989; 1990). Voudouris et al. administered uncomfortable stimulations using

an iontophoretic pain generator. The generator drives ions into the skils causing a prickling sensations at lower levels of stimulation and a cramping sensation at higher intensities. Voudourise paired the shocks with a placebo analgesic cream. Over a number of trials, Voudouris et al. surreptitiously reduced the intensity of the shocks, giving subjects the impression that the cream was effective. Finally, when Voudouris et al. reinstated the shocks to their original intensity, subjects reported less pain when the placebo cream was applied (Voudouris et al., 1985; 1989; 1990).

While the classical conditioning account provides a compelling explanation of placebo effects in animals, and some placebo effects in humans, more modern approaches view it less as an automatic, non-cognitive process, and one which can be mediated and influenced by cognitions, beliefs and desires (Montgomery & Kirsch, 1997; Rescorla, 1988; Stewart-Williams & Podd, 2004). For example, Montgomery and Kirsch (1997) examined whether Voudouris et al.'s (1985) placebo analgesic effect—a heavily cited example of classical conditioning in humans—was mediated by subjects' beliefs that the analgesic cream would reduce their pain. In a early account of classical conditioning and the placebo effect, beliefs should not matter; simply administering the cream and reducing the intensity of the shocks over trials should result in subjects' forming an association between the cream and decreased pain. But, Montgomery and Kirsch reasoned that if people were informed that the pain was being reduced, it would eliminate the effectiveness of the placebo cream. That is what they found: telling some subjects about the lowering of the shock intensity eliminated the conditioning, and thus the placebo effect.

Furthermore, some studies show placebo responses that work in the opposite direction of the conditioned response. For example, the pharmacological effect of

alcohol is to decrease sexual arousal, yet when given placebo alcohol, people tend to report increased sexual arousal—a response opposite to what a conditioned response should be (Fillmore & Vogel-Sprott, 1992; Hull & Bond, 1986, Kirsch & Weixel, 1988; Kirsch, 1985). Perhaps, some have speculated, these kinds of opposite responses are evidence of a kind of physiological compensation, and the body preparing for receiving an active drug while trying to maintain homeostasis. For example, the direct physiological effect of taking insulin is to reduce the level of glucose in the blood. But when placebo insulin is administered in place of real insulin, the body compensates by increasing glucose production (Siegel, 1972). However other opposite responses are purely social, and cannot be explained by physiological compensation. For example, studies show that when people drink placebo alcohol, they behave in line with social expectations or beliefs about how alcohol affects them such as displaying increased aggression or an increased tendency to laugh out loud at humorous material (Cherek, Steinberg, & Manno, 1985; Vuchinich, Tucker, & Sobell, 1979). On the other hand, pharmacologically active alcohol administered in the guise of a placebo does not induce these behaviours.

In sum, evidence suggests that classical conditioning may explain the occurrence of some placebo effects—especially those demonstrated in animals. But, the conditioning account of placebo effects in humans cannot be reconciled with placebo effect data without taking beliefs into account. The theory that has attempted to address the shortcomings of conditioning theory is expectancy theory.

Expectancy Theory

According to expectancy theory, the placebo effect occurs because people hold specific beliefs—response expectancies—about how they expect to respond to certain

stimuli (Kirsch, 1985; 1997). Kirsch defines response expectancies as self-confirming beliefs that certain external events or stimuli will produce certain types of involuntary behaviours—such as joy, anger, alertness, or fear (Kirsch, 1985; 1997; Kirsch & Lynn, 1999). When response expectancies are triggered, the behaviours that occur work almost like a domino effect: as the first domino falls over, the others fall in automatic response. In the placebo effect, the first behavioural domino is "pushed over" or triggered by the act of taking a substance believed to be active and consequently, other behaviours that lead to the expected outcome occur automatically without intention or awareness (Kirsch & Lynn, 1999). When the expected behavioural outcome ensues, people misattribute the behaviour as being caused by the placebo instead of being caused by themselves (Marlatt & Rohsenow, 1980).

A number of studies lend support to the expectancy account of the placebo effect. They show that what subjects are led to expect about their substance, or the beliefs they already hold, generally predicts the direction of the placebo response (Fillmore, Carscadden & Vogel-Sprott, 1998; Fillmore & Vogel-Sprott, 1992; Kirsch & Wiexel, 1988; Montgomery & Kirsch, 1997). Fillmore and Vogel-Sprott for example, administered placebo caffeine to all subjects but varied what subjects were told about their substance. Specifically, they told some subjects that caffeine would enhance their performance on a basic motor skills task; they told other subjects that caffeine would impair their performance. Another group of subjects—the control group—received no substance. Fillmore and Vogel-Sprott found that the information that subjects received about the placebo predicted the direction of their response: subjects who expected impairment performed worse than the control group while subjects who expected enhancement performed better than the control group.

Similarly, Fillmore et al. (1998) measured subjects' expectations about the impairing effects of alcohol and then gave them alcohol, placebo alcohol, or no substance. All subjects then took part in a timed information-processing task. The results showed that subjects performed the most poorly on the task when they received actual alcohol. Yet interestingly, subjects who expected more impairment performed poorly under alcohol, and under placebo alcohol. When no beverage was received subjects' expectancies yielded no effect on their information processing performance.

More recently, research suggests that even in the absence of administering an actual substance, expectation alone can alter behaviour. Crum and Langer (2007) examined whether people who expected that their daily work was good for their health would reflect this expectation in the form of measurable and positive health outcomes. To address their question, Crum and Langer told a group of hotel room attendants that their daily work was beneficial for their health. In addition, some attendants were provided with specific examples of how their daily activities benefited their health and how many calories each activity burned. Another group of attendants did not receive this specific information. Both groups had their general health behaviours and physiological well being measured in two sessions: first at the initial information session and then again, four weeks later. The results suggested that providing people with the expectation that their work was healthy resulted in objective and positive health outcomes: the informed attendants decreased their body fat percentage, blood pressure, body weight and body-mass-index.

In sum, research suggests that people's expectancies are a powerful determinant of the placebo effect. Thus, in the design and administration of placebo effect studies, the importance of accounting and controlling for expectancies has been recognised.

Methods for studying the placebo effect

Some of the earliest controlled drug trials recognised the important role that people's beliefs and expectations play in shaping behaviour (Gold, Kwitt & Otto, 1937; Shapiro & Shapiro, 1997). As such, researchers have primarily used single blind and double blind trials in an attempt to account for subject and patient expectancies.

Single Blind Trials (SBTs)

In single blind trials (SBTs), subjects are unaware of whether the substance they are taking is active or inactive. An assumption of SBTs is that if subjects do not know the true contents of their pill, expectancies cannot bias their behaviour. But while single blind trials aim to control for subjects' expectancies, one criticism of the design is that they fail to control for the expectancies and biases of the experimenter (Shapiro & Shapiro, 1997).

Rosenthal and colleagues conducted seminal research on whether one person's expectations could influence another person's behaviour. In one particularly famous study, Rosenthal and Jacobsen (1968) gave school children an IQ test, telling their teachers that the results of the test would predict which children would "bloom" the most during the school year: 20% of children were picked at random and pointed out to the teachers. At the end of the school year, when the children took the test again, those who showed the most improvement were the children who the teachers had expected to improve.

In a more direct study of experimenter bias effects, Rosenthal (1966) asked experimenters to show subjects various photos of people's faces, asking them to rate these faces on the degree of success or failure each person was experiencing. Rosenthal led some of the experimenters to believe that certain subjects' ratings would average

approximately 5 on a scale of -10 (extreme failure) to +10 (extreme success), while certain others would average around -5. Yet, unbeknown to the experimenters, the photos had previously been rated as neutral. The results demonstrated the biasing effects of the experimenters' beliefs on subjects' ratings: when experimenters were led to expect a certain range of responses, they typically obtained those responses.

Thus, with the research suggesting that the expectations of the experimenter can exert powerful biasing effects over subject' behaviours, a method needed to be established that took these expectations into account. The method that addresses this concern is the double blind trial (Gold et al., 1937; Marlatt & Rohsenhow, 1980).

Double Blind Trials (DBTs)

Double Blind Trials (DBTs) became the gold standard of placebo drug testing, or as Marlatt and Rohsenow put it, "the hallmark of design excellence" (pp. 163, 1980). Indeed, a literature search of the PubMed database suggests they still are: a search of articles that contain the phrase "double-blind placebo" produced 3005 articles published within the last 5 years. In DBTs neither the experimenter nor the subject is aware of what treatment the subject receives. Consequently, the design aims to remove both the subject and experimenter's expectations from the experimental setting.

Gold et al. (1937) carried out one of the earliest DBTs. They were in the middle of carrying out a single blind study to compare the effectiveness of Xanthines—a popular drug that people believed ameliorated cardiac pain—to a lactose placebo, when they discovered that some of the physicians were asking patients leading questions about the effectiveness of their treatment. When Gold et al. inspected the results it became obvious that the patients' ratings of pain were biased by these questions. To address this issue, Gold et al. developed the DBT so that neither the physicians nor

patients knew when placebos were being administered in place of the Xanthines. After changing the design, Gold et al. found that patients were unable to distinguish between what they had received and, as a result, it was concluded that Xanthines were not effective at reducing cardiac pain.

Yet even though DBTs are designed to account for both subject and experimenter expectancies, there are still some inherent problems with the procedure. First, researchers have questioned whether the double blind procedure is actually blind. Subjects may be "unblinded" to their drug condition if there is any obvious difference between the placebo and active drug (Desbiens, 2002; Shapiro and Shapiro, 1997a). For example, equating the placebo and active drug on taste, shape, colour and size is a difficult task. Some drugs, such as zinc, have a strong and particular taste. Matching a placebo to this taste is difficult (Fair & Gwaltney, 1987). In addition, active drugs often produce undesirable side effects. If the side effects are not mimicked in the placebo, both the subject and experimenter may be "unblinded" to the contents of the drug (Debiens, 2002).

Marlatt and Rohsenow (1980) identified a second problem regarding DBTs: until the 1980s it was common for subjects to be unaware that a placebo might be administered during the drug trial. Yet not revealing to patients that they may receive a placebo opens up an ethical quagmire. Patients who receive placebos without their knowledge, and who do not have their symptoms or condition improve, may conclude that their condition cannot be treated and experience feelings of hopelessness, fear and anxiety. One way of addressing this ethical dilemma is to inform subjects that there is a chance that they will receive a placebo. However, informing subjects that they might receive a placebo raises a second issue: this situation is not a good proxy of what

happens in a clinical setting or real-world situation (Kirsch & Weixel, 1988). For example, when people go to the chemist to pick up a prescription, they are not told that their medication may be active or may be a placebo. If this situation did occur, it is likely that people would spend a significant amount of time trying to guess whether the medication was active or inactive by scrutinising and interpreting every behaviour with caution, eventually coming to a decision. According to Sutton (1991), once people have made a decision about what they think they have received, people will most likely divide themselves into three distinct groups. In one group, people will think that they have been given the active drug, another group will think they have been given the placebo, and a third group will remain undecided. According to the expectancy account of placebo effects, the decision they make will trigger their response expectancies. That response expectancy then sets in motion the chain of automatic behaviours that lead to a self-confirming outcome and this outcome may be at odds or in accordance with what they actually received. Consequently, any difference or lack of difference observed between the active and placebo conditions could be due to the contents of the substance or due to subjects' expectations.

Thus, even though SBTs and DBTs attempt to control for both subject and experimenter expectations, in trying to eliminate them altogether they are introduced as confounds. A procedure called the Balanced Placebo Design (BPD; Marlatt and Rohsenow, 1980) addresses the limitations of SBTs and DBTs, and in doing so provides a direct measure of expectancy in the placebo effect.

The Balanced Placebo Design

The design of the BPD is 2 x 2: subjects are told that they will either receive the active drug or the inactive placebo and what they receive either matches or does not

match this information (see Figure 1.1). This design allows the effects of the active drug and expectancy to be targeted both in isolation from, as well as in combination with, one another.

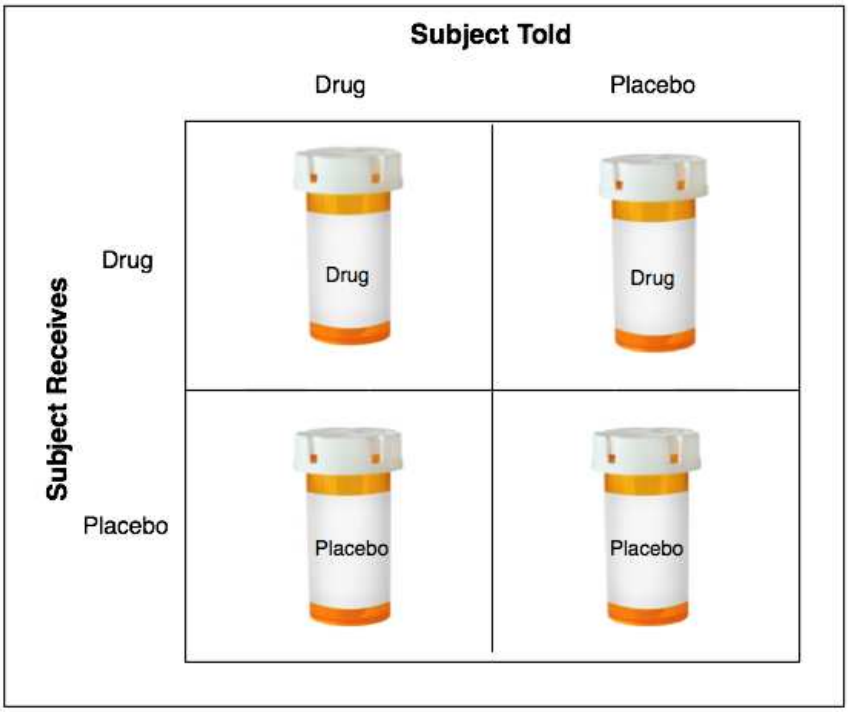

Figure 1.1. An illustration of the Balanced Placebo Design: subjects receive an active or inactive substance and what they are told matches or does not match this information

Placebo Effects and the BPD

Research using the BPD provides an accumulating body of knowledge regarding the types of behaviours that are susceptible to placebo effects, and offers further evidence that what people are told about their substance is an important predictor of the behaviours elicited under placebo administration (Kirsch & Weixel, 1988). A review of the literature follows.

Social Behaviours

Research using the BPD plays a key role in identifying a number of placebo effects that are mediated by people's expectancies, and typically, the majority of these behaviours are social. Social behaviours have been targeted for two reasons. First, placebos give people an outlet for explaining away their social misdemeanours (Hull & Bond, 1986; Marlatt & Rohsenow, 1980). That is, a placebo gives people an excuse to engage in otherwise undesirable behaviour because it removes the onus of blame from the person demonstrating the behaviour and places it on an external cause—the placebo (e.g. "it wasn't my fault I behaved liked that, it was the alcohol"). Second, people hold relatively strong views, expectations and behavioural scripts about how certain substances, like alcohol and nicotine, affect their social behaviours. For example, studies show that people's expectations about alcohol—that it decreases stress and tension, improves mood and increases positive social interaction—are a factor in maintaining their drinking (Cooper, 1994; Labrie, Hummer and Pedersen, 2007). Additionally, these beliefs are social in nature as they are often culturally specific (MacAndrew & Edgerton, 1969). Thus, research using the BPD has tended to focus on socially popular substances such as nicotine and alcohol.

Smoking. Wesnes, Revell & Warburton (1983) found that a cohort of college students reported that because smoking helped their concentration and arousal, they increased the amount they smoked during exam weeks. The results of this study suggest that people's expectations about nicotine may provide an excuse for them to increase or maintain their smoking behaviours.

To examine whether smoking increases concentration and arousal because of nicotine or because of expectancies *about* nicotine, Kelemen and Kaighobadi (2007)

used the BPD to compare people's expectations about nicotine with its pharmacological effects. Kelemen and Kaighobadi told some subjects that they would receive cigarettes containing nicotine and told other subjects that they would receive cigarettes that did not contain nicotine. Consequently what subjects received either matched or did not match this information. Next, Kelemen and Kaighobadi measured how subjects expected nicotine to affect their cognitive states, arousal, energy, and urge to smoke. Finally, to measure whether nicotine or expectancy resulted in a measurable behaviour change, all subjects took part in a prospective and free recall memory task. Subjects who received nicotine reported experiencing greater effects on the measures of taste, dizziness, irritability reduction and nausea. However, subjects who were told that they had received nicotine, regardless of whether they had or not, reported experiencing more wakefulness, concentration, hunger reduction and reduced urge to smoke. There was no effect of either nicotine or expecting to receive nicotine on the memory performance measures. In sum, while some subjective measures were directly affected by actual nicotine consumption, other behaviours were purely an artefact of subjects' beliefs. Research on alcohol and alcohol placebos has produced similar findings.

Alcohol. Myriad studies have shown that when people consume placebo alcohol they are likely to engage in socially taboo behaviours because, as previously discussed, it provides them with an excuse for explaining away their behaviours. Specifically placebo alcohol has led to decreased sexual inhibition (Lansky & Wilson, 1981; George & Marlatt, 1986; George, Stoner, Norris, Lopez & Lehman, 2000), increased risk taking (McMillan, Smith, & Wells-Parker, 1989), and increased aggression (Cherek, Steinberg & Manno, 1985; Lang, Goeckner, Adesso & Marlatt, 1975). For example, in one study George, Dermen and Nochajski (1989) found that subjects who were told that they had

consumed an alcoholic beverage were more likely to show interest in violent and erotic slides compared to the subjects who were told they had consumed a non-alcoholic beverage. Similarly, Lang et al. (1975) showed that when subjects believed that they had consumed alcohol, they were more likely to provide intense and painful electric shocks to an insulting confederate compared with the subjects who believed they had consumed a tonic beverage.

In conclusion, research using the BPD has found robust expectancy effects in regard to people's social behaviours such as maintaining their smoking behaviour or reducing their social inhibition. Do placebos affect behaviours like attention and memory that are typically thought of as cognitive rather than social? The answer seems to be, it depends.

Non-social behaviours

Several attempts have been made to obtain placebo effects on people's cognitive behaviours, however, many of these attempts have proved unsuccessful. A review of these attempts follows.

Attention. Clifasefi, Takarangi, and Bergman (2006) used the balanced placebo design to measure whether people who were told they had consumed alcohol were more at risk to inattentional blindness (IAB). The phenomenon of IAB occurs when people fail to perceive an object directly within their field of vision because their attention is diverted elsewhere (see Simons, 2000 for a review). In one particular IAB design, people watch a scene of a black shirted team and a white shirted team passing around two basketballs, and count the number of passes that either the black or white team make to each other. Halfway through the scene, a woman in a gorilla suit walks into the middle of the game, beats her chest and then walks out again. Simons and

Chabris (1999) found that across a series of experiments, approximately 50% of subjects failed to notice this highly distinctive and unusual event (Simons and Chabris, 1999).

To address their research question Clifasefi et al. (2006) told half of their subjects that they were receiving a vodka drink, and half the subjects that they were receiving a tonic drink. What subjects received either matched or did not match this information. After receiving their drinks, subjects took part in the "gorilla" IAB experiment. Clifasefi et al. found that subjects who received alcohol, regardless of what they told, were twice as likely not notice the gorilla than subjects who did not receive alcohol. In other words, there was no placebo effect: alcohol expectancies did not affect whether or not people noticed the gorilla.

Memory. Researchers have also studied how placebos affect memory. For example, a closer examination of Kelemen and Kaighobadi's (2007) study of placebo effects on smoking showed expectancy effects for social behaviours such as hunger suppression, self-reported alertness and concentration. But there were no expectancy effects on the objective measures of memory performance. That is, while subjects reported that smoking improved their concentration and increased their alertness, these beliefs did not translate to actual improvement on the free recall and prospective memory task.

Likewise, Kvavilashvili and Ellis (1999) gave subjects a sham "memory enhancing" or "memory impairing" drug before having them take free recall memory tests. Subjects who received the "enhancing" drug reported that their memories had improved while subjects who received the "impairing" drug reported that their memories were worse. But the drug expectancy affected only performance in the "impairment" condition: subjects who were led to expect that their memory would get

worse recalled fewer words and made more errors. Subjects who received the "enhancing" drug did not demonstrate any improvement on accuracy or quantity of information recalled on the word lists.

Kvavilashvili and Ellis's findings fit with the literature suggesting that placebos do not affect cognitive behaviours if those behaviours are not within the capabilities of the person (Kirsch & Lynn, 1999). For example, a decrease in memory functioning by the "expect impairment" subjects could have been caused by a decrease in effort or motivation, whereas the "expect enhancement" group could only have demonstrated improvement if they had the ability to do so.

In the only study to demonstrate actual improvement in recall memory, Van Oorsouw and Merkelbach (2007) examined whether a memory placebo could enhance or impair people's memories for an emotional event. Subjects came to the laboratory for a sham drug study and watched a 3-minute segment of the evocative and violent film *American History X*. In the particular scene that subjects saw, a neo-Nazi shoots two black men who are attempting to steal his car. After watching the video clip subjects received a bogus drug, and were either told it was memory enhancing, memory impairing or a control substance. Thirty minutes later, everyone took a memory test. After excluding subjects who did not believe the manipulation, Van Oorsouw and Merkelbach found that subjects who expected the drug to improve their memories recalled more accurate information than subjects who expected the drug to impair, or do nothing, to their memories.

While these results are interesting, they should be considered with some caution. Aspects of the methodology suggest that the "Told enhancement" subjects' better memory performance may have been caused by increased rehearsal. Although Van

Oorsouw and Merkelbach say that subjects were unaware that they would have their memories tested, the study was explicitly advertised as a study investigating the efficacy of memory drugs. Thus, it is likely that subjects would have been aware that their memories would be tested at some point. This knowledge might have alerted and motivated the "Told enhancement" subjects to try to remember the event well. If the authors had used a filler activity that stopped subjects from thinking about the event, the fact that subjects knew that they were taking part in a memory experiment should not have been a problem. But, the filler activity was not engaging or challenging: subjects filled out unrelated questionnaires and then read magazines. Consequently, it is possible that the "Told enhancement" subjects simply spent more time rehearsing the event than the "Told impairment" or control subjects.

Why are placebo effects less readily demonstrated on cognitive behaviours? At least three reasons are proffered in the literature. First, placebos give people an excuse to engage in risky or taboo behaviour—behaviours typically viewed as negative—but there is little reason to think that people would desire the same effects for their cognitions (Hull & Bond, 1986; Kvavilashvili & Ellis, 1999; Marlatt & Rohsenow, 1980). Second, while people appear to have relatively strong views and expectations regarding how placebos affect their social behaviours, they don't typically hold strong views or expectations about how placebos affect very specific cognitive or motor abilities (Kvavilashvili and Ellis, 1999). For example, a study by Miller et al. (1978) examined how alcohol affected people's memories for word lists and found no effect of placebo alcohol. The authors concluded "subjects are not likely to have had much drinking experience in situations in which free recall of lists of words is the relevant behaviour" (p. 48). On the other hand, people tend to have very strong beliefs and expectations

regarding how their social behaviours such as sexual arousal, aggression and confidence are affected by alcohol (Goldman et al. 1987). Third, for behaviour to be susceptible to a placebo, it must be within the capabilities of the person exercising it (Kirsch and Lynn, 1999). For example, if I take a sham pill that I expect will boost my general knowledge, it is unlikely that the pill would work because the amount of general knowledge I have in my head remains fixed and independent of the pill. Thus, while our social behaviours are within our control and can vary, many of our cognitive behaviours are not.

In summary, research suggests that cognitive behaviours such as attention and free recall memory are outside the influence of placebo effects. However, another group of studies—namely those on memory distortion—show that to obtain placebo effects on memory, a paradigm should be used that comprises of both a cognitive and social component**.** One paradigm capturing both these components is the misinformation effect paradigm.

The Misinformation Effect

In the 1970s Loftus and colleagues showed subjects an event and then gave them false information about that event. On a later memory test, subjects performed more poorly when they had received false information compared to subjects who did not receive false information (Loftus, Miller & Burns, 1978). This finding has since been replicated in hundreds of studies and is referred to as *the misinformation effect* (Bonto & Payne, 1991; Loftus et al., 1978; Takarangi, Parker & Garry, 2006; Tousignant, Hall & Loftus, 1986; Sutherland & Hayne, 2001).

The classic method for studying the misinformation effect comprises three stages (see Figure 1.2). First subjects watch an event—such as a man shoplifting his way through a university bookstore. In the second stage subjects receive postevent information (PEI) about that event, typically in the form of a narrative. The PEI is designed so that half the time subjects receive generic information about the original event ("*Jim picked up a candle*") and half the time the information is deliberately misleading ("*Jim picked up a yellow candle*" when he actually picked up a white candle). Researchers distinguish between these two types of PEI as *control* and *misled* items. In the last phase, subjects take a memory test where they are asked to recall specific details from the original event, such as "what was the colour of the candle that Jim picked up?" In a typical test, subjects choose between the original event item (a white candle) and the misleading item (a yellow candle). Results consistently show that subjects who receive control PEI are better at remembering details from the original event compared to subjects who receive misled PEI.

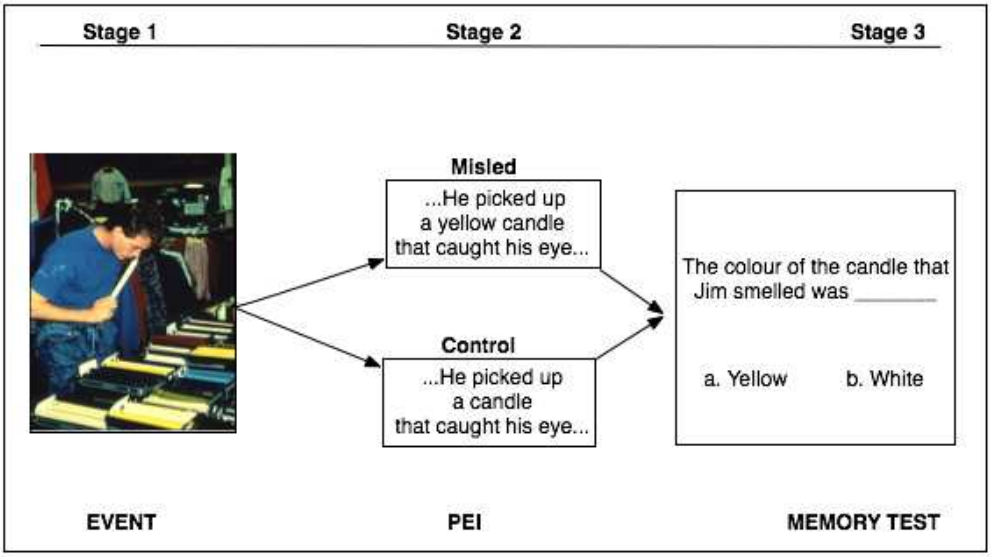

Figure 1.2. An illustration of the three-stage misinformation method

A strength of the misinformation effect paradigm is that it allows researchers to examine both cognitive and social components of memory. On the one hand, control items measure subjects' memory for the original event; memory that is free from experimenter manipulation. One the other hand, misled items measure both memory for the original event, and the willingness of subjects to take on board suggestion from another person. A substantial body of literature demonstrates that in applying social manipulations—for example bringing into question the accuracy or credibility of the PEI—susceptibility to the misinformation effect rises and falls (Dodd & Bradshaw, 1980; Echterhoff, Hirst & Hussy, 2005; Vornik, Sharman & Garry, 2003). Much research supports the hypothesis that source monitoring is the mechanism via which this susceptibility increases or decreases.

The Source Monitoring Framework

The Source Monitoring Framework (SMF) accounts for the processes underlying the attributions we make about our memories (Johnson, Hashtroudi & Lindsay, 1993). That is, how do we decide if we heard a piece of news from the TV or from our friend? How do we decide if an alien abducted us last night or if we simply dreamed that an alien abducted us?

According to the SMF, memories are not stored with explicit tags of source-specifying information attached to them that directly alert us to where, when and how we acquired a memory. Instead, we make decisions about the sources of our memories, based on the quality, type and strength of the qualitative characteristics encoded in memory during acquisition, and the judgement processes used at retrieval (see also Lindsay, 2008 for a recent review).

Qualitative characteristics

According to the SMF, memories contain various characteristics about where, when and how the memory was formed. Examples of these characteristics are the perceptual, contextual, semantic, affective qualities of the memory, and the cognitive operations involved at the time of acquisition. Accordingly, memories differ in the type and amount of qualitative characteristics they contain depending on where and when they were acquired. For example, Suengas and Johnson (1988) examined whether memories from different sources contain different qualitative characteristics. Subjects either imagined or experienced events such as having a soda and some snacks or writing a letter of complaint. The next day, subjects rated their memories of the events on the Memory Characteristics Questionnaire (MCQ; Johnson, Foley, Suengas & Raye, 1988) rating the clarity, sensory detail, context, thoughts and feelings, and intensity associated with each memory. Suengas and Johnson found that subjects rated their memories of perceived events as being clearer, containing more sensory and contextual details, and containing more information about thoughts and feelings. In addition, subjects rated experienced events as more intense than memories for imagined events. These results support the claim of the SMF that memories from different sources differ in the type and amount of qualitative characteristics they contain.

Yet, basing source decisions *only* on a memory's qualitative characteristics does not guarantee that we will correctly identify the source of that memory. For example, I may have a vivid and clear memory that last night I took a magic carpet ride around the city. My memory may feel clear and perceptually rich and I may have intense feelings and emotions surrounding it. Thus, if I were to base my attribution solely on these

characteristics, I would mistakenly conclude that because the memory feels real, I did indeed take the magic carpet ride and my memory originates from an actual experience.

Alternatively, two competing memories may share similar and overlapping characteristics, thus making the likelihood of discriminating between those sources difficult. Henkel and Franklin (1998) either showed or had subjects imagine some everyday objects. On a later memory test, subjects discriminated between objects they had seen and those they had imagined. When seen and imagined objects were perceptually similar—for example a magnifying glass and a lollipop—subjects were more likely to confuse an imagined object with a seen object.

Therefore, while using only the qualitative characteristics of a memory to make an attribution may lead to a correct source attribution, these same processes may also lead to source confusions and false memories. The second part of the SMF addresses how decision processes influence source attributions.

Decision processes

The SMF posits that decision processes help us determine whether qualitative characteristics provide sufficient evidence for attributing a memory to a particular source. The literature is in general agreement that usually, day-to-day decision processes occur rapidly and non-deliberatively with little conscious effort (Lindsay, 2008; Mitchell & Johnson, 2000). Typically, we engage in this type of automatic source monitoring when making decisions that have few serious consequences—for example, trying to decide which friend told us an amusing story. For an attribution based on rapid decision processes, the criteria may be based on whether or not the qualitative characteristics reach a certain level of familiarity or perceptual clarity: "if the familiarity of X is above Y then I will conclude that my memory comes from an actual experience."

Less frequently, people use more careful and deliberate decision processes: they scrutinise memories more carefully and search for corresponding information that provides further evidence for attributing a memory to a particular source (Johnson et al., 1993; Mitchell & Johnson, 2000). For example, I think that last night I took a magic carpet ride because the memory feels clear and vivid. Yet, when I compare this memory with my other beliefs and knowledge, for example I know that it is not plausible that carpets are magic and have the ability to fly, I am able to conclude that even though the qualitative characteristics of my memory make me feel like I took a magic carpet ride, my memory is false. We are likely to use these more deliberate decision processes when making important attributions: "did I really turn off the iron this morning or did I only think about turning the iron off?"

To examine the decision processes that people use when making source attributions, Johnson et al. (1988) asked subjects how they determined if they had experienced or imagined certain events. Subjects rated the temporal, perceptual and emotional characteristics of experienced events more clearly and reported that they used supporting memories that were related to the target memory as further evidence. Subjects reported relying more on reasoning, general knowledge and plausibility when rating imagined events.

Similarly, Dodson and Johnson (1993) examined the role that decision processes play in source monitoring. They showed subjects pictures and then showed them paragraphs of text. Some of the pictures and text were related; other pictures and text were unrelated. After subjects saw the pictures and text, they were divided into two groups and asked to identify the source of these materials. For one group, the source test had four possible choices: picture only, text only, both, or new. Another group took

a source test with only two choices: "Did you read this?" and then "if yes, was it a picture?" Subjects who took the four-choice source test made fewer source confusions than subjects who took the binary choice test. Dodson and Johnson reasoned that the four-choice source test required subjects to use more deliberate decision processes, examining all the possible sources of their memories, and scrutinising the characteristics of each source more carefully.

Taken together, the literature suggests that if people use more deliberate and effortful decision processes, they are less susceptible to source errors and confusions. Still, effortful decision processes do not guarantee a correct source attribution. The final attribution that people make is generally based on a combination of qualitative characteristics and judgement processes, but is affected by both social and cognitive factors.

Attribution

The final step in making a source attribution is heavily dependent on the quality of the encoding experience: if encoding conditions are poor—such as high stress or divided attention—then source characteristics will also be poor (Mitchell & Johnson, 2000; Troyer, Winocur, Craik & Moscovitch, 1999; Zaragoza & Lane, 1998). Zaragoza and Lane (1998; Exp. 1) examined the effects of divided attention on subjects' susceptibility to misinformation. First, all subjects watched an event. During the PEI phase, some subjects received PEI under full attention while others received PEI under divided attention, performing a secondary music identification task at the same time. Compared to the subjects who acquired the memory under full attention, the divided attention subjects made more source confusions. These results suggest that the increase in source confusions was due to the divided attention: subjects encoded fewer source-

specifying characteristics that they could later use to help identify and discriminate between items' sources.

People also make source attributions on the basis of their expectations, biases and beliefs. Bayen, Nakamura, Dupuis and Yang (2000) showed subjects objects and scenes that were consistent with their expectations (e.g. a towel in a bathroom), or objects that were inconsistent with their expectations (e.g. a nightstand in a bathroom). On a later source test, subjects were more likely to attribute the source to an item that was consistent with their expectations regardless of where the object actually came from. For example, a subject who saw a scene of a nightstand in a bathroom was more likely on the source test to incorrectly attribute seeing the nightstand in the bedroom. Similarly, Marsh, Cook and Hicks (2006) found that subjects were more likely to make source attributions that fitted with their gender-stereotypical beliefs. Specifically, subjects were more likely to attribute a statement as coming from a male speaker if it reflected stereotypical male beliefs and were more likely to misattribute a statement as coming from a female speaker if it reflected stereotypical female beliefs.

Thus, Mitchell and Johnson (2000) posit: "as imperfect judgement processes are applied to mental representations that are themselves imperfect some errors are bound to occur" (pp. 181). Consequently, source monitoring plays a fundamental role in people's susceptibility to false memories and in particular the misinformation effect.

Source Monitoring and the Misinformation Effect

The misinformation effect reflects people's ability to correctly monitor the sources of their memories. When subjects answer on the memory test with the misleading PEI, their memory distortions are a direct reflection a source confusion.

According to Johnson and colleagues, the design on a typical misinformation effect experiment increases subjects' likelihood of making source confusions for two reasons (Johnson et al., 1993; Mitchell & Johnson, 2000). First, as previously discussed, when two memories share similar qualitative characteristics, source confusions increase (Henkel et al., 1998; Lindsay et al., 1990). In a misinformation effect experiment, the two competing sources of information, the event item and PEI item, may share many of the same characteristics (Mitchell & Johnson, 2000). For example, the conditions under which people encode the event and PEI items are the same: people receive them in the same room, in the presence the same experimenter, and generally in the same experimental session. Additionally, the event and PEI narrative are essentially identical except from the critical details. Thus, there is high overlap between the contextual similarity of the information surrounding the event and PEI details, meaning that subjects may have trouble distinguishing which item came from which source (Mitchell & Johnson, 2000).

Second, the format of the standard memory test increases the likelihood that subjects will make source confusions (Johnson et al., 1993; Mitchell & Johnson, 2000). The critical items on the test are embedded among a number of relatively easy filler items that induce subjects to respond on the basis of familiarity. That is, the filler items require subjects to choose between an item actually encountered in the event (a familiar item) and an entirely new item (an unfamiliar item.) Because the filler items make up the majority of the test, the test encourages subjects to habitually respond on the basis of familiarity. If subjects start to respond habitually, they may stop attending to potentially important qualitative cues of the critical items and thus their susceptibility to misinformation increases. Yet, despite the fact that the typical format of misinformation

effect experiments maximises subjects' susceptibility to misinformation, research shows that increasing or decreasing their source monitoring behaviours—either directly or indirectly—changes susceptibility to the misinformation effect.

Giving subjects source monitoring tests directly increases their source monitoring behaviours (Lindsay & Johnson, 1989; Zaragoza & Koshmider, 1989; Zaragoza & Lane, 1994). Whereas forced choice recognition tests lead subjects to respond quickly and automatically on the basis of familiarity, source monitoring tests require subjects to slow down and examine all possible sources of their memory for each test item. For example, source monitoring tests typically ask subjects whether an item came from the event, the PEI, both, or neither. By asking this question subjects must examine their memories for characteristics of each possible source: someone who sees Jim steal a math book in the event but is told he steals a chemistry book during the narrative may think back to event and remember the book seemed bright, colourful and the label was white; in contrast they may think back to the narrative and think that the other details surrounding the book are incomplete or weak. Thus, they may accurately conclude that they saw the math book only in the event.

Lindsay and Johnson (1989) directly compared subjects' susceptibility to misinformation on recognition test and source monitoring tests. All subjects took part in a standard misinformation effect experiment. At test, subjects either took a standard forced choice yes/no recognition test or a source monitoring test. Over two experiments, subjects who took the source monitoring test were less misled than subjects who took the yes/no recognition test. That is, administering a source monitoring test decreased subjects' susceptibility to the misinformation effect. Other studies have found similar results (see Zaragoza & Koshmider, 1989 and Zaragoza and

Lane, 1994). Taken together, this group of studies shows that people's source monitoring can be directly manipulated with source monitoring tests and that these behaviours are ultimately reflected as more or less susceptibility to memory distortion. Other studies however, show that social manipulations—bringing into question the reliability of the PEI—also affect people's source monitoring behaviours.

When subjects receive misleading information about the event, they must at some stage capitulate to the misinformation. If subjects do not capitulate, they are likely to use better source monitoring—increased scrutiny of the PEI or increased effort at test—which is reflected in less memory distortion. One critical factor that affects whether or not capitulation occurs is the perceived social status or agenda of the "misinformation messenger." Studies manipulating the credibility of the misinformation's source show that if subjects judge the messenger to be untrustworthy, unreliable or even a little stupid, they are more likely to resist the misleading information (Dodd & Bradshaw, 1980; Echterhoff et al., 2005; Vornik et al., 2003). For example, Dodd and Bradshaw (1980) showed subjects a slide sequence of a traffic accident and then told subjects that the PEI was either written by a person who was involved in the car accident, or by an innocent bystander. Dodd and Bradshaw reasoned that subjects would perceive a person involved in the accident as having reason to lie about the details of the event; someone who simply observed the accident—an "innocent bystander"—would have no reason to lie. The results reflected this assumption: subjects were more likely to capitulate to misinformation if an innocent bystander provided it; subjects were more likely to reject the misinformation if someone perceived as untrustworthy provided it. Both groups, however, performed similarly on control items. Based on Dodd and Bradshaw's reasoning, it is likely that subjects who were "warned"

about the driver involved in the accident increased their source monitoring by paying more attention to the details in the narrative, thus increasing their ability to detect differences between the event and PEI. Subjects may also have increased their decision processes on the test by thinking carefully about their answers and not responding solely on the basis of familiarity (Johnson et al., 1993).

Similarly, Echterhoff et al., (2005) examined whether subjects' source monitoring behaviours would be affected by a social manipulation administered immediately before the memory test. Over four experiments, Echterhoff et al. manipulated the credibility of the misinformation messenger by bringing into question their credibility, trustworthiness or ability. Other subjects did not receive this social information, but were explicitly asked to monitor the source of their memories more carefully at test. Another group of subjects received no warning. Echterhoff et al. found that all subjects performed equally well on control items. But, both socially warned and source monitoring warned subjects were less misled than unwarned subjects. In addition, subjects who received the social or source monitoring warning were slower to respond on test. Echterhoff et al. reasoned that since their warnings were administered after the PEI, subjects were not less misled due to increased scrutiny of the PEI. Therefore, Echterhoff et al. reasoned that their post-PEI warnings induced subjects to use more deliberate and effortful decision processes during the test and their increased effort was reflected as increased response time.

Other studies have also demonstrated similar effects with the misinformation effect rising and falling depending on the relationship the subject has with the misinformation messenger (French, Garry & Mori, 2008), or the perceived attractiveness and power of the person delivering the PEI (Vornik et al., 2003). Thus,

there is ample evidence to suggest that subjects' source monitoring behaviours in a misinformation effect experiment are affected by social manipulations.

The Placebo Effect and Susceptibility to Misinformation

With research showing that the misinformation effect comprises both social and cognitive factors, and research showing that the placebos can affect people's social behaviours but not cognitive behaviours, Assefi and Garry (2003) hypothesised that the misinformation effect paradigm is an ideal method to study how placebos might affect memory. Specifically, they reasoned that telling subjects they had consumed alcohol might lead them to distrust their memories for the event and place more weight in the PEI. As a consequence, source monitoring behaviours may be reduced as subjects would be less likely to question or scrutinise the external suggestions provided by a misinformation narrative. If this occurs, subjects who receive misleading PEI may go through a deliberation process that results in a conclusion such as "I'm drunk, therefore I will trust what you're saying here as you know best". On the other hand, Assefi and Garry reasoned that placebo alcohol is not real alcohol. Thus, memory for control items—items that are a measure of the cognitive component of memory—should remain unaffected.

Assefi and Garry used half the balanced placebo design: half the participants were told that they were receiving a vodka drink mixed with tonic (Told Alcohol) and the other half were told that they were receiving a plain tonic drink (Told Tonic). In reality, none of the subjects received any alcohol, as the vodka was nothing more than flat tonic. To enhance the likelihood that subjects would believe the manipulation, they drank from glasses that had been rubbed with vodka soaked limes, the drinks were prepared in full view of the subjects, and vodka was poured from Absolut® Vodka

bottles that appeared to have unbroken seals. After consuming their drinks subjects took part in a standard misinformation effect experiment.

Assefi and Garry found two key findings. First, all subjects performed equally well on control items: both told tonic and told alcohol subjects were accurate for the items that they were not misled about. Second, a placebo effect was obtained on misled items for the Told Alcohol subjects. That is, subjects who were told that their drinks contained vodka, were more likely to capitulate to misleading information than their Told Tonic counterparts. The results of Assefi and Garry suggest that while a placebo can affect subjects' susceptibility to misinformation, true memory for the original event remains intact. Taken together, their findings converge with the literature on the placebo effect and social behaviours. First, an alcohol placebo did not affect the cognitive aspect of the misinformation effect: memory for control performance was equivalent in both groups. An alcohol placebo however, did affect the social component of memory—specifically subjects' susceptibility to misinformation.

Since a placebo increases susceptibility to misinformation by reducing effortful source monitoring, Clifasefi et al. (2007) reasoned that a placebo might also be able to decrease susceptibility to misinformation, if it increases effortful source monitoring. To test their hypothesis, they brought subjects to the laboratory under the guise of taking part in a drug trial testing the efficacy of a new cognitive enhancing drug—R273—on visual and verbal modes of learning. In reality, however, R273 was nothing more than lime-flavoured baking soda. Pains were taken to ensure that subjects believed the drug manipulation: a confederate in a white lab coat and posing as a pharmaceutical researcher from a fictitious drug company was present for the entirety of the session and subjects were informed that R273 had been tested on military radar operating

personnel and made them "better able to detect changes in their visual fields, and quickly and accurately distinguish enemy target signatures from simple environmental noise" (p. 114). In addition, subjects were weighed and measured and saw the drugs being prepared in full view. Clifasefi et al. told some subjects that they would receive R273 (Told Drug) and told some subjects that they would receive the inactive version (Told Inactive). After the drug administration phase, everyone took part in a misinformation effect experiment. In the final phase of the experiment, subjects were asked to rate the degree to which R273 had affected them on a range of specific physiological and cognitive measures.

Clifasefi et al. found three key results. First, Told Drug subjects rated themselves as experiencing more of R273's effects such as enhanced senses, better concentration, better memory, and quicker responses. Second, while the Told Inactive subjects demonstrated a classic misinformation effect, Told Drug subjects did not: subjects who were told that they had taken a cognitive enhancing drug were resistant to the effects of misleading information. Third, subjects performed no differently on control items: regardless of what subjects were told about their drug, neither of the groups had a better overall memory for the event. The finding that all subjects performed equally well on control items led Clifasefi et al. to conclude that their R273 effect was not simply a by-product of the Told Drug subjects paying more attention to the event, or rehearsing the event more than their Told Inactive counterparts. Therefore, Clifasefi et al. speculated that R273 reduced Told Drug subjects' susceptibility to misinformation because it increased their source monitoring.

Taken together, the studies of Assefi and Garry (2003) and Clifasefi et al. (2007) highlight some important findings. First, the placebo effect can be reflected in some

aspects of memory but not others. That is, cognitive aspects of memory are unaffected by placebo manipulations aimed at either decreasing memory (alcohol) or increasing memory (R273). Social aspects of memory however, are affected by placebo manipulations. Assefi and Garry demonstrated that a placebo could increase susceptibility to misinformation and Clifasefi et al. demonstrated that a placebo could decrease susceptibility to misinformation. Yet although the emerging literature suggests that placebos affect social—but not cognitive—components of memory by changing source monitoring, researchers still do not know how, or when, those source monitoring changes occur.

Thesis Overview

The overarching goal of this thesis was to extend the body of literature on placebo effects and memory by examining if a memory placebo called R273 decreased people's resistance to the misinformation effect because it increased their source monitoring. A second goal was to establish whether other memory tasks, which are affected by effortful monitoring, would also succumb to the R273 placebo effect.

Experiment 1 aimed to find empirical support for the hypothesis that R273 reduces the misinformation effect because subjects switch from their usually automatic and easy source monitoring to more deliberate and effortful source monitoring. If R273 produces response expectancies that lead Told Drug subjects to shift to more effortful source monitoring during the PEI or test, I might find that they take longer than Told Inactive subjects to answer misled test items. Experiment 1 also aimed to establish whether certain subjects—namely, those with higher working memory capacity (WMC)—might respond differently to R273.

The aim of Experiment 2 was to to align the method more closely with the literature on postwarnings and the misinformation effect, and find evidence that converged with the results of Experiment 1. Specifically, I examined whether the R273 placebo effect occurs because of subjects' source monitoring during the memory test. To do so, all subjects were told that they would receive the inactive version of R273, and were then run through a misinformation effect experiment. Immediately before the memory test however, I falsely told some subjects that they had actually received the active version of R273. If R273 "works" primarily because it changes source monitoring during the memory test, Told Drug subjects should be less misled than their Told Inactive counterparts.

Finally, Experiment 3 examined whether the underlying monitoring processes that people use to perform prospective memory tasks were similar to the source monitoring processes that they use for retrospective memory tasks. To address this question, the R273 drug administration procedure was combined with a prospective memory task. If R273 increased monitoring, Told Drug subjects should be better able than Told Inactive subjects to remember to perform certain types of prospective memory tasks. However, if Told Drug subjects have better prospective memories because of monitoring, they should be slower or less accurate at performing a concurrent and ongoing task.

Chapter 2

Experiment 1: A psychotropic placebo decreases the misinformation effect by increasing monitoring at test

My aims in Experiment 1 were three-fold. First, I aimed to replicate Clifasefi et al.'s (2007) finding that a sham cognitive enhancing drug could reduce subjects' susceptibility to the misinformation effect. Second, I aimed to find empirical support for the hypothesis that R273 reduces the misinformation effect because subjects switch from their usually automatic and easy source monitoring to more deliberate and effortful source monitoring. Third, I aimed to establish whether certain subjects—namely, those with higher working memory capacity—might respond differently to R273.

Identifying the Mechanism of R273

As discussed in Chapter 1, the SMF suggests that people's decision processes help them determine whether the qualitative characteristics of a memory provide sufficient evidence for attributing that memory to a particular source. Typically, these decision processes occur rapidly and non-deliberatively with little conscious effort, and in a misinformation experiment increase subjects' susceptibility to the effects of misleading information (Johnson et al., 1993; Lindsay, 2008; Mitchell & Johnson, 2000). Less frequently, however, people use more careful and deliberate decision processes: they scrutinise memories more carefully; search for corresponding information and evidence, and may require a higher threshold or criteria on any of the qualitative characteristics before attributing a memory to a source. Literature suggests that in a misinformation effect experiment, when subjects use more effortful and deliberate

source monitoring, they are less susceptible to the effects of misleading suggestion (Echterhoff et al., 2005; Lindsay & Johnson, 1989). Thus, the misinformation effect literature suggests two ways by which R273 may increase subjects' source monitoring and consequently decrease their susceptibility to the misinformation effect.

The first point at which R273 might lead subjects to use more effortful and deliberate source monitoring is during the PEI—research suggests that subjects who pay greater attention to the PEI are less misled on the later memory test (Greene et al., 1982; Tousignant et al., 1986). In one study, Greene et al. (1982) warned subjects either before the event, PEI or memory test that some of the PEI was incorrect. They found that while warning subjects before the event and the memory test did nothing to reduce their susceptibility to misleading information, warning subjects immediately before the PEI decreased their susceptibility to misleading information. In addition, warned subjects read the PEI more slowly than their un-warned counterparts. Convergent evidence from Tousignant et al. (1986) also showed that subjects who read the PEI more slowly—either of their own accord or because they were told to—were less misled. Tousignant et al. reasoned that when subjects scrutinise the PEI more carefully, they are more likely to notice the discrepancy between what they saw and what they read. Tousignant et al. called the likelihood of noticing the differences *the principle of discrepancy detection*. I hypothesised that R273 might produce response expectancies that lead subjects to increase their discrepancy detection during the PEI. Specifically, Told Drug subjects might read and scrutinise the misleading passages more slowly and carefully than Told Inactive subjects.

The second point at which R273 might lead subjects to use more effortful and deliberate source monitoring is during the memory test. Recall from Chapter 1, the

format of a typical 2-alternative forced-choice (2AFC) recognition test encourages subjects to take the test by relying on easy and effortless source monitoring, answering misled items quickly but inaccurately, and increasing the likelihood of source confusions (Johnson et al., 1993; Lindsay & Johnson, 1989; Mitchell & Johnson, 2000). On the other hand, research tells us that when subjects use more deliberate and effortful source monitoring during the memory test, their susceptibility to misleading information decreases. Potentially, when subjects use more slow and effortful source monitoring on the memory test, they override their tendency to judge accuracy on the basis of familiarity and pay more attention to a greater variety of qualitative characteristics. For example, a host of studies suggest that directly alerting subjects to the erroneous nature of the PEI immediately before the memory test leads them to increase their source monitoring and be less misled (Chambers & Zaragoza, 2001; Christiaansen & Ochalek, 1983; Echterhoff et al., 2005; Frost, Ingraham & Wilson, 2002; Meade & Roediger, 2002). In addition, subjects who are slow to respond to test items (using more effortful source monitoring) tend to be more accurate; subjects who are fast to respond to test items (using quick and automatic source monitoring) tend to be more inaccurate (Echterhoff et al., 2005; Loftus et al., 1989). Echterhoff et al. (2005), for example, ran subjects through a standard misinformation effect experiment but gave some subjects a warning about the quality of the PEI immediately before they took the memory test. Specifically, Echterhoff et al. told some subjects that the PEI was prepared by someone who was not credible and likely to lie, or by someone who was of questionable intelligence. Echterhoff et al. found two key results: first, warned subjects were less misled, and second, warned subjects were slower to respond to misleading test questions. Taken together, Echterhoff et al.'s accuracy and response time findings lend

support to the idea that warning subjects about the PEI leads them to switch from easy, heuristic source monitoring to effortful and deliberate source monitoring. If R273 produces response expectancies that lead Told Drug subjects to shift to more effortful source monitoring at test, Told Drug subjects might take longer than Told Inactive subjects to answer misled test items.

Working memory capacity

My third aim in Experiment 1 was to address whether the effectiveness of R273 is related to subjects' WMC. A growing body of research suggests that WMC is central to people's ability to control attention and affects their ability to perform myriad of higher-order cognitive tasks such as dichotic listening tasks, anti-saccade tasks, reading comprehension, language comprehension, and reasoning (Conway, Cowan & Bunting, 2001; Daneman & Carpenter; 1980; Kane, Bleckley, Conway & Engle, 2001; Kane, Hambrick & Conway, 2005). Put simply, WMC encompasses people's ability to keep important information active, while blocking out interference—skills that are the essence of successful source monitoring (Conway et al., 2001; Engle, 2002; Engle & Kane, 2004; Hester & Garavan, 2005; Kane, et al., 2001; Kane & Engle, 2000; 2003). As such, WMC has been linked with people's susceptibility to certain types of false memories (Jaschinski & Wentura, 2002; Watson, Bunting, Poole & Conway, 2005).

In one study, Jaschinski and Wentura (2002) measured subjects' WMC using the Operation Span Task (OSPAN; Turner & Engle, 1989) and then ran them through a misinformation effect experiment. In an OSPAN task, subjects solve mathematical equations while trying to remember strings of random letter sequences or words. For example, subjects might see the sequence *Q, A, V, B, S, X, L* and are then asked to

solve the equation *(2 x 7 – 4 = 8: true or false)*. Subjects' goal on an OSPAN task is to correctly remember the letter strings whilst keeping their math accuracy high. The more letters correctly recalled, the higher the OSPAN. Consequently, higher OSPAN scores indicate a higher WMC—people known as *high spans*; lower OSPAN scores indicate a lower WMC—people known as *low spans*. Jaschinski and Wentura found that their results converged with the idea that higher spans are better able to focus their attention and block out interfering information; OSPAN score was negatively correlated with subjects' susceptibility to the misinformation effect. In other words, the lower subjects' WMC, the more likely they were to be misled.

Other false memory effects that are closely tied to source monitoring—namely the Deese (1959), Roediger and McDermott (1995; DRM) illusion—suggest that in certain situations, higher spans may be more "cognitively equipped" to resist false memories. In a DRM task, people are shown a list of thematically related words (e.g. *bed, rest, awake, pillow, dream, snooze, snore, drowsy*) that are all highly associated with a particular non-presented target word (e.g. *sleep*). On a later recognition memory test subjects are presented with words from the original list (*old* words; e.g. *pillow*); words that are new and unrelated to the original list (*new* words; e.g. *mountain*); and the previously non-presented, yet highly associated target word (*critical lure;* e.g. *sleep*). The typical and robust finding is that subjects are very good at identifying words that are old and rejecting words that are new. Often, however, subjects misattribute the critical lure as being from the original list (Roediger & McDermott, 1995; 1998; Smeets, Jelicic & Merkelbach, 2006).

In a typical DRM experiment, WMC differences do not occur. That is, higher spans are no better at resisting the critical lure at test than their lower span counterparts.

Similar to the familiarity driven processes that lead people to be misled in a misinformation effect experiment, DRM subjects are thought to rely on a relatively automatic process to determine if they encountered the lure word in the word list. Because an automatic mechanism does not demand controlled attention, it makes sense that WMC differences do not emerge. Yet research shows that high spans are better able to control their attention and reduce their DRM errors accordingly, if they are alerted to override their reliance on familiarity. For example, Watson et al. (2005) ran all subjects through a typical DRM paradigm but warned some subjects about the false lure that would be presented during the memory test. Thus, unwarned subjects were simply asked to remember the related words from the list; warned subjects were asked to remember words from the list as well as trying to identify—and then ward off—the distracting influence of the critical lure. Watson et al. found that warned subjects with a higher WMC were better able to heed the warning about the DRM effect and resist false memories at test. Without the warning, WMC did not matter. These results suggest that higher spans could capitalise on a warning in a way that lower spans could not, using their superior cognitive control to block the automatic tendency to otherwise report the lure word.

I hypothesised that R273 might cause a pattern of results similar to those obtained by Watson et al. (2005). Specifically, subjects might act in line with R273's response expectancies, adopting a deliberate source monitoring strategy similar to one produced by a warning about the DRM. If so, higher spans who are told they are receiving the drug should be better able to identify discrepancies between what they saw and what they read, and use their cognitive control to block their tendency to otherwise report the suggested detail during the test. I hypothesised that I would find a

relationship between WMC and resistance to misleading suggestion among Told Drug subjects, but not Told Inactive subjects, for whom R273 should not produce response expectancies.

Method

Subjects

Ninety-six introductory psychology students took part for course credit. They were run in groups of three or less, and did not interact with one another during the session.

Design

I used a 2 x 2 mixed design with drug instruction (Told Drug or Told Inactive) as the between-subjects factor, and PEI (control or misled) as the within-subjects factor. To control for potential time of day effects (Hasher, Goldstein, & May, 2005) I ran two experimental sessions in the morning and two in the afternoon.

Materials and Procedure

The procedure was based on Clifasefi et al.'s (2007) method with some minor modifications. There were five phases to the experiment; the key phases are summarised in Figure 2.1.

Phase 1:OSPAN. In a departmental mass testing session, I obtained scores from 759 first year psychology students on the automated Operation Span task (OSPAN; Unsworth et al., 2005). The OSPAN task consisted of 75 trials in which people solved mathematical equations while attempting to remember a sequence of random letters. This sequence continued until the end of each trial, at which point people had to choose which letters had been presented from a grid of 12 letters. There were three to seven letters per trial. To control for the possibility that subjects would concentrate only on

remembering the letters and not solve the math equations, math accuracy had to remain above 85%; the computer issued a warning if accuracy dropped below this point.

For each subject, I calculated an OSPAN score as the total number of letters correctly recalled on successfully completed trials. After excluding 66 subjects because they did not complete all 75 trials or because their overall math accuracy fell below 85%, I was left with scores from 693 subjects. These scores ranged from 0 to 75, with a median of 40 (M = 38.92, SD = 18.40) and were comparable to those reported in other published studies (see Unsworth et al., 2005).

A week later, I advertised a new and ostensibly unrelated experiment restricted to those who had taken part in the mass testing session. This experiment was advertised as a clinical trial testing the efficacy of a new cognitive enhancing drug, R273, on visual and verbal modes of learning.

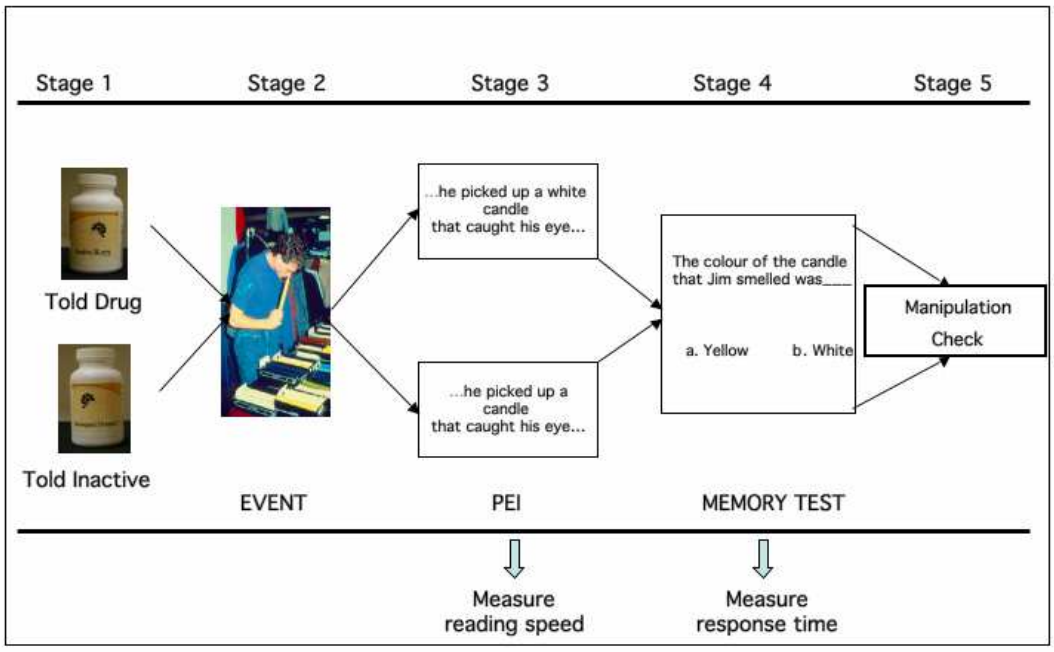

Figure 2.1. Overview of the procedure used in Experiment 1

Phase 2: Cultivating response expectancies. In the second phase, I worked to cultivate response expectancies about R273. To that end, a small laboratory on campus was set up (see Figure 3.1) that was seemingly run as a joint partnership between a fictitious drug company, Jinal Placard, and the School of Psychology. The laboratory was designed to have a high security, corporate ambience: a fake swipe card access machine was fitted to the door; a dummy security camera was installed; and I created high quality promotional Jinal Placard posters with a corporate logo (see Figure 2.2). I block-mounted the posters and hung them on the walls of the laboratory in full view of the subjects. I told people that I was a PhD student working in collaboration with the pharmaceutical company and, to further enhance my credibility, appeared in the laboratory toting a Jinal Placard mug, used a desk littered with Jinal Placard pens, and sat near a Jinal Placard first aid kit.

When subjects came into the laboratory, they were seated in individual compartments so they could not see or communicate with each other, and received information and consent forms. To enhance the authenticity of the trials, the sheet informed subjects that they must withdraw from the trial if they took any blood thinning medication, frequently experienced migraines, had liver dysfunction, there was a chance they may be pregnant, or if they had a sensitivity to Vitamin C.

Next subjects watched a fictitious promotional movie about R273, purportedly produced by its (also fictitious) pharmaceutical company. In reality, I created the movie using Final Cut Pro 3 and iDVD 4 software from Apple, Inc.© The movie lasted for approximately 6 minutes and informed people that previous trials had shown R273 to be safe and effective in increasing mental alertness and cognitive functioning. The movie also informed people that a "close cousin" of R273 had been tested on US

military radar operators and had significantly increased their ability to detect and distinguish changes in their visual fields. A scientist explained the mechanism of action. At no stage did the movie or scientist mention the word "memory" or a related concept. After the movie finished, to further increase response expectancies, subjects were warned that R273 produced some mild physiological side effects, such as an increase in heart rate, a slight head rush and mild tingling in the fingertips.

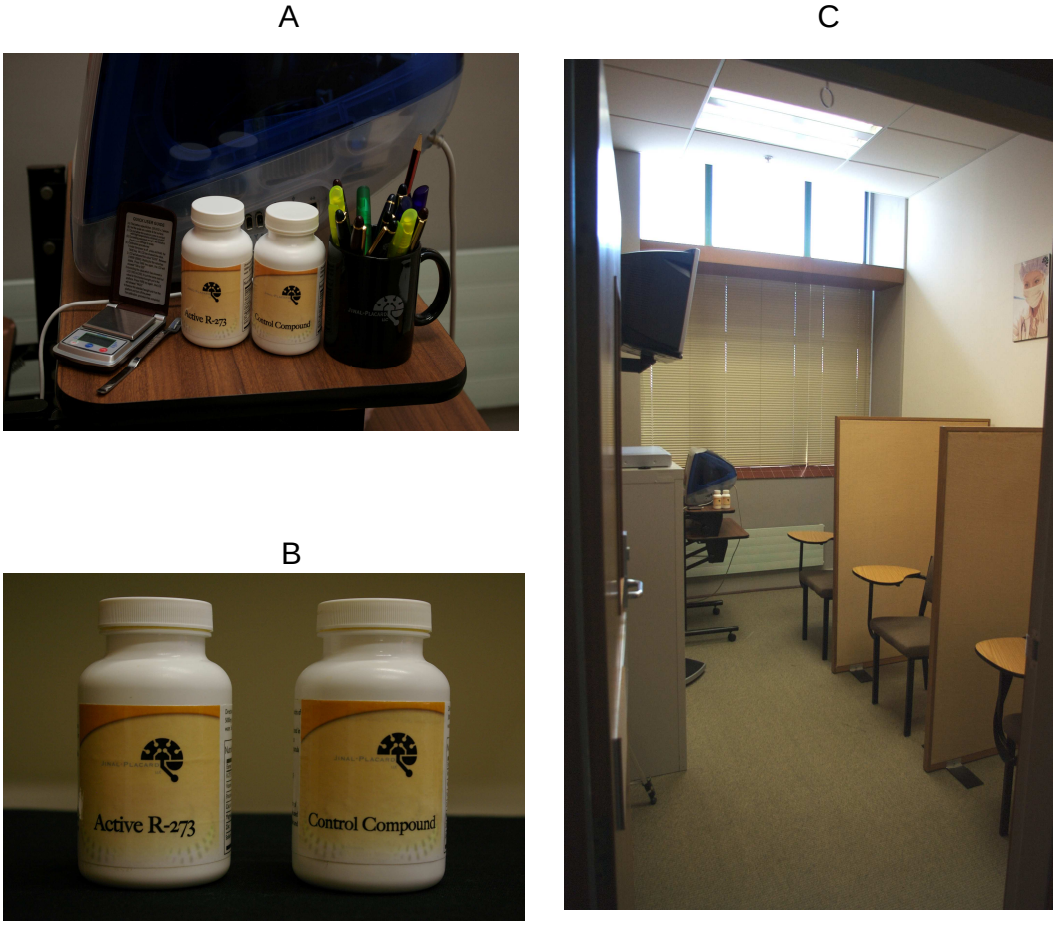

Figure 2.2 (**A**) Photographs of the equipment displayed on the experimenter's desk that included: the drug bottles, the Jinal Placard mug and pens, and the electronic scales for measuring out the powder; (**B**) the bottles that were on display to subjects throughout the experiment; (**C**) a photograph of the laboratory showing where subjects were seated.

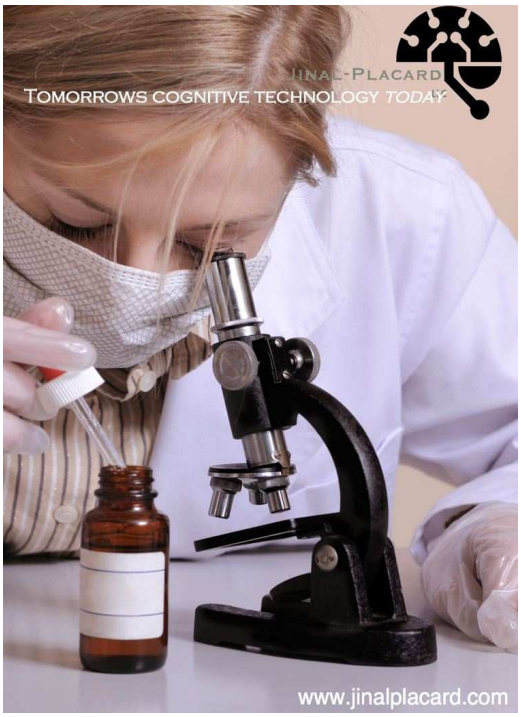

Figure 2.3. Photographs of block-mounted posters that were displayed on the walls of the Jinal Placard laboratory.

Phase 3: Drug administration. After the response expectancy phase, the drug administration phase began. each subject's weight and sex was recorded and subjects were told that this information would be used to determine the exact amount of substance each would receive. Next, I recorded weight data into a computer and waited while the computer software "randomly assigned them to their drug condition." These steps were also completely bogus. I told subjects whether they were to receive the active drug or inactive compound, and then they watched as a weighted dose of R273 or inactive compound was transferred from clearly labelled bottles onto a scientific balance. The substance was mixed with 20mls of water and then distributed to each subject who drank his or her portion. Subjects were informed that R273 needed several minutes to take effect, and in the meantime, watched a 10-minute action clip from the movie *Harry Potter and the Sorcerer's Stone* that was actually used to stop subjects from introspecting about their physiological and psychological state.

Phase 4: Misinformation effect. When the action clip ended, the misinformation effect phase began. So that I was consistent with Clifasefi et al.'s (2007) procedure I used the misinformation stimuli from their study[1].

Subjects watched one of two versions of a slide series depicting a man shoplifting various items from a bookstore (see Loftus, 1991). There were 62 slides; each slide appeared for 2.5 seconds, and the entire event lasted 2 minutes and 57 seconds. Eight of the slides contained a critical item—an item that would later be described with generic or misleading information in the misleading postevent summary. I display the slides in Table 2.1.

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[1] Examples of the materials used in this experiment appear in the Appendices

Table 2.1 Eight critical differences between the misinformation event (Loftus, 1991)

Critical Detail	Slide Version 1	Slide Version 2
Candle	 Yellow Candle	 White Candle
Notebook	 Green	 Yellow
Stapler	 Red	 Blue
Text book	 Chemistry	 Computer
Sweatshirt	 Mickey Mouse	 Minnie Mouse
Magazine	 GQ	 Vogue
Lift Door	 Open	 Closed
Towel	 Light blue towel	 White towel

After a 12-minute filler task, subjects read the misleading summary. There were four versions, each counterbalanced so that every critical item from the slides appeared equally often as a control and misled item. Every combination of drug and PEI summary also appeared equally often across the four time-of-day sessions.

I divided the 541-word summary into 16 passages, each with a mean of 33.69 words (SD = 9.53, Range = 14-54) and used Superlab 4.0 to present them on a 14-inch iBook, which each subject used throughout the session. Eight of these passages referred to a critical event item, and contained a mean of 34.88 words (SD = 9.33 Range = 14-41). Four of the eight passages were *control* items, those described only generically, while the remaining four were *misled* items, those described inaccurately. Subjects read the passages at their own pace and pressed the space bar to move from one passage to the next. While they did so, I covertly measured reading speed.

Phase 5: Memory Test. After a 3-minute distracter task, I tested subjects' memories for the original event. Using the iBooks, everyone took a 20-item, 2AFC memory test. Eight of the questions referred to the critical items from the slide sequence; the four questions about misled items forced subjects to choose between the item that appeared in the event and an item that was only suggested in the summary. The remaining questions were fillers. For every question, subjects also rated their confidence on a scale of 1 (*not at all confident*) to 5 (*very confident*). Once again I covertly recorded response times for each question.

Finally, subjects completed a short questionnaire that was used as a manipulation check. On a 1 (*not at all*) to 5 (*very much so*) scale, they rated the degree to which they had experienced specific cognitive effects associated with R273. Examples of the questions used are "My senses were enhanced," "I had an easier time

remembering things," "My responses were quicker than normal," and "I was able to concentrate more easily." A space at the end of the questionnaire also provided subjects with the option of elaborating on how they felt throughout the session.

Results and Discussion

Manipulation Check

Before turning to my primary analyses, I determined whether Told Drug subjects reported that they had observed cognitive effects in line with some of R273's response expectancies. In other words, did the drug manipulation work? To answer this question, I classified the six cognitive effects measures according to whether subjects were told they had received the active or inactive version of the drug, and display these means in Figure 2.4.

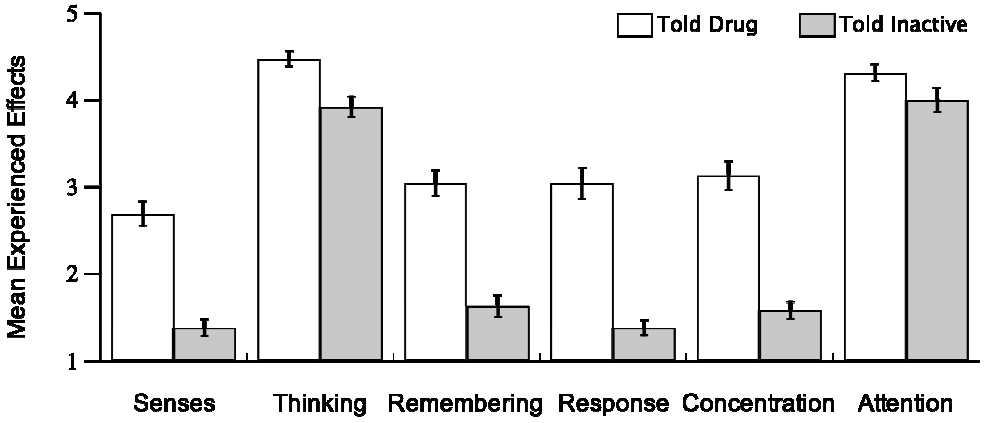

Figure 2.4 Mean score for the manipulation check by drug instruction.

As Figure 2.4 shows, subjects believed the manipulation: Told Drug subjects reported better cognitive abilities than Told Inactive subjects, F (1,93) = 79.15, p <. 01, $\eta_p 2$= .80. However, Told Drug subjects did not report uniformly better cognitive abilities, as the interaction between drug instruction and cognitive ability ratings shows,

F (5, 89) = 5.38; $p < .01$, $\eta_p^2 = .23$. Follow-up pairwise comparisons revealed that although there was a trend for Told Drug subjects to rate themselves as higher on the cognitive effect of attention, t (94) = 1.69, $p = .09$, this trend did not reach significance. Told Drug subjects rated all other cognitive abilities significantly higher than their Told Inactive counterparts (all $p < .01$).

Subjects' comments also fit with these empirical findings. For example, subject 19 wrote "I'm very aware of things happening, it is like everything around me looks sharper like I could focus perfectly at something. When I came in I was exhausted but I feel alert now." Similarly, subject 43 reported "felt more alert and awake than I did when I first came into the room," while subject 57 reported a "greatly increased clarity of vision."

Misinformation Effect

My first goal in Experiment 1 was to replicate Clifasefi et al.'s (2007) finding that a sham cognitive enhancing drug could protect subjects from the misinformation effect. To examine Told Drug and Told Inactive subjects' susceptibility to misinformation I calculated each subject's mean correct responses to the four control questions and the four misled questions, and classified these scores according to whether I told subjects that I had given them the active or inactive version of R273. I display these means in Figure 2.5.

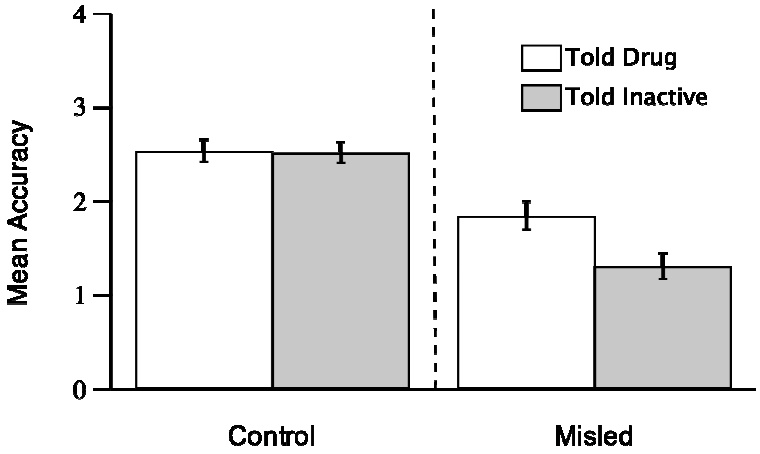

Figure 2.5. Mean number of items correct by drug instruction.

As the figure shows, regardless of what subjects were told about their substance, all subjects were better at correctly remembering control items than they were at correctly remembering misled items, F (1, 94) = 58.66, $p < .001$, $\eta_p 2 = .38$. In other words, comparing just the white bars and just the grey bars, shows there was a misinformation effect in both the Told Drug, t (47) = 3.79, $p < .001$, *Cohen's d* = .55, and Told Inactive conditions, t (47) = 7.18, $p < .001$, *Cohen's d* = 1.04. But were Told Drug subjects any more resistant to the misleading information than their Told Inactive counterparts? The answer is yes: comparing the white and grey bar on the right hand side of the dotted line shows that Told Drug subjects were more accurate than their Told Inactive counterparts on misled items, t (94)= 2.47, $p = .02$, Cohen's $d = .49$. In addition, Told Drug subjects' resistance was not merely a consequence of better memory for the event; comparing the white and grey bars on the right side of the dotted line shows that Told Drug subjects were as accurate as Told Inactive subjects on control items, t (94)= .11, $p = .91$, *ns*. In other words, the interaction between PEI and drug

instruction suggests that the sham cognitive enhancing drug reduced subjects' susceptibility to the misinformation effect, $F(1, 94) = 4.43$, $p = .04$, $\eta_p^2 = .05$.

In sum, these findings on accuracy show that I replicated the basic pattern of findings from Clifasefi et al. (2007): I found that both Told Drug and Told Inactive subjects performed equally well on control items, however, Told Drug subjects had better memories than Told Inactive subjects for misled items.

These findings fit with the literature on source monitoring and the misinformation effect. Specifically, these results suggest that Told Drug subjects were better able to monitor the sources of information from the event and PEI and thus reduce their susceptibility to false memories. The results also fit with a growing body of literature demonstrating that source monitoring is affected by social information (Johnson et al., 1993, Lindsay, 2008). In particular, subjects' ability to use effective source monitoring, and whether or not subjects capitulate to misleading information, can be guided not only by their expectations and beliefs about the misinformation messenger, but also about themselves (Assefi & Garry, 2003; Dodd & Bradshaw, 1980; Clifasefi et al., 2007; Echterhoff et al., 2005; French et al., 2008; Vornik et al., 2003).

Although these results tell us about R273's ability to affect memory accuracy they do not tell us about R273's ability to affect source monitoring. To determine how R273 might affect source monitoring I examined subjects' reading speeds and response times during the PEI and the memory test.

Evidence of Source Monitoring

My second goal in Experiment 1 was to find empirical support for the hypothesis that R273 causes Told Drug subjects to engage in more stringent source monitoring during the PEI or memory test. I hypothesised that Told Drug subjects

might use more effortful source monitoring during the reading of the PEI, at the test, or both.

Reading Speed. Greene et al. (1982) and Tousignant et al. (1986) found that subjects who slowed down their reading speed of the PEI and increased their discrepancy detection, were less susceptible to misleading information. If R273 leads people to engage in more stringent source monitoring, I might expect Told Drug subjects to read the misleading portions of the summary more slowly than Told Inactive subjects.

To address this issue, I calculated each subject's mean reading time of the filler passages—text about neither control nor misled items—and then did the same for passages containing misled items. These results appear in Figure 2.6. Because I found 5 outliers—3 in the Told Drug condition and 2 in the Told Inactive condition—I used two statistical techniques in order address this research question. I first conducted a 2 x 2 mixed ANOVA to examine whether the information that subjects received about their substance affected the speed with which they read the misled and control portions of the narrative. The result suggested that drug condition had no effect on subjects' reading speeds, $F < 1$. In order to make sure this result was not due to the outliers in the dataset reducing the statistical power of the ANOVA, I next performed an M-estimator robust regression to determine whether the speed with which subjects read the narrative was related to the drug instruction. Yaffe (2002) suggests that robust regression is the preferred statistical test when the assumption of equal error variance is violated by the presence of outliers. The method is an increasingly popular statistical alternative to ordinary least squares (OLS) regression and also has the added virtue of being supported by the APA task force on statistics (Wilkinson et al., 1999; Wright &

London, 2007). In M-estimator robust regression—a form of weighted least squares regression—weights are assigned to the residuals. Small residuals receive an assigned weight of 1 while large residuals (outliers) receive small weights. The method minimises the impact that outliers make to the overall model by dampening their contribution without any loss of data. The resulting model is a good fit to the majority of the data and is more statistically sound than methods that trim and remove outliers altogether (Bellio & Ventura, 2005; Wright & London, 2008).

Once I controlled for baseline reading speed of the filler portions, drug condition still did not predict how long people took to read the misleading or control parts of the narrative, *t's* (93) < 1, *ns*. That is, I found no evidence that Told Drug subjects used more effortful source monitoring during the narrative than their Told Inactive counterparts; as the white and grey bars show in Figure 2.6 reading speed for misled and control portions of the narrative was the same.

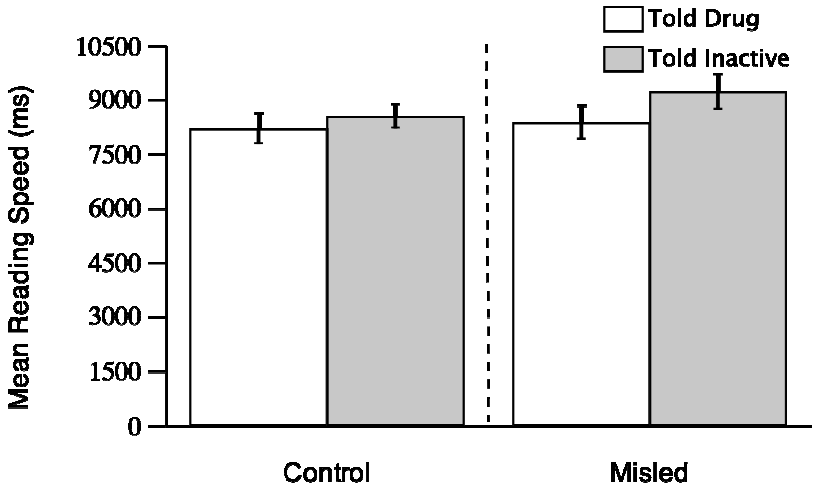

Figure 2.6. Mean reading speed of PEI passages that contained a critical item by drug instruction.

Reaction Time. If R273 does not increase Told Drug subjects' source monitoring during the PEI, does it affect their source monitoring during the test? Recall that I

predicted that more stringent source monitoring at test might lead Told Drug subjects to respond to misleading test items more slowly than Told Inactive subjects. To address this prediction, I calculated baseline response time by determining the mean amount of time each person took to answer filler items—items that both Told Drug and Told Inactive subjects should have answered quickly and effortlessly. I then did the same for misled items and control items. Because I identified four outliers in my data set, I again used two statistical methods for determining whether the drug instruction affected subjects' response times on the test. The 2 x 2 mixed ANOVA suggested that there was a marginally significant interaction between the drug instruction and subjects' response speeds, F (1, 94) = 2.96, p = .09 $\eta_p 2$ = .03. To further examine where R273 might be affecting response times, and to increase the power of the test, I used two robust regressions with both drug instruction and filler response time to predict how long subjects took to respond to misled and control questions on the memory test. By using the robust regressions, the effect of the outliers was minimised.

After controlling for how long subjects took to respond to the filler test questions, I found that the information subjects received about their substance was a significant predictor of how long they took to respond to misled items, t (93) = -2.16, p = .03, *Cohen's d* = .34, but not control items, $t < 1$, *ns*. In other words, Figure 2.7 shows that Told Drug subjects answered misled test questions more slowly than their Told Inactive counterparts, and more slowly than they answered the filler questions. The figure also shows that Told Inactive subjects responded as quickly to misled test questions as they did to filler test questions. This pattern of results lends support to the hypothesis that Told Drug subjects used slower and more deliberate source monitoring for misled items.

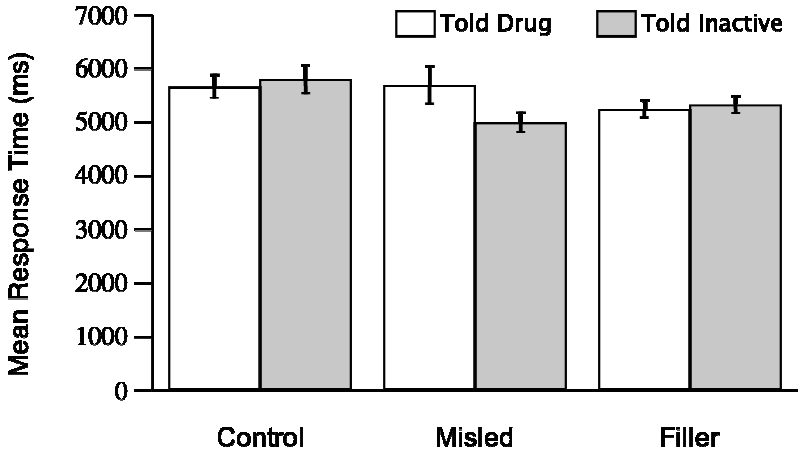

*Figure 2.*7 Mean response time to answer critical item questions during the memory test by drug instruction.

In summary, the response time findings lend support to the hypothesis that Told Drug subjects used more effortful and deliberate decision processes during the test than their Told Inactive counterparts. More specifically, the results suggest that instead of responding quickly and automatically, Told Drug subjects slowed down their responding—deliberating more carefully over the qualitative characteristics of their memories—and were less misled. In addition, this pattern of findings converge with the studies whose results suggest that subjects who use a slower and more careful response strategy on the memory test tend to be more accurate than subjects who respond quickly (Echterhoff et al., 2005).

Confidence

Thus far, the results suggest that R273 affects Told Drug subjects' accuracy and their speed of responding to misled items on the memory test. But does R273 affect subjects' subjective appraisals of their memories? To examine this question each subject's mean confidence was calculated for the four control and four misled test

questions, and then classified these means according to whether subjects were in the Told Drug or Told Inactive condition.

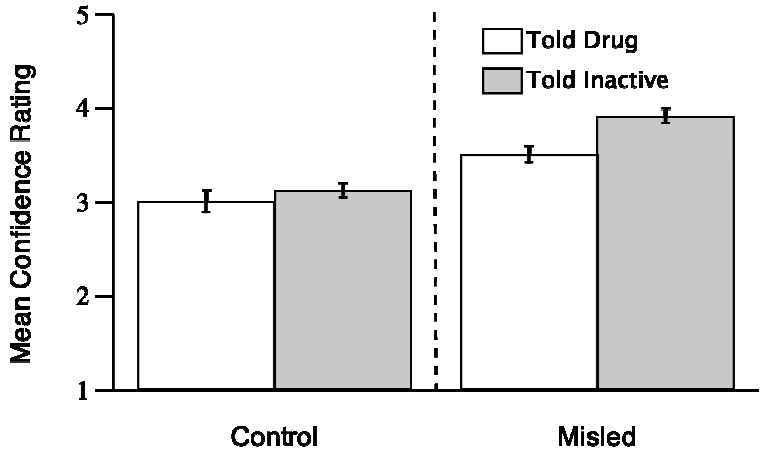

Figure 2.8. Mean confidence for control and misled items by drug instruction (Told Drug or Told Inactive).

As Figure 2.8 shows, regardless of what subjects were told about their drug, they were more confident about their responses to misleading items than control items, F (1, 94) = 66.85, $p < .01$, $\eta_p 2 = .42$ (see also Assefi & Garry, 2003; Loftus et al., 1989). However, a marginal interaction between what subjects were told about their substance and their confidence shows that subjects were not equally confident in their control and misled memories F (1, 94) = 3.56, $p = .06$, $\eta_p 2 = .04$. Follow-up pairwise comparisons showed that while Told Drug and Told Inactive subjects were similarly confident of their answers to control items, $t < 1$, *ns*, Told Inactive subjects were more confident of their misled answers t (94) = 2.99, $p < .001$, *Cohen's d* = .62.

These results, like those obtained on accuracy and response time, lend support to the hypothesis that Told Drug subjects used more cognitive effort during the

memory test than Told Inactive subjects in two ways. First, research suggests that when subjects experience an answer as coming to mind easily, and that answer seems familiar, they are more confident that they are correct regardless of whether they are correct (Kelley & Lindsay, 1993). Second, research suggests that when subjects experience a memory as being difficult to retrieve, they infer from this difficulty that the memory is incomplete or fragmented (Belli, Winkielmen, Read, Schwarz & Lynn, 1998). The confidence findings converge with these lines of research: Told Inactive subjects' reaction time data suggests they responded to misled items in the quick and effortless manner on the basis of familiarity. As such, it seems unlikely that Told Inactive subjects would have questioned the accuracy of their answers to misled test questions. Conversely, Told Drug subjects' reaction time data suggests they responded to misled items slowly and carefully. Consequently, Told Drug subjects might have inferred from their increased cognitive effort that their memories are inconsistent, fragmented or incomplete.

Next I examined subjects' confidence in their true memories (correct responses to control items) and false memories (incorrect answers on misled items). These data appear in Figure 2.9

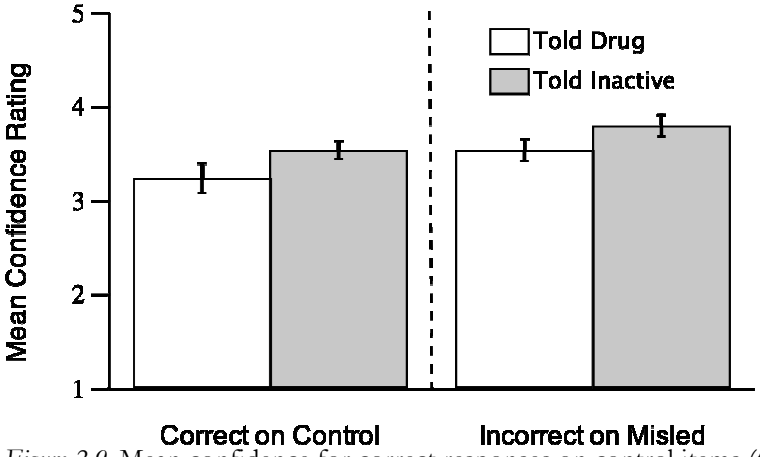

Figure 2.9. Mean confidence for correct responses on control items (true memories) and incorrect responses on misled items (false memories) by drug instruction (Told Drug or Told Inactive).

As the figure illustrates, subjects were more confident of their false memories than their true memories, as shown by a main effect for PEI, F (1, 89) = 4.48, p = .04, $\eta_p 2$ = .05. However, as shown by a marginal main effect for condition, F (1, 89) = 3.55, p = .06, $\eta_p 2$= .04, Told Drug subjects were less confident than Told Inactive subjects in both their true and false memories. These results fit with the findings for overall confidence, and once again suggest that Told Drug subjects might have used more cognitive effort on the memory test than their Told Inactive counterparts.

WMC

My third goal in Experiment 1 was to investigate whether WMC was related to the effectiveness of R273; I expected to see a relationship between OSPAN and subjects' resistance to misleading suggestion among Told Drug but not among Told Inactive subjects.

To examine this issue, I first obtained OSPAN scores from the 693 subjects who took part in mass testing, and found 76 of whom had later volunteered for the

R273 experiment. Of these 76 volunteers, 36 had been randomly assigned to the Told Drug condition, and 40 to the Told Inactive condition. Mean OSPAN score did not differ between conditions, M_{Drug} = 45.44 (*SD* = 17.00), and $M_{Inactive}$ = 40.28 (*SD* = 21.12), t (74) = 1.17, p = .12, *ns*.

Next, to examine whether WMC was associated with subjects' susceptibility to misleading information partial correlations were calculated between subjects' OSPAN scores and their misled performance, while controlling for subjects' overall belief in the drug[2]. An overall belief score was calculated by summing the scores across the six cognitive effects on manipulation check.

The zero-order correlations indicated that there was no relationship between subjects' OSPAN scores and their performance on misled items. However, there was a negative correlation between OSPAN scores and belief in the drug indicating that the higher subjects' OSPAN, the less likely they were to say that they experienced the effects of R273. Thus, to examine what happens to OSPAN and misled performance when belief is controlled, I conducted a series of partial correlations.

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[2] Partial correlation is a technique used in the "causal" modeling of small models consisting of 3-5 variables. According to Cohen et al. 2003 the partial correlation technique asks whether when a third variable is held constant, is the relationship between x and y the same as when the third variable was ignored.

Table 2.2 Zero-order correlations between measures without controlling for belief and misled item performance

	Drug Condition					
	Told Drug			Told Inactive		
	OSPAN	**Belief**	**Misled**	**OSPAN**	**Belief**	**Misled**
OSPAN	1	-.45*	.37	1	-.11	.05
Belief	-.45*	1	.34**	-.11	1	.03
Misled	.37	.34**	1	.05	.03	1

* = p < .01 ** = p < .05

Once belief was controlled for, I found in the Told Drug condition WMC was related to subjects' susceptibility to misinformation: the higher a subject's WMC in the Told Drug condition, the less likely they were to be misled. In the Told Inactive condition, WMC was unrelated to subjects' susceptibility to misinformation. In other words, WMC was significantly associated with resistance to misleading suggestion among Told Drug subjects, but not among Told Inactive subjects, $pr(33) = .38$, $p = .02$; $pr(37) = .06$, $p = .72$, *ns,* respectively.

In source monitoring terms, these results fit with the idea that in situations that demand controlled, effortful attention, people with a higher WMC are better able to monitor the sources of their memories and block out the interfering, misleading PEI. While WMC was not associated with subjects' resistance to misleading PEI in the Told Inactive condition, WMC was associated with subjects' resistant to misleading PEI in the Told Drug condition. These results converge with the evidence from Watson et al. (2005) who found that subjects with higher spans were better able to heed a warning about a false memory effect than their lower span counterparts.

The working memory results of Experiment 1 also fit with a larger body of research showing that in certain conditions, higher spans possess an advantage over lower spans. For example, Kane et al., (2007) examined whether higher and lower spans

differ in the amount of mind wandering they experience throughout the day. Subjects were given Intel Corporation Palm Pilot personal digital assistants (PDAs: model m100, m125, or m130) that beeped randomly eight times a day. When the PDA beeped, subjects completed questionnaires that recorded what they were doing at the time and if their minds had wandered during their current task. Kane et al. found that higher spans differed only in the amount of mind wandering that they did during cognitively demanding tasks. That is, when the task that the subjects were engaged in demanded effortful attention, higher spans were better able to keep their attention focused and their minds on the task at hand.

Summary

Experiment 1 produced three important results. First, R273 reduced subjects' susceptibility to misleading information. While all subjects performed equally well on control items—indicating that the misled performance was not a by-product of better overall memory of the event—Told Drug subjects were less likely than Told Inactive subjects to report the incorrect PEI item on the memory test. What is more, I found support for the idea that this increase in accuracy might be due to Told Drug subjects' source monitoring at test: Told Drug subjects were slower to respond to misled test questions than their Told Inactive counterparts. This finding fits with an SMF tenet that the decision processes people use to determine the sources of their memories play an important role in their ability to correctly attribute source to a memory. By slowing down their responding on the test, it is possible that Told Drug subjects examined more qualitative characteristics of their memories and selected their answers not solely on the basis of familiarity. Finally, these results suggest that R273's effectiveness is related to WMC; OSPAN was associated with better resistance to misleading suggestion—

especially when subjects were told they would receive R273. Taken as whole, the results of Experiment 1 suggest that R273 decreases the misinformation effect because it affects subjects' behaviours during the memory test.

This pattern of results extends the literature examining postwarnings and people's resistance to the misinformation effect (Chambers & Zaragoza, 2001; Meade & Roediger, 2002; Echterhoff et al., 2005). Recall that Echterhoff et al., (2005) gave subjects a postwarning about the misinformation messenger and found that warned subjects were slower to respond to misled test questions and more accurate. In my study, however, I did not suggest to subjects that R273 may be more effective during a particular part of the method, nor did I tell them in the cover story that R273 affects memory. R273 was administered before subjects watched the event, and subjects used their response expectancies about R273 to guide their source monitoring during the memory test.

To align the R273 method more directly with the postwarning literature, and to find convergent evidence that R273 works because it affects subjects' source monitoring during the memory test the aim of my next experiment was to target subjects' source monitoring behaviours at test. To address this question, Experiment 2 used a design whereby all subjects were told that they had received an inactive placebo. Then immediately before the memory test some subjects were informed that they had actually received the cognitive enhancing drug R273.

Chapter 3

Experiment 2: R273 administered before a memory test reduces the misinformation effect

The results of Experiment 1 suggest that R273 increased Told Drug subjects' resistance to the misinformation effect by leading them to use slower and more effortful source monitoring during the memory test. Yet these results do not rule out the possibility that Told Drug subjects' source monitoring during the PEI was affected in ways beyond that which could be detected with a measure of reading speed, nor the possibility that Told Drug subjects changed their source monitoring in between the PEI and memory test. Therefore, the next step was to investigate whether giving subjects R273 immediately before the memory test would provide a similar pattern of results to Experiment 1. If administering R273 immediately before the memory test reduced the misinformation effect, there would be further evidence to suggest that R273 "works" because it affects subjects' source monitoring during the test. Literature on postwarnings, source monitoring and the misinformation effect shed light on how this reduction might occur.

As discussed in Chapter 2, studies show that when subjects receive direct and explicit warnings before the memory test, alerting them to the discrepancies between the event and the PEI, they are less misled. Specifically, telling subjects that some of the details in the PEI are incorrect, enlisting the help of a confederate to accuse the experimenters of deliberately trying to trick subjects, and warning subjects that their discussion partner might have made mistakes, are some of the ways that postwarnings have been used to increase subjects' resistance to misleading suggestion (Chambers and Zaragoza, 2001; Christiaansen & Ochalek , 1983; Meade & Roediger 2002). Similarly,

research using a Dodd and Bradshaw (1980) type of warning that brings the credibility of the misinformation messenger into question, has also successfully led subjects to resist the effects of misleading postevent suggestion (Echterhoff et al., 2005). Taken as a whole, there is ample evidence suggesting that the memory-distorting effects of misleading PEI can be reduced by subjects' behaviours at test, if they are provided with a warning about the PEI. A warning may potentially lead subjects to scrutinise the source of their memories more carefully during the test and use more careful and effortful monitoring processes.

Another body of literature also sheds light on the important role that source monitoring plays during the memory test, and comes directly from studies that have used explicit source monitoring tests—as opposed to 2AFC recognition tests—in misinformation effect experiments. Specifically, another way of increasing subjects' resistance is to simply give them a source monitoring test. On a source monitoring test, subjects are encouraged to use processes different from the familiarity-driven processes in the standard 2AFC or yes/no recognition tests (Johnson et al., 1993; Lindsay & Johnson, 1989). Recall from Chapter 1 that the typical format of a source monitoring test asks subjects to examine all possible sources of their memory in order to attribute a source to an item. Specifically, subjects are asked to classify whether an item came from the slides, the narrative, both, or neither. In making this classification, a subject who saw the math book and then read about a computer book might think, "I think I saw the math book, but I also think I read about a computer book." Such a process should encourage subjects to retrieve even more qualitative characteristics of "seen" and "read" items, highlight the qualitative differences between them, and deliberate more carefully than they would in a 2AFC test. Consequently, a certain portion of subjects who take a

source monitoring test, and engage in these more effortful decision processes, should shift away from adopting the familiar yet misleading "computer" suggestion compared to subjects who took the recognition test. Subsequently, a number of studies—such as those reviewed in Chapter 1—have directly compared source monitoring tests to recognition tests and reliably show that source monitoring tests can reduce, and in some cases even eliminate, the misinformation effect (Lindsay & Johnson, 1989; Zaragoza & Koshmider, 1989; Zaragoza & Lane, 1994).

As a whole, the findings on postwarnings, the misinformation effect and source monitoring suggest that an instruction after the PEI that increases effortful source monitoring should decrease the misinformation effect. Yet research examining postwarnings and the misinformation effect has used manipulations that either directly alerted subjects to the erroneous nature of the PEI—by telling them about the discrepancies or by insinuating that the misinformation messenger is not credible—or by using explicit source monitoring tests. To date, no research has examined whether an instruction before test that says nothing about the PEI, or the source of the PEI, can reduce the misinformation effect. Therefore, administering R273 immediately before the memory test would answer two important questions. First, considered in concert with the findings of Experiment 1, administering the drug instruction immediately before subjects take the memory test would provide further evidence on whether R273 "works" because it changes Told Drug subjects' source monitoring only during the memory test. Second, it would also fill a gap in the postwarning literature that has established that explicit postwarnings reduce the misinformation effect, but has not established whether implicit postwarnings—warnings that say nothing about the discrepancies in the PEI nor its source—reduce the misinformation effect. If I find that

telling subjects about R273 immediately before the memory test still reduces their susceptibility to misinformation, it would be the first study showing that an implicit warning that says nothing about memory or the erroneous nature of the PEI, is able to change subjects' source monitoring at test and thus reduce their susceptibility to misinformation.

Method

Subjects

Ninety-six undergraduate psychology students participated for course credit. Subjects took part in groups of no more than three and did not talk to each other during the session.

Design

The experiment used a 2 x 2 mixed design with drug instruction at test (Told Drug or Told Inactive) as the between-subjects factor, and PEI (control or misled) as the within-subjects factor.

Materials and Procedure

The procedure in Experiment 2 was exactly the same as in Experiment 1, with two exceptions (see Figure 3.1).

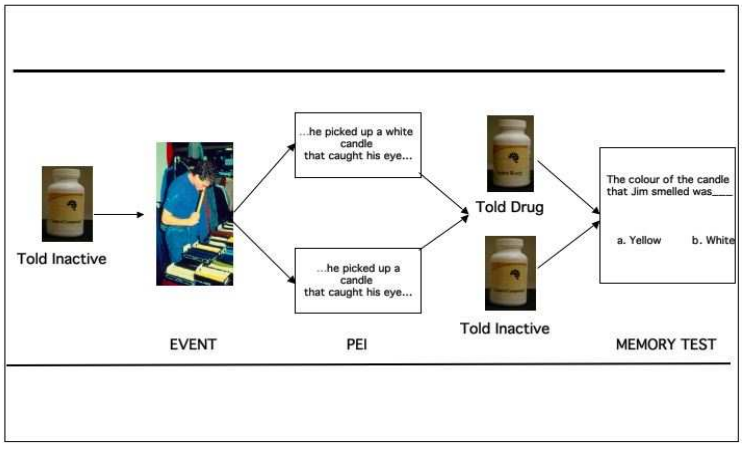

Figure 3.1. An overview of the method used in Experiment 2

First, because I was not examining subjects' WMC in Experiment 2, I did not collect OSPAN data. Second, during the drug administration phase, all subjects were told that they had been assigned to receive the inactive version of the drug. Then, after subjects had taken their substance, read the PEI narrative, and completed the filler task, I told everybody that I had misinformed some subjects about the contents of their drug. Specifically I told subjects:

> In clinical drug studies we use one of several techniques to examine the effectiveness of a particular drug. One commonly used technique is called the balanced behavioural separation technique {*a made-up name for the purpose of the study*}. This technique is very helpful because it allows us to identify abnormal or unusual patterns of responding from participants. We try to identify these subjects by using a number of techniques and one of these techniques is to run some sessions where I don't tell you the true nature of the substance you're taking until later on in the session. I will now reveal to you which group you are in.

Half the subjects were then truthfully told that they had received the inactive drug (Told Inactive); half the subjects were told they had received the active drug (Told Drug). Immediately after subjects were informed of their drug condition they took the memory test.

Results and discussion

Manipulation Check

As in Experiment 1, I first examined whether Told Drug subjects would report that they had experienced drug effects, in line with some of R273's response expectancies.

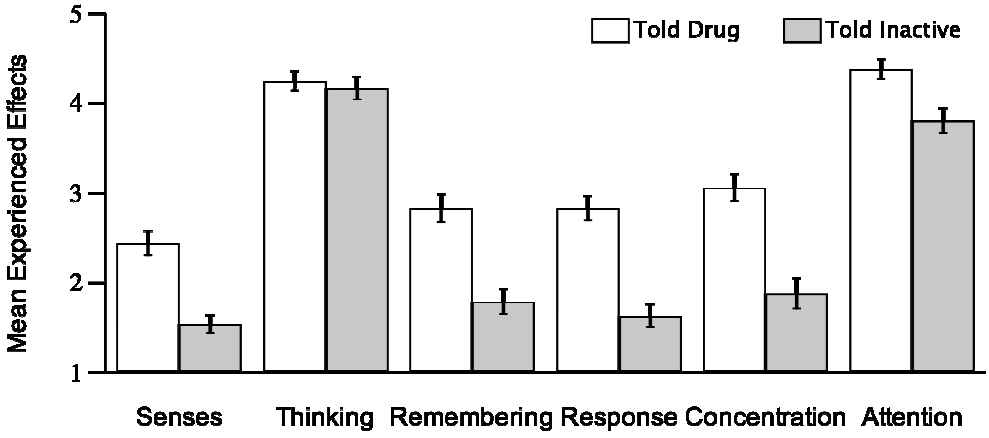

Figure 3.2. Mean score for the manipulation checks by drug instruction

Figure 3.2 shows a pattern of results similar to those obtained in Experiment 1: Told Drug subjects reported feeling more effects of R273 than the Told Inactive subjects, F (1, 94) = 35.33, $p < .01$, $\bullet_p^2 = .27$. Once again however, Told Drug subjects did not report the benefits of R273 on all six measures, as shown by the interaction between drug instruction and cognitive abilities rating, F (5, 90) = 4.18, $p < .01$, $\bullet_p^2 = .19$. Follow up t-tests revealed that Told Drug subjects rated every cognitive ability significantly higher than the Told Inactive subjects (all p's $< .01$) except for thinking, $p = .65$

Subjects' comments once again fit with these empirical findings. For example, one subject wrote that "I was tired before the experiment and noticed a definite rise in

awareness after the short clip...I soon became aware that I may not have taken the placebo as I felt much more focused than before." Subjects 15, 20, and 53 reported feeling "more alert," while subject 18 reported that he experienced a "slight head-rush" and subject 20 claimed that he felt "mild tingling in the fingers."

Misinformation Effect

I now turn to my primary research question: was there empirical support for the prediction that R273 could act as an implicit postwarning, and produce effects similar to those obtained in Experiment 1? If so, I should find that Told Drug subjects were as accurate as Told Inactive subjects on control items, and that Told Drug subjects were more accurate than Told Inactive subjects on misled items. To address this issue, I first calculated each person's mean correct responses to the four misled and four control questions, and then classified these means according to whether I told subjects that I had given them the active or inactive version of R273. Because I found four outliers—one in the Told Drug group and three in the Told Inactive group—I used both a 2 x 2 mixed ANOVA to determine the effect of drug instruction on memory accuracy, and an M-estimator robust regression, which minimises the effect of the outliers and provides a model with a better fit to the majority of the data, and increased power.

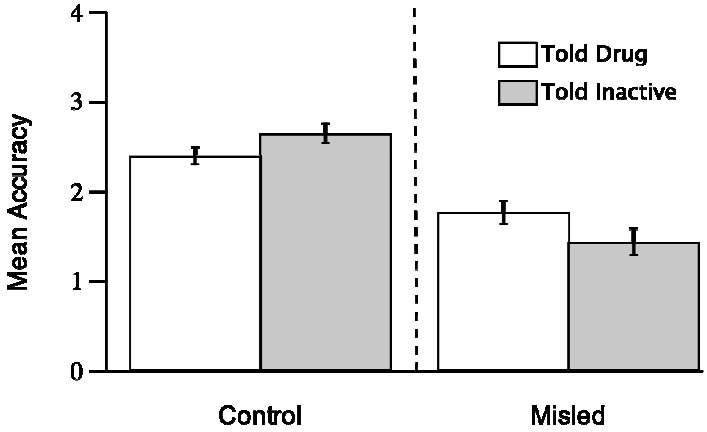

Figure 3.3. Mean number of items correct by drug instruction

As Figure 3.3 shows, R273 caused a pattern of responses similar to those obtained in Experiment 1; regardless of what subjects were told about their substance, all subjects were better at correctly remembering control items than they were at correctly remembering misled items, F (1, 94) = 47.05, $p < .001$, $\eta_p 2 = .38$. In other words, comparing just the white bars and just the grey bars, shows there was a misinformation effect in both the Told Drug, t (47) = 3.56, $p < .001$, *Cohen's d* = .70, and Told Inactive conditions, t (47) = 5.99, $p < .001$, *Cohen's d* = 1.22. But were Told Drug subjects any more resistant to the misleading information than their Told Inactive counterparts? The bars on the left side of the dotted line suggest that Told Drug and Told Inactive subjects were similarly accurate on control items;[3] the bars on the right side of the dotted line show that Told Drug subjects were more accurate on misled

[3] The control bars on Figure 4.2 appear to show Told Inactive subjects having slightly better memory performance than Told Drug subjects. However, the robust regression revealed that their performance was not significantly different. To ensure that this pattern of results was not simply due to a lack of power I conducted analyses in G-Power (Faul et al., 2006) to calculate the least significant number of subjects. The analysis showed that with power of .95 I required at least 486 subjects to detect a difference between Told Drug and Told Inactive subjects for control items (*Cohen's d* = .30). Therefore I concluded that it was not lack of power that resulted in non-significant findings.

items than their Told Inactive counterparts. This finding was qualified by a significant interaction between what subjects were told and PEI type, F (1, 94) = 4.76, p = .03, $\eta_p 2$ = .05. However, follow up t-tests suggested that there was not enough power to detect a difference between Told Drug and Told Inactive subjects' performance for control and misled items. Thus, two robust regressions were carried out, in order to increase the statistical power of the test. The M-estimator robust regression showed that what subjects were told about the drug did not predict their memory performance on control items, t (94) = 1.44, p = .15, *ns,* but did predict their memory performance on misled items, t (94) = 2.08, p = .04, *Cohen's d* = .32. These results suggest that giving subjects R273 acted similarly to a direct postwarning, and produced response expectancies that were reflected in the form of more effortful and effective source monitoring.

Response Time

Next, I examined how long subjects took when they responded to misleading questions on the memory test. Recall that in Experiment 1, I found Told Drug subjects were slower to respond to misleading test items than were Told Inactive subjects. Based on this finding, I expected to find a similar pattern here. Because I found one outlier in the Told Drug condition, and two outliers in the Told Placebo condition, I conducted both a 2 x 2 mixed ANOVA and a robust regression, following the same procedure for analysing the reaction time data as in Experiment 1.

As Figure 3.4 shows, I did not replicate the pattern of findings from Experiment 1. That is, although Told Drug subjects took longer to answer the misled test items, the results of both the ANOVA and robust regression indicated they did not take significantly longer, $F < 1$, ns and $t < 1$, *ns* respectively. Yet when Told Drug subjects were correct, they were marginally slower at responding to misled test items than were

Told Inactive subjects, t (93) = -1.81, p = .07, *Cohen's d* = .22, but were equally fast to respond to control items, t <1, *ns*.

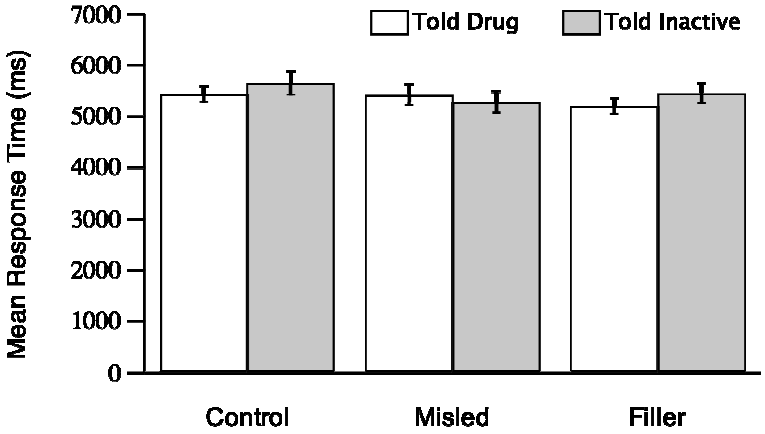

Figure 3.4. Mean response time to answer critical item and filler questions during the memory test by drug instruction

Although I expected to find convergent evidence for increased source monitoring in the form of Told Drug subjects' longer response times during the test, I did not. What am I to make of this result? One explanation is that the methodological differences between Experiment 1 and Experiment 2 affected both Told Drug and Told Inactive subjects' behaviours at test. More specifically, the semi-debriefing that subjects received before the memory test may have alerted them to the fact that the study used deception. As a result, some subjects might have been puzzled as to why I was informing them of the deception and may have guessed that the study had an ulterior motive. In the same vein, the semi-debriefing that subjects received may have given Told Drug subjects a small boost to their confidence, thus causing them to increase their response times and answer the test questions more quickly than the Told Drug subjects in Experiment 1. Thus it is possible that a portion of suspicious Told Inactive subjects increased their source monitoring, scrutinising their memories more carefully

and slowing down their responding on the memory test, while a portion of Told Drug subjects decreased their source monitoring, deliberating less carefully and responding to misled test questions more quickly, causing the difference between Told Drug and Told Inactive subjects' response times to disappear. Indeed, comparing subjects' response times across Experiments 1 and 2 (see Table 3.1), suggests that Told Inactive subjects were slightly slower than Told Inactive subjects in Experiment 1, while Told Drug subjects were slightly faster than Told Drug subjects in Experiment 1. This change in response time could explain why I failed to find a difference. Yet if this is the case, I might expect to see these response time changes reflected in subjects' accuracy on misled test questions—but I do not. Thus, I do not find this counter explanation a compelling account of why I failed to replicate the reaction time findings in Experiment 2.

Table 3.1. Means and Standard Deviations for Reaction Time (Misled) across Experiments 1 and 2

	Drug Condition			
	Told Drug		Told Inactive	
	Mean	SD	Mean	SD
RT (ms) Experiment 1	5694.24	2572.13	4995.57	1400.78
RT (ms) Experiment 2	5422.84	1559.76	5280.29	1587.74

Another more likely explanation, is that given my maximum sample size—an allocation from the department participant pool—an a priori power analysis based on data from Experiment 1 suggested very good statistical power to answer the primary

research question (Power = .97)[4] but far less power to detect response time differences (Power = .23). Of course, I should not take this lack of a significant effect to mean that Told Drug subjects did not engage in more deliberate and careful source monitoring at test because source monitoring involves many attributes, and I measured only one of these attributes (Johnson et al., 1988). One possibility is that Told Drug subjects might have set a higher criteria or threshold on the qualitative characteristics of their memories than their Told Inactive counterparts (Hekkanen & McEvoy, 2002). That is, Told Drug subjects may have required more qualitative characteristics, or a greater amount of one particular qualitative characteristic, before they accepted or rejected an item. If indeed a criteria shift did occur, this shift in behaviour would not necessarily be detected using a measure of reaction time. In addition, both the objective empirical data on subjects' memory performance and their own self-reports suggest that they experienced clear benefits from taking a substance that does nothing to change their abilities.

Confidence

Did telling subjects that they had taken R273 make them more confident in either their control or misled answers? As Figure 3.5 shows, the answer is no: both Told Drug subjects and Told Inactive subjects were more confident of their responses to misled items than control items, regardless of what they were told about their drug (see also Assefi & Garry, 2003; Loftus et al., 1989). In short, a 2 (drug instruction) x 2 (PEI) mixed ANOVA, showed a main effect for PEI F (1, 94) = 30.58, $p < .01$, $\bullet_p^2 = .25$, and no effect for drug instruction $F < 1$.

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[4] I conducted power analyses in G-Power (Faul et al., 2006).

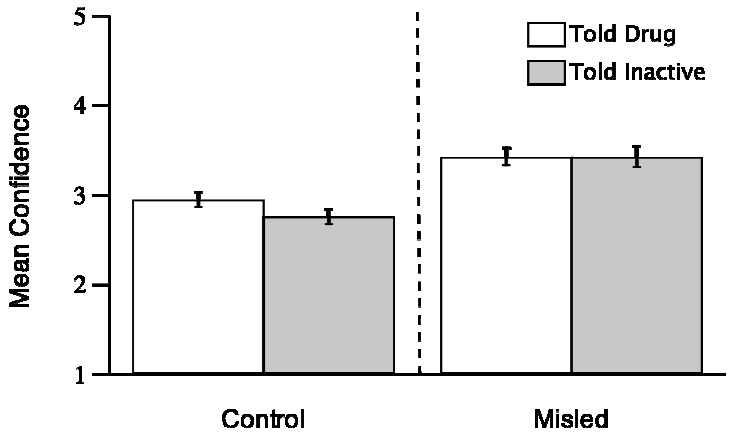

Figure 3.5. Mean confidence for control and misled items by drug instruction

Did telling subjects that they had taken R273 affect their confidence in either their true or false memories? Again the answer is no: while the pattern of results showed that Told Drug subjects were slightly more confident of their true memories, and less confident, of their false this pattern did not reach statistical significance. In other words, there was no interaction between PEI and condition, F (1, 89) = 2.27, p = .14, ns, and no main effects for either PEI or condition, F's < 1, *ns*.

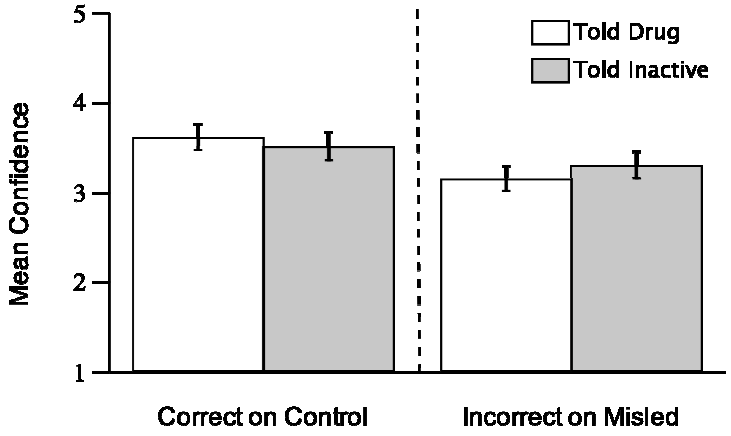

Figure 3.6. Mean confidence for correct responses on control items (true memories) and incorrect responses on misled items (false memories) by drug instruction.

In sum, the confidence data did not replicate the pattern of results that I obtained in Experiment 1: the drug instruction did not affect subjects' subjective appraisals of their memories.

Summary

Experiment 2 aimed to find further evidence that the R273 placebo effect occurs because of subjects' source monitoring during the memory test. The primary finding supported this prediction: subjects who were told they had received R273 immediately before taking the memory test were less misled than their Told Inactive counterparts. However a secondary finding did not lend support to this prediction. Specifically, I failed to find a significant difference between Told Drug and Told Inactive subjects' response time on misled test questions. However, while this non significant finding is at first perplexing, there is some evidence to suggest that the response time pattern of results is due to lack of power.

Experiment 2 has both practical and theoretical implications. Theoretically the results obtained in Experiment 2 contribute to the literatures on source monitoring and

the misinformation effect by showing that the processes that people use during the memory test can lead them to resist the effects of erroneous and misleading postevent suggestion. More specifically, because R273 was administered immediately before the memory test, this reduction in susceptibility to misleading information can only be attributed to subjects' source monitoring during the test, and not during the encoding of the event or during the PEI. Thus the findings of Experiment 2 are in concert with Experiment 1 and, taken together, suggest that a sham drug can reduce the misinformation effect by setting in motion behaviours that override subjects' tendencies to rely on automatic and non-conscious behaviours. Indeed the results suggest that R273 causes subjects to switch from their usual automatic and effortless processing to more deliberate and effortful strategies.

Experiment 2 also has practical implications and mimics more closely than Experiment 1 what could occur in a real-world eyewitness situation. Recall that the drug administration phase in Experiment 1 occurred before subjects watched the event, but in a real-world situation, witnesses usually do not know when they are going to see a crime and therefore, cannot presciently take a memory-enhancing drug before it occurs. In Experiment 2 on the other hand, the drug administration occurred after subjects watched the event *and* received PEI about that event. It is possible that police interviewers might one day have a number of promising techniques to reduce eyewitness memory error, even after those eyewitnesses have been exposed to the contaminating effects of misleading postevent suggestion. In sum, while eyewitnesses cannot necessarily prepare themselves for when they will see a crime, they can adjust their behaviours when they recall that crime, which leads to them being more accurate.

Second, the results of this experiment extend those of Experiment 1 showing that subjects' beliefs about their own abilities can protect them from the effects of misleading suggestion. This belief can be induced in witnesses without directly telling them about the misleading PEI or mentioning the word memory. Taken together, these experiments suggest that witnesses might be able to motivate themselves to use more careful source monitoring and disregard erroneous and misleading PEI.

Chapter 4

Experiment 3: A psychotropic placebo can improve prospective memory

Einstein and McDaniel (2004) report that on a day-to-day basis the most common type of memory failure experienced by both young and old adults is forgetting to perform intended future actions—prospective memory (PM). In some cases forgetting to remember proves nothing more than a mere annoyance; in other cases forgetting to remember proves deadly. For example, on 2 October 1996 Aeroperu Flight 603 crashed into the Pacific Ocean killing everyone onboard. An investigation into the cause of the crash revealed that the most likely explanation was a PM failure: a plane technician forgot to remove a piece of tape that he had placed over a vital piece of equipment during routine cleaning (Ladkin, 1997). Thus, with PM playing such an important role in people's everyday lives, and with the consequences of PM failures ranging so vastly in their ramifications, psychologists are interested in understanding the cognitive processes underlying PM.

The Underlying Cognitive Processes of Prospective Memory

Our days and our heads are filled with things to remember: turn on the house alarm before you leave for work; pick up the kids from cricket practice at 4.30; put out the rubbish for collection in the morning, and so on. But among the myriad PM tasks we must remember to perform each and every day, are the attention absorbing, ongoing tasks such as writing that upcoming lecture, watching the latest episode of *Lost* or conversing with friends. Therefore, a critical component of PM is bringing the intended action to mind, in the absence of an explicit request to remember, and performing it at the right time in the face of ongoing distraction (McDaniel & Einstein, 2000). To

address how people remember PM tasks—or put another way, how they remember to put out the rubbish—McDaniel and Einstein (2000) propose the multiple-processes framework.

The Multiple Processes Framework

The central tenet of the multiple-processes framework is that prospective remembering occurs through one of two processes. On the one hand, remembering can occur through controlled and effortful *monitoring* whereby people actively monitor their environments and ultimately remind themselves of what they need to do. According to McDaniel and Einstein (2000), when people form an intention to perform an action in the future, an attentional system actively monitors the environment until it is time to perform that action. When appropriate, the attentional system interrupts the ongoing activity and initiates the processes necessary to perform the PM action.

Because the monitoring approach can be thought as being similar to divided attention (e.g. attention is split between performing an ongoing task and monitoring the environment), research suggests that the more monitoring people use, the more detrimental effects are seen on ongoing task performance. For example, people are often slower to complete their ongoing task when they are using monitoring in order to remember their PM task (Marsh & Hicks, 1998; Smith, 2003). In addition, people are not always accurate at remembering to perform their PM task because constant monitoring is hard to sustain and easily disrupted (Einstein et al., 2005).

On the other hand, successful prospective remembering can occur through an automatic and effortless *spontaneous retrieval* process whereby people rely on the cues of the situation to remind them about what they need to do. According to McDaniel and Einstein (2000), when people develop the intention to perform a PM action they form

an association between a target cue—something or someone that specifies that it is time to perform the action—and the intended action. When this cue is encountered, an automatic associative system delivers the intended action to mind. Because spontaneous retrieval demands fewer cognitive resources than monitoring, it is the more commonly used process (McDaniel & Einstein, 2007).

Both subjective and objective evidence suggests that people use spontaneous retrieval in order to remember PM tasks. Subjectively, people report that the thought of the PM action just "pops" into mind. Also, probed at various points throughout an experiment people rarely mention thinking about the PM task. Objectively, when people use spontaneous retrieval, their PM performance remains high yet there are typically few costs observed to their concurrent and ongoing task (Einstein & McDaniel, 1990; Reese & Cherry, 2002; Einstein et al., 2005).

If spontaneous retrieval is the less effortful of the two PM processes, and usually equates with people remembering to perform their intended PM action, why would people use monitoring in order to remember PM tasks? According to the literature, the process that people rely on is influenced by a number of factors—many beyond the scope of this thesis. However, two key factors have been identified. These two factors are the cues in the environment and the importance of the PM task.

Cues

Like many types of memory, PM can be facilitated by cues. For example, when we need to remember to put out the rubbish, we may encounter something in our environment that prompts us to remember this PM task. The effectiveness of these cues, however, depends heavily on the overlap between features of the cue and features

of the ongoing task. Consequently, cues are influential in determining the cognitive process used in order to retrieve the PM task.

Focal cues: In some cases, there is high overlap between the ongoing task and the PM cue. In this instance the PM cue becomes *focal* because its relation to the ongoing task means that there is a high chance that it will be attended to, processed and brought into awareness. As a consequence, focal cues encourage spontaneous retrieval of the PM task. For example, imagine that it is Monday night—the night that you must remember to put out the rubbish (*the PM task*). You are in the kitchen making dinner (*the ongoing task*) and in the process, scrape a pile of scraps into the rubbish bin (*focal cue*). The action of putting the scraps into the rubbish bin brings the concept of "rubbish" directly into your awareness. Thus, upon opening the bin, you are automatically reminded that 1) it is rubbish night and 2) you should put the rubbish outside for collection. In this case, the presence of opening the bin prompts reflexive remembering of the PM task ("put out rubbish") without needing additional cognitive effort, attention and resources allocated to remembering the PM task. Therefore, focal cues typically demand spontaneous retrieval and encourage accurate PM performance, without causing detrimental effects to ongoing task performance.

Nonfocal cues: On the other hand a PM cue might not form part of the information extracted from the ongoing task and is therefore harder for the cognitive system to detect. Thus, if a PM cue is less easily detected it becomes a *nonfocal* cue. For example, imagine once more that it is Monday night—the night that you must remember to put out the rubbish (*the PM task*). Instead of cooking dinner you are engrossed in watching your favourite show on TV (*ongoing task*). In the ad break you head into the kitchen and grab a snack out of the fridge before going back into the

lounge. Although the bin (*the nonfocal cue*) is in the kitchen and could be detected by your cognitive system, it is unlikely it will enter your awareness without conscious effort because the ongoing task does not call direct attention to it. Thus, nonfocal cues are unlikely to prompt spontaneous retrieval of the PM task: monitoring and allocating attentional resources to try and remember the task are likely to be the most successful methods of retrieving the PM task.

Task Importance

To recap, the process that people use to remember a PM task—spontaneous retrieval or monitoring—varies with the type of cues available in the environment. However, the strategies that people use also vary with the characteristics of the PM task, such as importance. In one study, Einstein et al. (2005) asked subjects to complete a laboratory based PM task. Subjects completed an ongoing word categorisation task (a task analogous to watching the TV programme or cooking dinner) but were also asked to remember to press a certain key when they encountered a certain type of cue (the PM task). Some subjects received focal cues that, because of the ongoing task, were likely to be processed and attended to (e.g. press the key when you see the word "*Dormitory*"). In this instance the cue is analogous to "rubbish bin" when you are putting scraps into the bin; subjects were likely to process and attend to the cue because their ongoing task brought direct attention to it. Other subjects received nonfocal cues that were unlikely to be attended to and detected without subjects using additional cognitive effort (e.g. press the key when you see the syllable "*tor*"). In this instance the cue is analogous to "rubbish bin" when the ongoing task consists of watching TV; subjects were unlikely to process and attend to the cue without additional cognitive effort because their ongoing task comprised of processing whole words and not just parts of words. Critically,

Einstein et al. also varied the perceived importance of the task: subjects were either told that it was *very* important that they remember to perform the PM task, or they were told that it was more important to correctly categorise the words.

Einstein et al. (2005) found three key results. First, regardless of task importance, subjects remembered to perform the PM task—pressing a key—when they had a focal cue, compared to subjects who had a nonfocal cue. Einstein et al. reasoned that this was because the focal cue encouraged spontaneous and automatic retrieval of the PM action. Second, when subjects received high-importance instructions subjects' performance on their ongoing task suffered. That is, when subjects thought that remembering the PM task was important there was evidence that they used monitoring in both the focal and nonfocal cue conditions and, as a result, subjects were slower to categorise the word-pairs during the ongoing task. Third, while the high-importance instructions increased monitoring in the focal and nonfocal conditions, subjects' performance on the PM task only improved in the nonfocal condition. That is, the benefits of increased monitoring only occurred when the PM task demanded effort, attention and control.

In sum, the literature reviewed thus far suggests that various factors influence whether people use spontaneous retrieval or monitoring in order to retrieve PM tasks. More specifically, these factors appear to play an influential role in the amount of cognitive effort that people use in order to remember their PM task. The idea that the amount of cognitive effort used can result in more or less memory accuracy brings the processes of PM into close alignment with those of source monitoring.

PM and Source Monitoring

The reviewed literature suggests that the underlying processes of PM may share some similarities with those of source monitoring. First, both PM and source monitoring can occur via one of two processes: either through an automatic and effortless process, or through a deliberate and effortful process. Second, like source monitoring, the process that people use depends on the characteristics of the PM task. For example, when people think that the to-be-remembered task is important or difficult, they are more likely to rely on effortful monitoring. When people think that it is unimportant or easy to remember the to-be-remembered task, they are more likely to rely on effortless and automatic retrieval (Einstein et al., 2005; Kvavilashvili, 1987). This claim aligns closely with an SMF tenet suggesting that people will use deliberate effortful source monitoring in situations where they think it is important to correctly attribute source to a memory (e.g. testifying in court), and will use the "good enough" heuristic processes when there are little, if any, consequences for misattributing source to a memory (e.g. when telling a story to a friend; Johnson et al., 1993). Because of the similarities between PM and source monitoring, and because Experiments 1 and 2 suggest that source monitoring can be influenced by people's expectations about their own abilities, I hypothesised that R273 might also improve subjects' prospective memories—but how?

Experiments 1 and 2 suggest that Told Drug subjects switched from automatic and effortless source monitoring to effortful and deliberate source monitoring. Therefore, I predicted that R273 might lead Told Drug subjects to switch from automatic and effortless PM processing to effortful and deliberate PM processing. If so, I might find a similar pattern of results to those of Einstein et al. (2005). Specifically, I

predicted that if Told Drug subjects used more effortful monitoring than Told Inactive subjects, they should be better at remembering to perform a PM task, but only in a situation that demands this monitoring. That is, Told Drug subjects who receive a nonfocal cue should be better than Told Inactive subjects at remembering to perform the PM task; Told Drug subjects who receive a focal cue should be no better than Told Inactive subjects at remembering to perform the PM task.

Second, if telling subjects that they have received R273 increases their tendency to use effortful monitoring, we should see greater costs to Told Drug subjects' performance during their ongoing task. More specifically, Told Drug subjects should take longer than Told Inactive subjects to categorise word-pairs, regardless of whether their cue to remember the PM task is focal or nonfocal.

Method

Subjects

In total 96 subjects participated in the study. Seventy-seven were first year psychology students who took part in return for course credit; nineteen were recruited by advertising around the campus and received a $10 music or grocery voucher in return for their participation.

Design

The experiment used a 2 x 2 x 2 mixed design with drug instruction (Told Drug or Told Inactive) and word condition (focal or nonfocal) as the between-subjects factors, and presence of a PM task (Control or PM) as the within-subjects factor.

Materials and Procedure

There were three phases to the procedure.

Phases 1 and 2: The first two phases (cultivating response expectancies and drug administration) were the same as Phases 2 and 3 in Experiment 1. After subjects had taken their substance and watched the 10-minute action clip, Phase 3 began.

Phase 3: Prospective Memory Phase. Phase 3 consisted of two halves that subjects completed on individual 14-inch iBooks. In one half subjects completed *only* an ongoing word categorisation task (*Control half*; see Figure 4.1); in the other half they completed an ongoing word-categorisation task *and* a PM task (*Experimental half*).

For the ongoing word categorisation task, common to both the PM and control tasks, two 160 word-pair sets were created from the Battig and Montague (1969) norms.[5] The sets were counterbalanced across both halves of Phase 3 so that each appeared equally often in the PM and control halves. The order of performing the PM and control halves was also counterbalanced so that half of the subjects performed the PM task first and half the subjects completed the control task first.

All subjects had a short break between performing the PM and control halves of the experiment: during this break they completed the Mill Hill Vocabulary Test (Raven, 1965) before continuing with the second half of Phase 3.

[5] Examples of materials used in Experiment 3 appear in the Appendices.

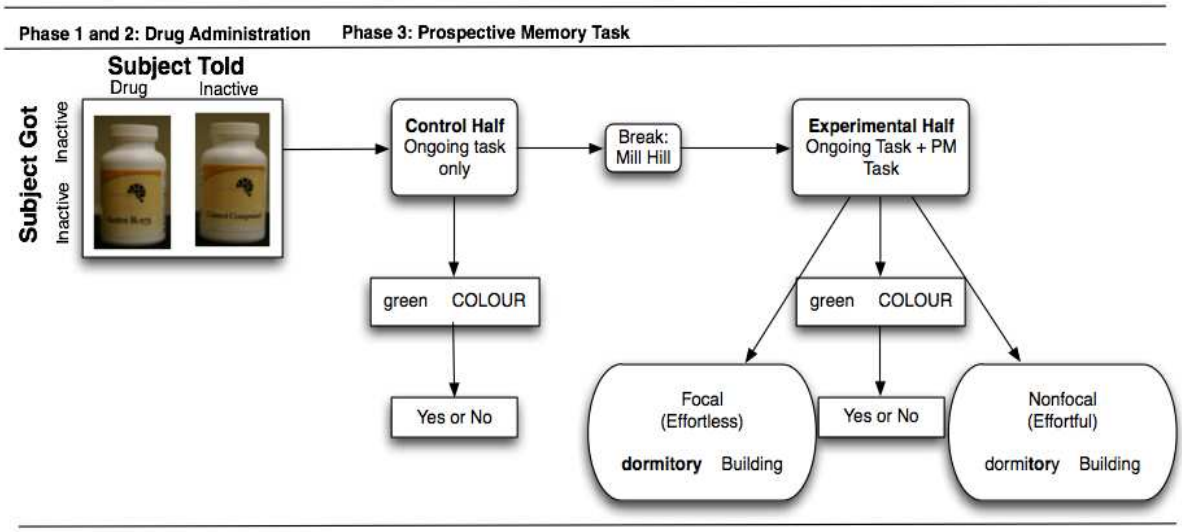

Figure 4.1. Overview of the procedure used in Experiment 4

Control half. For the control half, subjects saw 160 word-pairs and were asked to decide as quickly as possible whether a lower case word on the left of the screen belonged to the category of an upper case word on the right of the screen. For example, if "green" and "COLOUR" appeared on the screen subjects should respond by pressing the "Y" key (Yes). If "green" and "ANIMAL" appeared subjects should respond by pressing the "N" key (No). The word pair stayed on the screen until a subject made a response and this response triggered the next word pair.

Regardless of task order, all subjects initially received instructions on how to complete this ongoing word-categorisation task and then received 6 word-categorisation practice trials. After completing the practice trials subjects received instructions emphasising that their main goal was to complete the ongoing word trials as quickly and accurately as they could. Next, subjects were given 11 more practice trials that provided them with accuracy feedback. Subjects either then went on to perform the control task or they received the instructions for performing the PM task.

Experimental half. During the experimental half subjects completed 160 word-categorisation trials but *also* performed a PM task. Subjects were told that their primary task was to complete the ongoing task, but were asked to ignore the ongoing word-categorisation task and instead press the "Q" key whenever they saw a particular target item. Recall, Einstein et al. (2005) reasoned that a focal cue leads subjects to rely on spontaneous retrieval because they are likely to process and attend to the cue as they read the words for the ongoing task. Because they attend to the cue, they should be automatically reminded of the PM task. Nonfocal cues, however, lead subjects to rely on monitoring because they are less easily detected and processed, as the ongoing task does not call direct attention to them. Thus, in Experiment 3, varying whether subjects received a focal or nonfocal target cue manipulated the ease of performing this PM task. In the focal condition, half the subjects received a single target item *tornado* while the remaining half received the target item *dormitory*. Subjects in the nonfocal condition received the target item *tor*, which appeared once in each of the words dormitory, tornado, history and tortoise. The target item in both the focal and nonfocal conditions always occurred in positions 40, 120, 80 and 160. The word pair remained on the screen until a subject made a response and this response triggered the next word pair.

Finally, subjects completed two short questionnaires used as manipulation checks. The first was the cognitive effects manipulation check from Experiments 1 and 2. The second questionnaire asked subjects to indicate what their cue had been and which key they had pressed when they encountered the cue. The questionnaire also asked subjects to rate on a 1 (*Not at all important*) to 5 (*Very important*) scale their perceived importance of the ongoing task and PM tasks.

Results and Discussion

Recall, the primary aim of Experiment 3 was to see if R273 could improve people's prospective memories and whether it did so by leading them to use more cognitively demanding and effortful monitoring. Before I answered these primary questions however, I established that subjects correctly recalled their cue (Dormitory, Tornado or Tor) and the PM task (pressing the Q key), and whether the R273 drug manipulation worked.

Manipulation checks

Cognitive effects: As in Experiments 1 and 2, I first examined whether Told Drug subjects reported better cognitive abilities than Told Inactive subjects. Once again the manipulation worked: Told Drug subjects reported more cognitive effects in line with R273's response expectancies than Told Inactive subjects, F (1,94) = 45.08, p <. 01, $\bullet_p^2$= .32. Like in Experiments 1 and 2, an interaction between drug instruction and cognitive ability ratings shows Told Drug subjects did not report uniformly better cognitive abilities, F (5, 90) = 5.45; p < .01, partial $\bullet^2$ = .23 (see Figure 4.2). Follow up t-tests revealed that Told Drug subjects rated every ability significantly higher than their Told Inactive counterparts (all p < .01) except for thinking, t (94) = 1.68, p = .10.

Subjects' comments also fit with these empirical findings. For example, subject 26 wrote "it was easier to focus on a computer screen than normally is." Similarly, subject 20 reported "I felt very awake and aware."

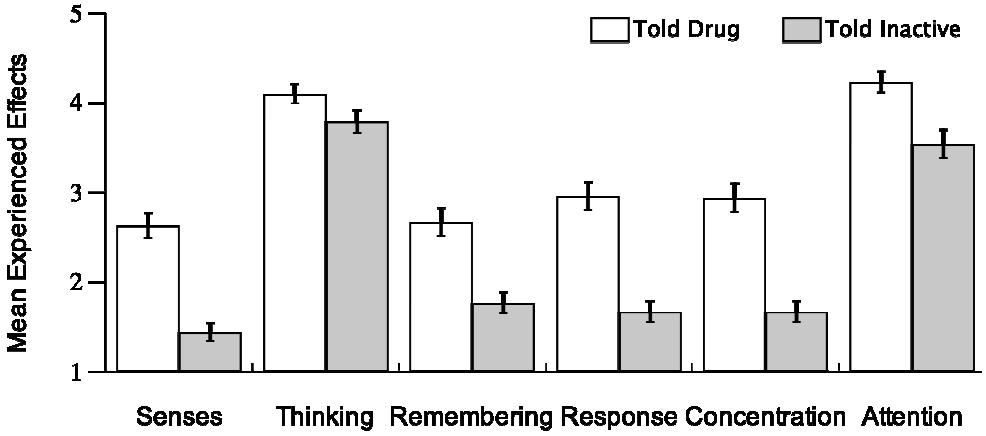

Figure 4.2. Mean score for the manipulation check by drug instruction

PM instructions. When quizzed at the end of the experiment, 100% of subjects correctly recalled the PM action (press the Q key) and recalled their specific cue. Therefore I concluded that if subjects encountered a cue, but failed to press the Q key, it was not because they did not know what their PM cue or task was.

PM Accuracy

I now turn to my first primary research question: would a sham memory drug improve people's ability to remember to perform an action in the future? That is, would R273 increase subjects' ability to remember to press the Q key in the presence of a particular cue? Recall, I predicted that R273 would improve subjects' prospective memories only in the nonfocal condition—a condition that called for effortful monitoring. I predicted that R273 would not improve subjects' prospective memories in the focal condition—a condition that called for automatic and spontaneous retrieval.

To answer my first research question I calculated the mean proportion of times Told Drug and Told Inactive subjects remembered to press the Q key. I then classified these means according to what subjects were told about their substance and whether their cue to remember required cognitive effort to detect (nonfocal) or whether their cue to remember did not require cognitive effort to detect (focal). These results appear in Figure 4.3.

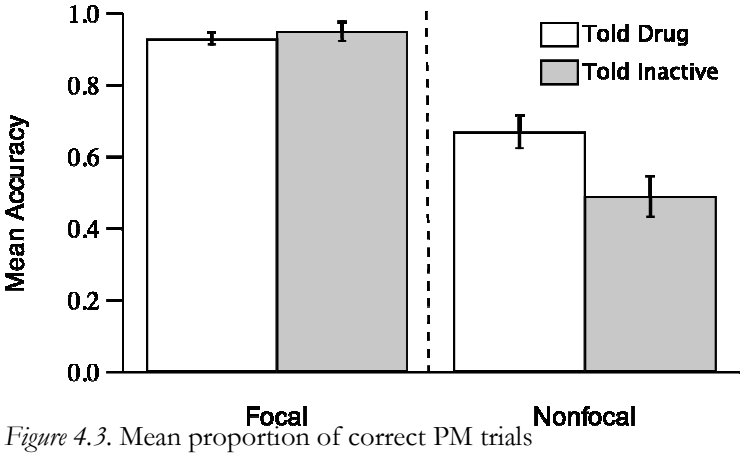

Figure 4.3. Mean proportion of correct PM trials

Figure 4.3 shows two key findings. First, comparing the bars on the right side of the dotted line with the bars on the left side of the of the dotted line, shows that subjects were worse at remembering to press the Q key when they received a nonfocal cue that encouraged monitoring, (M = .58, SD = .29) compared to a focal cue that encouraged spontaneous retrieval (M = .94, SD = .12). In other words, a main effect for Cue, F (1, 92) = 67.89, $p < .001$, $\bullet_p^2 = .43$, tells us that regardless of whether subjects were told they had received the active or inactive version of R273, they were better able to remember to perform the PM action when they received a focal cue compared to a nonfocal cue.

Second, comparing the bars on the left side of the dotted line shows that Told Drug and Told Inactive subjects remembered to press the Q key at similar rates in the focal condition, $t < 1$, *ns*. Yet comparing the bars on the right side of the dotted line shows that Told Drug subjects in the nonfocal condition remembered to press the Q key more often than their Told Inactive counterparts, $t\,(46) = 2.22, p = .03$, *Cohen's d* = .65. In other words, the interaction between Cue and Drug indicates that a when a PM task required effortful monitoring and attention, R273 effectively enhanced subjects' PM, $F\,(1, 92) = 5.15, p = .03, \bullet_p^2 = .05$.

These two findings replicate similar results reported by Einstein et al. (2005). That is, it is harder to remember PM tasks when ongoing task activity does not call direct attention to it. However, people are more likely to remember to perform the PM task if they think the task is important. The results of Experiment 3 extend those of Einstein et al. by demonstrating that PM performance was increased, not by manipulating information about the PM task, but by manipulating information regarding subjects' abilities. Specifically, when people were given a behavioural instruction—in the form of a memory placebo—that manipulated their expectations about their cognitive abilities, people were more likely to perform the PM task. This memory enhancement however was only found in the condition that called for effortful monitoring. In a situation that called for effortless and automatic retrieval of the PM task, no enhancement was found.

Yet, while these results tell us about a memory placebo's ability to increase people's prospective memories, they do not provide direct evidence that subjects used more monitoring. In order to answer this question I now turn to examine how the R273

drug instruction and type of PM cue influenced subjects' performance on their ongoing task.

Objective Measures of Monitoring

Response time. Did telling subjects they had taken a cognitive enhancing drug lead them to use more cognitive effort—monitoring—than subjects who were told they took a placebo? If Told Drug subjects use more monitoring than their Told Inactive counterparts, there should be a cost to their ongoing task performance. More specifically, Told Drug subjects should be slower to categorise word pairs than their Told Inactive counterparts.

To examine whether there was evidence that Told Drug subjects used more monitoring than their Told Inactive counterparts I first calculated subjects' mean response times on correctly answered word-pair trials. I then classified subjects' mean response times according to whether their drug condition was active or inactive, whether their cue was focal or nonfocal and when they performed the PM or Control tasks. These results are displayed in Figure 4.4. The bars on the left side of the dotted line indicate how long subjects took to categorise the word-pairs when they were also performing a PM task. The bars on the right side of the dotted line indicate subjects' response times for when they were only performing the ongoing task—essentially these bars represent baseline performance.

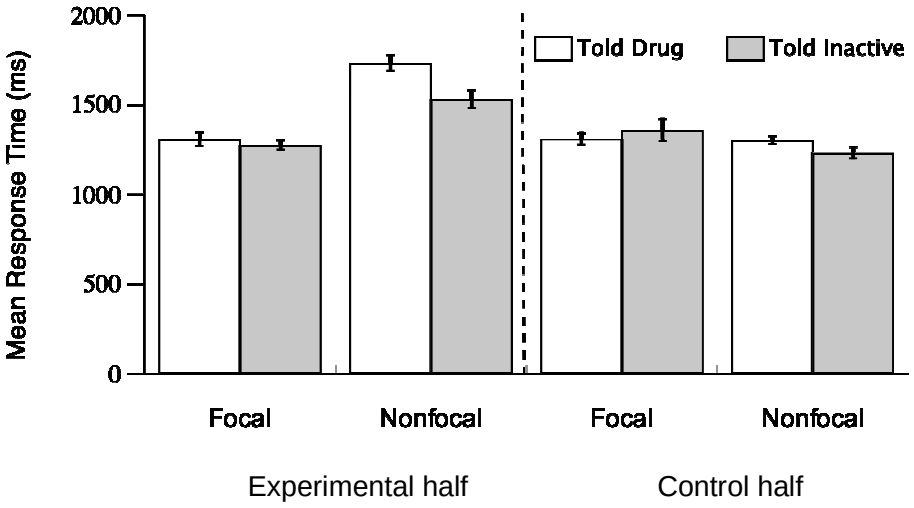

Figure 4.4. Mean response time to categorise word-pairs on correctly answered trials.

Figure 4.4 shows three key findings. First, comparing the bars on the left side of the dotted line with the bars on the right side of the dotted line shows that subjects were slower to categorise words when they also had to remember to perform a PM task. In other words, there was a main effect for Task, F (1, 92) = 43.98, $p < .001$, $\bullet_p^2 = .32$, in that subjects' PM task response times were longer (M = 1462.15, SD = 292.29) than Control task response times (M = 1301.25, SD = 225.51), t (95) = 4.99, $p < .001$, *Cohen's d* = .51.

Second, examining the bars on the left side of the graph shows that when subjects performed the PM task, they were slower to categorise words with a cue that encouraged effortful monitoring than with a cue that encouraged automatic and effortless retrieval. However, examining the right side of the graph shows a different pattern of results: when subjects performed the Control task, they categorised words at a similar rate, regardless of the cue. In other words, I found an interaction between Cue

and Task, F (1,92) = 70.65, p < .001, $\bullet_p^2$ = .43. Follow up t-tests showed that subjects categorised words more slowly with a nonfocal cue (M= 1632.52, SD = 277.32), than a focal cue (M = 1291.78, SD = 191.04), t (95) = 7.01, p < .001, *Cohen's d* = 1.42. There was no significant difference between subjects' categorisation times during the Control task, regardless of whether they saw a focal cue (M= 1334.81, SD = 268.92) or nonfocal cue (M = 1267.68, SD = 167.84), t (95) = 1.47, p = .15, *ns.*

Finally, comparing the bars on the left side of the figure with the bars on the right side of the figure shows that when subjects had a PM action to remember, Told Drug subjects categorised words more slowly than Told Inactive subjects; when subjects were only performing word-categorisation trials, Told Drug subjects categorised words at the same speed as Told Inactive subjects. In other words, there was an interaction between Task and Drug, F (1, 92) = 4.72, p = .03, $\bullet_p^2$ = .05. Follow up t-tests showed that Told Drug subjects (M = 1520.40, SD = 314.50) categorised words more slowly than Told Inactive subjects during the PM Task (M = 1403.89, SD = 258.53), t (94) = 1.98, p = .05, *Cohen's d* = .40; however, there was no difference during the Control Task (M = 1306.78, SD= 165.17, M = 1295.71, SD = 274.67 respectively), t < 1, *ns.*

To further examine the relationship between response time and PM accuracy I conducted I conducted two multiple logistic regressions by simultaneously regressing PM accuracy and response time on drug condition (told drug or told inactive). In multiple logistic regression, each of the regression coefficients is a partial regression coefficient; each is interpreted adjusting for the other effects in the model (Cohen, Cohen, West & Aiken, 2003). Using this model allows us to examine whether accuracy

predicts drug condition while holding response time constant, and whether response time predicts drug condition while holding accuracy constant.

In the focal condition, the overall model was non significant: χ (3) = 3.07, p = .38 and accounts for very little variance (R^2 = .04). Neither accuracy nor response time predicted drug condition. However, in the nonfocal condition, the overall model is significant: χ (3) = 12.17, p < .01 and accounts for about 18% of the variance (R^2 = .18). Additionally, both response time (p = .03) and PM accuracy (p = .04) significantly predict drug condition. These results indicate that the association between told condition and PM is significant even with response time controlled which would suggest that response time partially mediates the effect of drug instruction on accuracy.

Taken together, these results suggest that Told Drug subjects used more monitoring that their Told Inactive counterparts. Told Drug subjects were slower to categorise word-pairs when they were also performing a PM task. These results suggest that Told Drug subjects were dividing their attention between the ongoing task and the PM task. Yet taken in light of Told Drug subject' accuracy on performing the PM task, increased monitoring only affected accuracy in the condition which called for monitoring. In sum, this pattern of results is similar to those obtained by Einstein et al. (2005).

Accuracy: Another way to examine whether the R273 drug instruction affected subjects' ongoing task performance is to examine their accuracy at categorising the word pairs. To answer this question I calculated the mean proportion of word-pair trials subjects answered correctly and classified these means according to what subjects were told about their substance, the type of cue they received and whether or not they were performing a concurrent PM task. I display these results in Figure 4.5.

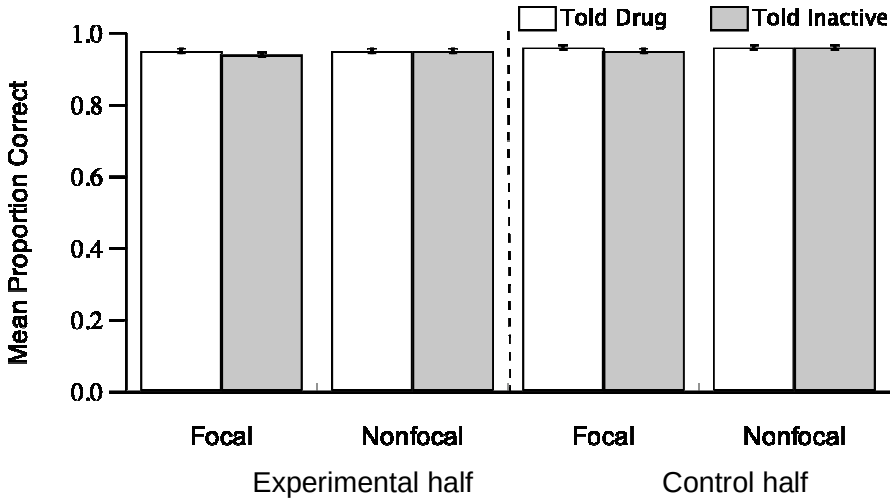

Figure 4.5. Mean proportion of ongoing trials answered correctly

Subjects' accuracy on performing the ongoing task was not affected by what subjects were told about their substance, nor the type of cue (focal or nonfocal) they received. In other words, drug instruction $F = (1, 92) = 1.55$, $p = .23$, *ns* and cue type, F $(1, 92) = 1.99$, $p = .16$, *ns*, did not affect subjects' ability to correctly categorise the word pairs. In fact, as shown in the figure, all subjects were good at correctly categorising the words—accuracy was close to ceiling. There was a marginally significant trend for subjects to be more accurate to categorise the word pairs when the ongoing task was their sole task, F $(1, 92) = 4.07$, $p = .05$, $\bullet_p^2 = .04$. This result might reflect the notion that having subjects engage in two tasks at the same time is harder than engaging in just one. Therefore it seems logical that all subjects were marginally less accurate at categorising words when also completing the PM task.

In sum the findings on response time and ongoing task accuracy replicate those of Einstein et al. (2005). Specifically, the finding that Told Drug subjects were slower to perform the ongoing categorisation trials when they were also performing a PM task suggests that Told Drug subjects used more monitoring than Told Inactive subjects, especially in the nonfocal PM condition. This finding extends the literature on the multiple-processes framework by providing evidence that people can be led to use more effortful monitoring by manipulating their expectancies about their cognitive abilities, as opposed to manipulating their expectancies about the task (e.g. task importance; Einstein et al., 2005).

Subjective Measures of Monitoring

Finally, I examine whether there was any subjective evidence that Told Drug and Told Inactive subjects differed in their perceptions of the PM task and the word-categorisation task. To examine this question I calculated subjects' mean ratings of task importance for both the word categorisation and PM tasks. I then classified these means according whether subjects were in the Told Drug or Told Inactive condition and whether their cue was focal or nonfocal. I display these means in Figure 4.6.

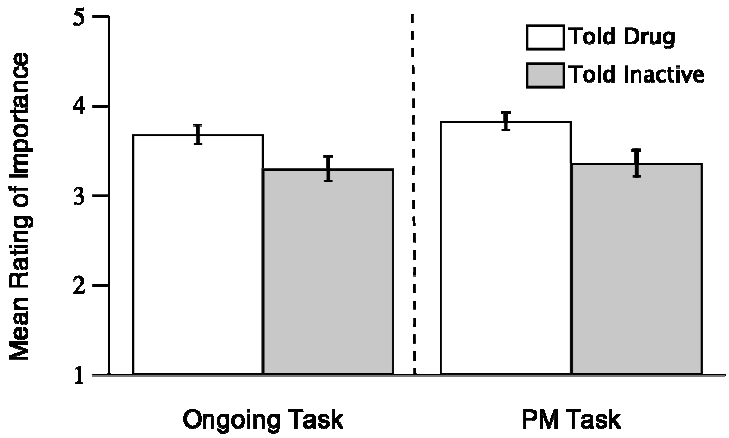

Figure 4.6. Mean ratings of importance of the ongoing and PM tasks by drug condition

As the figure shows, Told Drug subjects rated both the ongoing task and the PM task as more important than the Told Inactive subjects. In other words, a main effect for Drug, F (1, 92) = 6.21, p = .01, $\bullet_p^2$ = .07, suggests that what subjects were told about their drug resulted in altered perceptions of task importance.

These results provide evidence as to why Told Drug subjects used more monitoring compared to their Told Inactive counterparts. Even though subjects were not given information about the importance of their tasks, this pattern of results suggests that response expectancies about R273 might have been reflected onto the tasks they were performing. As a consequence, Told Drug subjects might have been more motivated than Told Inactive subjects to perform their tasks accurately.

Summary

In sum, the pattern of results obtained in Experiment 3 show that a placebo can improve people's prospective memories. Specifically, Told Drug subjects were better at remembering to perform a PM task when that task demanded they use effortful and deliberate retrieval strategies, but were slower to perform their ongoing task. As a whole, this pattern of results suggests that Told Drug subjects used more cognitive effort in order to effectively recall the PM action. Consequently, it is likely that some of the cognitive resources they would usually have allocated to the ongoing task were instead allocated to remembering the PM task.

These results converge with the findings of Einstein et al. (2005) who found that subjects who thought the PM task was important had better PM, but were slower to categorise word-pairs. The results of Experiment 3, however, extend the previous research of Einstein et al. (2005). Specifically, while Einstein et al. improved people's prospective memories by manipulating the characteristics of the PM task, the results of Experiment 3 suggest that PM can be improved simply by manipulating people's perceptions of their own cognitive abilities. In this study, people simply ingested a small amount of Vitamin C powder that they were led to believe was a cognitive enhancing drug. Consequently, subjects' prospective memories were improved.

The results of Experiment 3 converge with those of Experiments 1 and 2, suggesting that R273 "works" because it leads people to switch from their usual easy and effortless cognitive behaviours to deliberate and effortful cognitive behaviours. Considered as a whole, these results have theoretical implications. Specifically, they provide some evidence that the same underlying processes that caused subjects to switch from their usual and effortless source monitoring, also caused them to switch

from their automatic and effortless strategies for PM retrieval. Secondly they build on the cognitive-enhancing placebo literature by showing that a memory placebo can affect people's memories in another memory paradigm—not just susceptibility to false memories.

Practically, the results of Experiment 3 highlight the role that people's expectancies play in shaping their behaviours—even those behaviours that may be typically thought of as cognitive—and also highlight the importance of taking these expectancies into account when examining the effectiveness of cognitive enhancing drugs. Specifically, while there are no drugs currently available to eyewitnesses enhancing their memories (as in Experiments 1 and 2), there are a host of drugs on the market that claim to sharpen thinking, increase focus and mental clarity, and improve memory. What is more, recent research reports the growing use and acceptance of these drugs (Chattergee, 2004; Maher, 2008). Future research might address the effectiveness of these so called "smart" drugs and investigate whether they work because of the physiological properties contained in the drug or because people have the desire, expectation and need for them to work.

Chapter 5

General Discussion

The overarching goal of this thesis was to establish whether a placebo could lead people to engage in more effortful monitoring, thereby improving their performance on retrospective and prospective memory tasks. To achieve this goal I first examined the evidence that a memory placebo improved effortful source monitoring in a misinformation effect experiment, thus decreasing people's susceptibility to memory distortion. Next, I examined the evidence that a memory placebo improved effortful monitoring in a prospective memory task, thus increasing people's prospective memories.

Overview of Experiments and Key findings

In Experiment 1 (Chapter 2) I aimed to find empirical support for the hypothesis that R273 reduces the misinformation effect because subjects switch from their usually automatic and easy source monitoring to more deliberate and effortful source monitoring. I also aimed to establish whether certain subjects—namely, those with higher WMC—might respond differently to R273. To answer my research questions I ran subjects through a sham drug experiment, and then had them take part in a standard misinformation effect experiment. I also surreptitiously measured subjects reading speeds of the PEI and their response times on the memory test. The pattern of results in Experiment 1 suggested that R273 did not affect effortful source monitoring during the PEI but did affect effortful source monitoring during the memory test. I also found individual differences in people's responsiveness to R273. Specifically, people

with higher WMC who were told they had taken the sham drug were less misled than their higher WMC counterparts who were told they had received the inactive placebo.

My goals in Experiment 2 (Chapter 3) were to align my methods more closely with the literature on postwarnings and the misinformation effect, and find evidence, which converged with the results of Experiment 1. Specifically, I examined whether the R273 placebo effect occurs because of subjects' source monitoring during the memory test. To do so, I ran subjects through the basic R273 and misinformation effect experiment but informed subjects of their "true" drug condition immediately before the memory test. The primary finding of Experiment 2 added further support to the idea that R273 affects subjects' decision processes: Told Drug subjects were less misled than their Told Inactive counterparts.

Finally, in Experiment 3 (Chapter 4) I examined whether the underlying monitoring processes that people use to perform prospective memory tasks were similar to the source monitoring processes that they use for retrospective memory tasks. To do so, I combined the R273 drug administration procedure with a prospective memory task. The results suggested that R273 increased subjects' effortful monitoring. As a consequence Told Drug subjects' prospective memories were more accurate than Told Inactive subjects on certain prospective memory tasks.

In summary, the results of this series of experiments suggest that the sham cognitive enhancing placebo R273 both improved people's ability to resist misleading suggestion, and to perform prospective memory tasks because it led them to use more effortful monitoring.

The Source Monitoring Framework

Considered as a whole, the results in this thesis are consistent with literature on the SMF; people either rely on automatic or effortful processes in order to monitor the sources of their memories, and these processes can affect the accuracy of people's source attributions (Johnson et al., 1993; Mitchell & Johnson, 2000). As previously discussed throughout this thesis, in the misinformation effect, people who use more effortful and deliberate monitoring tend to be less susceptible to the effects of misleading suggestion (Echterhoff et al., 2005; Zaragoza & Koshmeider, 1989; Lindsay & Johnson, 1989).

My results lend direct support to this idea. First, subjects in Experiment 1 were slower to respond to misled test items, and more accurate than Told Inactive subjects. This finding suggests that Told Drug subjects used more effortful and deliberate source monitoring than their Told Inactive counterparts. The results of Experiment 2 also fit with the idea that R273 affected Told Drug subjects' source monitoring during the test, even though there was no explicit evidence in the form of response time differences between Told Drug and Told Inactive subjects. Because the drug instruction was administered immediately before the memory test, source monitoring behaviours could not, and should not, have been different between Told Drug and Told Inactive subjects during either the event or the PEI. It thus seems logical to conclude that decision processes are the only aspect of source monitoring that were affected by the R273 drug instruction in Experiment 2.

While the pattern of results obtained in this thesis fit with the SMF, they also resonate with several other literatures highlighting the important dichotomy between automatic and controlled cognitive processes, and their effects on behaviour.

Automatic vs. Controlled Behaviour

Automaticity

Literature in both the cognitive and social psychological domains suggests that the majority of our behaviours occur automatically, without conscious and deliberate effort or thought (see Bargh & Chartrand, 1999 for a review). In fact, years of research suggest that although we may not be aware, our environments, and cues received from these environments, shape and influence our behaviour (Schwarz & Clore, 1983). For example, Williams and Bargh (in press) demonstrated that when people had recently experienced physical warmth or coldness—induced by having them hold a hot or iced cup of coffee—they were more likely to make interpersonal judgements about people that were congruent with the temperature of the beverage they had held. Subjects who held the warm coffee were likely to judge a target person as warm; subjects who held the ice-cold coffee were likely to judge a target person as cold. Broadly, Williams and Bargh's results suggest that behaviours can occur automatically. More specifically, their results lend weight to the idea that without people's awareness, a physical cue in the environment can influence a future behaviour without people being aware of the influence occurring.

Similarly, myriad studies show that experiences we have in one context can lead us to adopt a mindset that influences our behaviour in another context. In a study by Wilson and Capitman (1982), male subjects in the experimental condition read a classic "boy meets girl" story. Male subjects in the control condition read a neutral story about

the Mississippi River. Next, in a supposedly unrelated experiment about problem solving, "boy meets girl" subjects were friendlier to a female confederate than the "river" subjects. That is, "boy meets girl" subjects smiled more, talked more, gazed more, and had more open body language than their "river" story counterparts. Wilson and Capitman reasoned that when "boy meets girl" subjects read the story, it activated a "boy meets girl" script, which in turn directed and influenced subjects' behaviour. Wilson and Capitman's results converge with those of Williams and Bargh (in press) by suggesting that certain contexts or cues encountered in the environment can instigate and offset behaviours, even though people are unaware of this influence occurring. How do these findings inform the results of this thesis?

Across the three R273 studies Told Drug subjects rated themselves as experiencing more enhancement of their senses, a greater ability to concentrate, a quickening of their responses and an improvement of their memories even though they took the same inactive substance as the Told Inactive subjects. Perhaps then, information about R273 conveyed by the video and experimenter, coupled with the drug instruction, triggered a "cognitive enhancement" script in Told Drug subjects. For example, Wilson and Capitman's (1982) results suggest that when subjects activated a "boy meets girl" script, they unconsciously altered their behaviours to act in line with this script. Subjects in Experiments 1 to 3 of this thesis might have activated a "cognitive enhancement" script, leading them to unconsciously adopt behaviours consistent with the response expectancies provided to them about R273. Consequently, the activation of the "cognitive enhancement" script might have set in motion a chain of behaviours, which lead Told Drug subjects to "experience" more of R273's effects than Told Inactive subjects (Kirsch, 1997). Yet if Told Drug subjects' behaviours were

driven by unconscious and automatic response expectancies, how would this lead to them use more controlled and effortful monitoring during the memory tasks?

While many behaviours may be initiated automatically, the activation of these behaviours can sometimes lead people to then use more controlled and effortful cognitive processes in order to achieve their goals (Hassin, Bargh & Zimmerman, in press). For example, Hassin et al. primed people to activate an "achievement" goal by presenting them with lists of words that were related to achievement concepts such as *win, compete, strive, attain, master and achieve, etc.* In the non-primed condition subjects read neutral words such as *ranch, carpet, river, hat, etc.* Subjects then completed the Wisconsin Card Sorting Task (a neuropsychological task where subjects match up pairs of cards though they are not informed of a how they should match the cards; experiment 1) or the Iowa Gambling Task (a decision making task; experiment 2). Hassin et al. found that when primed for achievement, subjects completed the tasks more accurately. More broadly, the results suggest that by simply activating concepts all linked to a particular goal or outcome, people can automatically activate and initiate that goal, even though as a consequence, they use more controlled and effortful cognitive processes.

Likewise, my data are congruent with the idea that an automatic response can unconsciously offset a controlled process. For example, if the Told Drug instruction led Told Drug subjects to activate a "cognitive enhancement" script, they may have also activated a "cognitive enhancement" goal. Consequently, Told Drug subjects might have unconsciously acted in ways consistent with the activated behavioural script activated, which then lead them to use more careful and effortful monitoring. Similarly, if the Told Inactive instruction did not lead Told Inactive subjects to activate a "cognitive enhancement" goal, they should have had no reason to change their

behaviours. Indeed, evidence obtained in this thesis suggests that Told Drug subjects used more effortful monitoring than Told Inactive subjects. Specifically, Told Drug subjects responded more slowly on the memory test in Experiment 1, and took longer to categorise the word pairs in Experiment 3, thus improving their prospective memories.

Considered as a whole, I found a pattern of results that resonate with the psychological literature on automaticity. While many behaviours occur automatically, shaped and offset by cues in the environment, automatic processes can also lead people to engage in more controlled and effortful processing. However, the results of this thesis also resonate with literature on hypnosis, which is itself closely tied to automaticity.

Hypnosis

Literature on hypnosis informs the results of this thesis in two ways. First, just as there is no particular ingredient that makes a placebo work other than the subject's expectancies, there is no particular hypnotic procedure that induces a hypnotic state. For instance, Kirsch and Lynn (1999) draw parallels between hypnosis and placebo effects, noting that "a hypnotic induction is like a placebo in that its effects do not depend on the specific ingredients (e.g., instructions to relax) but rather on people's beliefs about those ingredients" (p. 507). Indeed, as early as the 1960's research suggested that a hypnotic procedure was not needed in order generate behaviours that are typically demonstrated under hypnosis. Barber (1969) showed that hypnotic states such as sleepiness or deep relaxation could be induced by suggestion alone, without the formal protocols used by hypnotists. This idea supports the notion that R273 lead Told Drug subjects to experience more of the drug's effects because subjects were lead to

expect those effects. More specifically, across three experiments, in which all subjects received exactly the same inactive substance, Told Drug subjects rated their subjective experience of R273 as being higher than that of the Told Inactive subjects.

The second way the literature on hypnosis informs my results is that hypnotic suggestion can lead people to override their habitual and usual automatic processes. Take, for example, the Stoop effect (1935). In a Stroop effect experiment subjects see words in coloured ink that also spell the word of a colour. The colour the word spells and the colour of the ink are either congruent (see Figure 5.1A; e.g. the word is presented in the colour red and spells the word "RED") or incongruent (see Figure 5.1B; e.g. the word is presented in the colour red and spells the word "GREEN"). Subjects' task is to ignore the colour that the word spells and only name the ink that the word is printed in. When the words and colours are congruent the task is easy to complete; when the words and colours are incongruent the task is difficult to complete. The Stroop effect taps into automatic processes because for a proficient reader, reading the words is automatic and cannot be withheld without using deliberate and conscious effort.

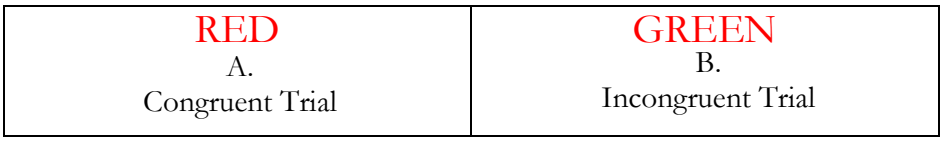

Figure 5.1. Illustration of the Stroop task. Box A shows a congruent trial—the word and colour correspond. Box B shows an incongruent trial—the word and colour do not correspond.

Research suggests that hypnotic suggestion can induce people to override their automatic tendency to name the colour that the word spells (Raz, Shaprio, Fan, & Posner, 2002; Raz, Fan & Posner, 2005, Raz, Moreno-Iniguez, Martin, & Zhu, 2007). In one study, Raz et al., (2007) recruited a group of highly hypnotizable and suggestible,

but proficient, readers and ran them through a Stroop task. Before the Stoop task began, some subjects took part in a hypnotic induction whereby they were told that when the experimenter clapped [his or her] hands, symbols would appear on the screen that would seem like characters from a foreign language. In the no-suggestion condition, subjects were simply given standard instructions to respond quickly and name the ink colour of the word.

Raz et al. (2007) found the hypnotic suggestion did not affect subjects' reaction times on the congruent trials (where word colour and ink colour matched). However, hypnotic suggestion did affect subjects' reaction times on the incongruent trials (where word colour and ink colour did not match). Hypnotised subjects were faster to name the colour of the word than were non-hypnotised subjects, and made fewer errors. Thus, the results of the current thesis converge with the idea that using expectancy and suggestion can lead people to override their automatic and habitual ways of responding. Suggestion led people to override their automatic responses in a Stroop effect. In this thesis, suggestion lead people to override their automatic processes in a misinformation effect experiment, and prospective memory experiment.

To further examine the idea that the R273 placebo "works" because it overrides automatic processes, future research could examine R273's effectiveness in leading people to resist the Stroop effect. If subjects use the drug suggestion to override their automatic processes, R273 might lead people to use more controlled and effortful processing, and decrease Stroop errors.

Working Memory

Finally, the results of Experiment 1 showed that WMC was associated with subjects' resistance to misleading suggestion in the Told Drug condition, but not in the

Told Inactive condition. This finding fits with literature suggesting that when given a reason to do so, people with higher WMC can direct and control their cognitive processes, resulting in greater resistance to false memories (Watson et al., 2005). More broadly, the WMC findings in Experiment 1 resonate with literature highlighting the important role that WMC plays in relation to the use of automatic and controlled processes.

For instance, just as suggestion has been shown to override people's automatic processes in the Stroop effect, so too have WMC differences. In a series of five experiments, Kane and Engle (2003) measured subjects' OSPAN and then ran them through the Stroop task. Critically, Kane and Engle manipulated the number of congruent and incongruent trials in each test. In one condition there were no congruent trials (low congruent condition), and subjects had to continually keep the Stroop task in mind. In the other condition, 75-80% of the trials were congruent (high congruent condition), meaning that subjects should have responded in a habitual and automatic fashion, forgetting to name the colour on the incongruent trials. Kane and Engle reasoned that it should be harder for lower spans to correctly name the colour of the word in the high congruent condition; the trials would not encourage subjects to keep the task in mind. However, higher spans, who are better at maintaining their attention in cognitively demanding situations, should be better able to switch back and fourth from completing congruent and incongruent trials. In both conditions, lower spans made more errors compared to higher spans. However, the number of errors that subjects made varied with the number of congruent and incongruent trials. When the task was made of primarily congruent trials—trials that promote the responding on a habitual and fast manner—lower spans made more errors than higher spans. This finding

suggests that higher spans were better able to break their response habit and keep the goal of the experiment in mind. Put another way, higher spans possessed an advantage in a context demanding effortful control.

Future research could further examine the relationship between R273 and WMC. One means of examining this issue would be to look at R273 and WMC using the prospective memory paradigm from Experiment 3. For example, literature suggests that WM is related to prospective memory performance. In one study, Marsh & Hicks (1998) gave subjects an event-based prospective memory task (similar to the PM ask in Experiment 3; when "X" occurs do "Y") but varied the amount of cognitive load that the ongoing task required. They reasoned that overloading working memory would drain cognitive resources available for remembering the PM task. Indeed, Marsh and Hicks found that when subjects performed the PM task under high cognitive load, subjects were worse at remembering to perform the PM task. Under low load there was no difference. Thus, with research linking WM to prospective memory, and research linking WM to R273, the next step would be to examine whether R273's effectiveness during the prospective memory task is related to subjects' WMC.

Recall that R273 improved prospective remembering only in a task that required effortful control. R273 did not affect prospective remembering in a task that relied on automatic processes. These results suggest several hypotheses for future research. On the one hand, it seems unlikely that there would be a relationship between WMC and R273 in a prospective memory task that is prompted by an easily detectable focal cue; higher span WMC people tend to only show an attentional advantage on tasks that are difficult and require control (Kane et al., 2007). On the other hand, if the R273 drug instruction acts in a similar fashion to a warning, higher WMC subjects who receive

R273 might use more monitoring than their higher WMC counterparts who receive the placebo. If so, Told Drug subjects with higher WMC might have better prospective memory than Told Inactive subjects with higher WMC. In addition, because WM is related to prospective memory, higher WM subjects might perform more accurately on a prospective memory task than their lower WM counterparts, regardless of drug condition. If such results were obtained, they would provide further insight into the relationship between R273 and WMC, and extend the growing body of literature showing that people with high WMC are better at focusing on a task than low WMC people, especially when the task is hard, or when prompted to do so (Kane et al., 2007; Watson et al., 2005).

Counter Explanations

Although my data suggest that the R273 memory placebo lead people to experience subjective effects associated with R273, increased people's resistance to misleading information, and improved their prospective memories because of their response expectancies, there are alternative explanations for these results.

Subjective Effects. Although Told Drug subjects rated themselves as experiencing significantly more of R273's effects than Told Inactive subjects, maybe these ratings reflected Told Drug subjects simply going through a thought process of "You told me I took a drug that enhances my cognitive abilities. I guess you want me to say that I experienced these effects." However, if Told Drug subjects were simply responding in an appeasing manner it is equally likely that others would have responded in a way that countered the R273 effect. Specifically, some other subjects might think, "You told me I took a drug that enhances my cognitive abilities. I guess you want me to say that I experienced these effects. Why should I do that?"

In addition, subjects' reactions to the debriefing in Experiment 2 suggested that some subjects genuinely believed the manipulation. Some subjects, for example, appeared unsurprised when they were told they had received the active drug instead of the inactive placebo, saying things like "I thought I'd taken the real thing," or "I knew it!" Similarly, subjects' comments across the three studies show that many were willing to go just beyond the ratings and elaborate on the ways in which they had "felt" the bogus drug. In short, there is little evidence to support the counter-explanation that wanting to appease the experimenter drove subjects' responses to R273

Objective Effects. An alternative explanation also exists as to why Told Drug subjects performed more accurately on the memory tests of Experiments 1 to 3. Maybe Told Drug subjects were simply more motivated than Told Inactive subjects to perform well. Recall, the results of Experiment 3 suggested that Told Drug subjects thought both their ongoing and prospective memory tasks were more important than Told Inactive subjects. Perhaps then, the R273 placebo effect is simply caused by motivation. However, if R273 increased resistance to misleading suggestion simply because Told Drug subjects were more motivated to do well, I should have also found that Told Drug subjects exerted more effort during the event and the PEI. Specifically, if Told Drug subjects exerted more effort during the event, or rehearsed the event more, they should have demonstrated better performance than Told Inactive subjects on control items. In addition, I might expect that if Told Drug subjects were motivated to do well they may have also exerted more effort during the PEI, which should have been evidenced by longer reading times of the PEI. However, I found no evidence to indicate that Told Drug subjects exerted more effort during the event—Told Drug and Told Inactive subjects performed equally well on control items. Nor did I find evidence to suggest

Told Drug subjects exerted more effort during the PEI—reading speeds of the PEI were no different between Told Drug and Told Inactive subjects. In short, there is little support for the counter explanation that Told Drug subjects were more motivated than Told Inactive subjects.

Implications

The SMF

The source monitoring literature has established that people's expectancies can be helpful or harmful to source monitoring, and consequently, to memory. For example in one study, Sherman and Bessenoff (1999) examined how expectations, in the form of stereotypes, influence people's ability to use effective source monitoring. They had subjects read lists of friendly and unfriendly behaviours. One list of behaviours was attributed to either a priest or a skinhead; the other list was attributed to the experimenter. The next day subjects saw the old lists and a new list and were asked to make source attributions about whether the behaviours were old or new, and if they were old, who had performed them. The experimenters also attempted to reduce the likelihood that subjects would engage in effortful and deliberate source monitoring by having some subjects complete a divided attention task at the same time as making the source attributions. Subjects who had the divided attention task made more stereotyped source confusions, suggesting that when they were unable to divide full attention to their decision processes, they used stereotypes to guide their source attributions. Specifically subjects misattributed more unfriendly behaviours to the skinhead and misattributed more friendly behaviours to the priest.

However, research suggests that people's expectations about other people might also influence source monitoring in misinformation effect experiments: when people

expect that the source is untrustworthy, unreliable, and not credible, they are more likely to engage in effortful and deliberate source monitoring which leads them to be less susceptible to the effects of misleading suggestion (Dodd & Bradshaw, 1980; Echterhoff et al., 2005).

Taken together, these two lines of research suggest that people's expectancies about people affect how they will monitor information both about, and from, those people. My results extend this body of literature by suggesting that people's expectancies about themselves also influence how they monitor information. Specifically, subjects in Experiments 1 and 2 never received information about the credibility of the PEI, and subjects should have had little reason to think that details from the event and PEI might be different. Thus my results suggest that manipulating people's expectancies about their own abilities lead them to use more effortful source monitoring.

The Placebo Effect

My results extend the literature on placebo effects and memory in two ways. First, the results suggest a potential mechanism by which the R273 placebo affected subjects' behaviours, which lead to more accurate memory performance. Across three experiments I found patterns of results suggesting that people used their expectations about the placebo to override their habitual and automatic cognitive behaviours, and thus engaged in more effortful and controlled monitoring.

Second, my results extend the literature on placebos and memory by demonstrating that susceptibility to memory distortion is only one aspect of memory that a placebo can affect. I found that a placebo could affect people's prospective memories using an event-based prospective memory task. In light of these results, future research may look at using other cognitive-based paradigms in which people can

better their performance depending on whether they use automatic or controlled cognitive processes. As has already been mentioned, the Stroop effect may be one potential paradigm whereby R273 might lead people override their habitual and automatic cognitive processes.

Cognitive Enhancing Drugs

My results have implications for the important and timely social issue of society's growing use and acceptance of cognitive enhancing drugs. For example, 5-15% of American college students routinely use drugs such a modafinil and methylphenidate, which were originally developed to treat Attention Deficit Disorder and narcolepsy (Nature, 2007). In addition, a recent survey of 1400 people conducted by Nature found that 1 in 5 people reported using cognitive enhancing drugs to increase their focus, attention, concentration and memory (Maher, 2008).

However my results suggest that people might not need to take actual cognitive enhancing drugs in order to experience the effects of those drugs. Indeed, examining subjects' ratings on the manipulation checks across three experiments, as well as subjects' comments, suggests that when people were told that R273 would increase their attention, focus and ability to concentrate, people thought it did. In addition, people reported experiencing these cognitive effects after one supposedly small dose of a "drug" that they had no previous exposure to, or experience with.

In light of the powerful effect that expectancies can have on people's behaviour, future research might examine whether expectancies about cognitive enhancing drugs affect people's subjective and objective experience of those drugs. There are many ways in which this issue could be examined. One way is to recruit people who believe that cognitive enhancing drugs are effective and ask them to take R273 every day for a set

number of weeks. If expectancies play a key role in eliciting people's responses to cognitive enhancing drugs, we may find that people's subjective responses to R273 grow stronger. That is, people's expectations of cognitive enhancement may consistently create effects congruent with cognitive enhancement. Consequently, the creation of these subjective effects may then feedback into fuelling and maintaining their expectations. Such a finding would be congruent with Kirsch's (1985; 1997) account of response expectancies. On the other hand, we may find that because R273 is simply just a placebo, people will come to realise that the "drug" does nothing. In this case the subjective effects may become subject to extinction.

The second way of examining expectancies and cognitive enhancing drugs is to recruit groups of people who regularly endorse and use cognitive enhancing drugs, and people who do not endorse or use cognitive enhancing drugs. Then, running people through the R273 memory paradigms might demonstrate that cognitive enhancing drug users—people who are likely to believe that cognitive enhancing drugs work—are more susceptible to R273's effects than non users.

Finally, a full balanced placebo design could be used with actual cognitive enhancing drugs. This design would enable the components of actual cognitive enhancing drugs that cause subjective and behavioural changes to be isolated into those that are caused by active ingredients, and those that are caused by desire and expectancy.

Eyewitness Memory

A report released by the Innocence Project (2008) states that in the USA alone, since 1989, over 200 people have been exonerated of committing crimes that they did not commit. Mistaken eyewitness testimony played a leading role in over 75% of these

convictions. Taken in light of this report, and the fact that it is well established that incorrect suggestions and information given to people after they have witnessed a crime can damage their memories (Loftus et al., 1978, Loftus, 1991), my results show that in certain situations PEI will not always disrupt and damage people's original memories. In fact, my results suggest that by manipulating people's expectancies about their cognitive abilities, they were motivated to resist this erroneous suggestion by using more effortful and careful source monitoring.

While the cognitive technology does not yet exist whereby witnesses can take drugs that improve their memory, this may be a scenario that society faces in the future. For example, a significant amount of research conducted by the Defence Advanced Research Projects Agency (a military research institution in the USA) investigates the effects of pharmaceuticals on cognition (George, 2003). Chatterjee (2004) predicts that some of this research will have flow-on effects to regular civilians. As it stands currently, smart drugs are used to improve functioning in students, academics, pilots, and military personal. Thus, it may only be a matter of time before we are faced with the possibility that smart drugs might be made available to eyewitnesses.

However, even in the absence of actual cognitive enhancing drugs for eyewitnesses, my results suggest that although in the real world we rarely have the luxury of knowing when witnesses are providing correct or incorrect information, it is vital that witnesses are led to be as accurate as possible. Indeed, my results, and those obtained in the postwarning literature suggest that even when people have been exposed to false information, that information will not necessarily damage or change a memory.

Conclusions

In summary, my findings provide evidence suggesting that when people are told they have taken a cognitive enhancing drug, they set in motion a chain of response expectancies which results in them using more controlled and effortful monitoring. These behaviours have important consequences on people's ability to resist the effects of misleading suggestion, as well as their ability to remember to perform tasks in the future. In situations where memory accuracy is important—such as recalling details about a crime that one was a witness to, or in situations where people have difficult tasks to remember to perform—people can increase their chance of accurate remembering if they expect that they have the ability to do so. From a more practical perspective, the research in this thesis implicates the role of cognitive control in some memory failures, and suggests that in some cases these failures can be corrected.

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Appendix A: Sample Misinformation Narrative

One sunny day after a long day of school, Jim Davis, an average looking guy with light brown hair, good build, wearing jeans and a short-sleeved T-shirt decided to visit his campus bookstore. Although there were several things he needed, he had accidentally left his wallet at home and wasn't interested in coming back at a later time with his wallet.

After entering the bookstore, Jim started down an aisle and looked around a bit. He was eventually attracted by a table full of colorful candles. Jim bent down to inspect them. He picked up a white candle which caught his eye and thinking that it might be one of those scented ones, smelled it. But finding that the candle was odorless, Jim put it back down and continued on his way. Feeling a little hungry, Jim nervously snuck a Snickers candy bar into his backpack. He looked at a Michael Jackson album, and then down several aisles Jim went, quickly glancing at school supplies and many other things. As he browsed his way down one particular walkway, Jim happened to partially step on a notebook while passing it. As he moved through the supply department, Jim remembered that he needed some glue for a project he was working on. Soon he found a shelf displaying various types of glue next to a blue stapler. He stopped for a moment, touching a bottle of Elmer's glue. He then looked up and noticed someone else in the aisle and decided against stealing it. He retreated to from the aisle to the battery display, and stuck a package of Duracell batteries into the right hip pocket of his jeans.

Feeling comfortable about his previous pilferage, Jim went looking for something new to steal when he saw a book that he needed for a class and carefully inspected it. Because of its bulk, Jim decided against stealing the book. It suddenly dawned on him that he needed a tie for a dance that was coming up at the end of the week. Since the tie section was secluded, Jim thought, "What the hell" and, after checking carefully, shoved a tie into his pack. To cover his tracks, Jim walked past a Minnie Mouse sweatshirt on the wall, on his

way to the Levi's section. He spent quite a while there and went on to inspect many sweaters and vests.

While looking, Jim bumped into his good friend, Doris Everett, a petite young woman. They hugged and looked at each other warmly. They then moved on to the magazine section. After wandering around the section, she settled on a magazine which she took off the shelf. Jim followed Doris to some chairs. They sat and looked through it for a few minutes and enjoyed the models' contrived poses. Doris suddenly realized she had to leave for work. Jim walked her down the aisle and they hugged again. Doris left.

Alone again, Jim strolled past a closed elevator door, and into the linen section. Jim thoroughly surveyed the section and then examined a towel, while looking for security guards who might have been waiting for his next move. Upon finding no sign of any such watchman, Jim strolled quickly out of the store, untouched.

Appendix B: Recognition Test Questions

You will now be asked some questions about the slide sequence you saw. We are testing your memory for these slides.

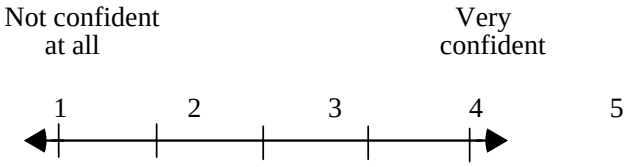
Each question has two parts:
[1] the first part asks you about a particular item from the slides;
[2] the second part asks you how confident you are about your answer.

Here is a sample question.

Jim was shopping at _____

a. The UW bookstore b. Nordstrom

How confident are you that your answer is correct?



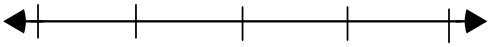
1. The candy bar that Jim stole was a _____ bar

a. Snickers b. Butterfinger

How confident are you that your answer is correct?

Not confident at all — Very confident

1 2 3 4 5



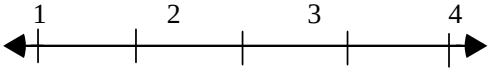
2. Jim was wearing _____

a. tennis shoes (sneakers) b. cowboy boots

How confident are you that your answer is correct?

Not confident at all — Very confident

1 2 3 4 5



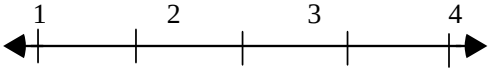
3. The color of the candle that Jim smelled was _____.

a. white b. yellow

How confident are you that your answer is correct?

Not confident at all — Very confident

1 2 3 4 5



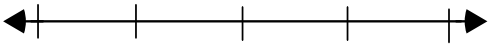
4. Jim looked at a _____ album

a. Prince b. Michael Jackson

How confident are you that your answer is correct?

Not confident at all — Very confident

1 2 3 4 5



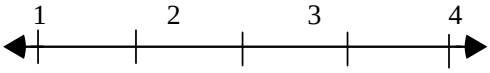
5. Doris was wearing _____

a. slacks b. a skirt

How confident are you that your answer is correct?

Not confident at all — Very confident

1 2 3 4 5



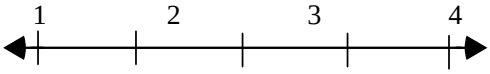
6. The color of the notebook that Jim stepped on was _____.

a. yellow b. green

How confident are you that your answer is correct?

Not confident at all — Very confident

1 2 3 4 5



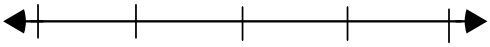
7. Jim and Doris seemed to be _____

a. close friends b. acquaintances

How confident are you that your answer is correct?

Not confident at all — Very confident

1 2 3 4 5



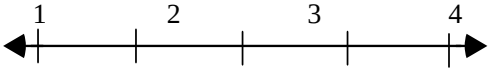
8. The color of the stapler next to the Elmer's glue was _____.

a. red b. blue

How confident are you that your answer is correct?

Not confident at all — Very confident

1 2 3 4 5



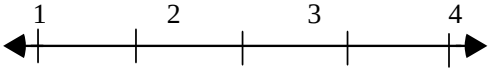
9. Jim put a package of _____ batteries in his back hip pocket.

a. Duracell b. Everready

How confident are you that your answer is correct?

Not confident at all — Very confident

1 2 3 4 5



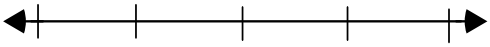
10. In some slides, Doris was wearing a _____.

a. scarf b. hat

How confident are you that your answer is correct?

Not confident at all — Very confident

1 2 3 4 5



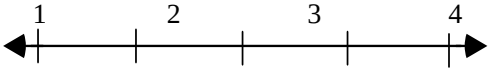
11. The textbook that Jim inspected was a _____.

a. chemistry book b. computer book

How confident are you that your answer is correct?

Not confident at all — Very confident

1 2 3 4 5



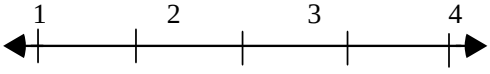
12. Jim was carrying a _____.

a. briefcase b. backpack

How confident are you that your answer is correct?

Not confident at all — Very confident

1 2 3 4 5



13. The sweatshirt that Jim walked by had _____ on the front.

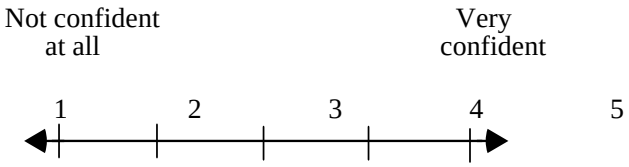
a. Minnie Mouse b. Mickey Mouse

How confident are you that your answer is correct?

14. When Jim left the store it was _____ time outside

a. daytime b. nighttime

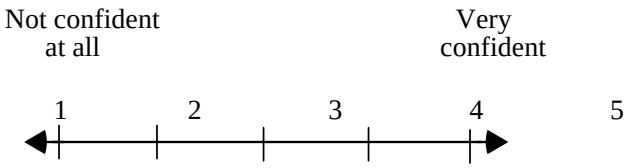
How confident are you that your answer is correct?



15. The magazine that Doris and Jim looked at was _____.

a. Vogue magazine b. GQ magazine

How confident are you that your answer is correct?



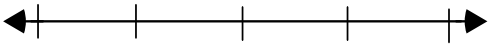
16. What kind of hairdo did Doris have?

a. ordinary b. punk

How confident are you that your answer is correct?

Not confident at all — Very confident

1 2 3 4 5



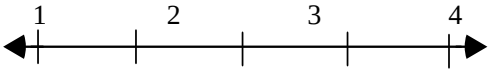
17. The elevator doors that Jim walked by were _____.

a. wide open b. closed

How confident are you that your answer is correct?

Not confident at all — Very confident

1 2 3 4 5



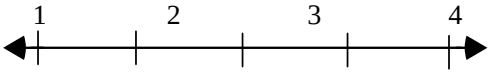
18. Jim had _____ hair

a. fairly straight b. wavy/curly

How confident are you that your answer is correct?

Not confident at all — Very confident

1 2 3 4 5



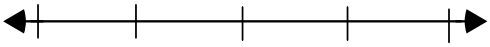
19. The color of the towel that Jim handled was _____.

a. light blue b. white

How confident are you that your answer is correct?

Not confident at all — Very confident

1 2 3 4 5



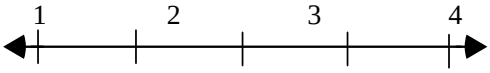
20. Jim and Doris hugged each other _____.

a. once b. twice

How confident are you that your answer is correct?

Not confident at all — Very confident

1 2 3 4 5



Appendix C: R273 Manipulation Check

Thank you for participating in today's R273 trials.

During these trials we would like to know if you experienced any effects over the past hour. These effects may vary from person to person which is why we are interested in finding out how R273 affected *you*.

A number of statements are given below. Please read each statement and circle the number that represents how you felt during the trial. There are no wrong or right answers – we just ask that you are honest.

Please indicate on the scale below the extent to which your experienced each effect.

Effect	**The extent to which you experienced the effect** *Not at all*				*Very much*
My senses were enhanced	1	2	3	4	5
I had difficulty thinking	1	2	3	4	5
I had an easier time remembering things	1	2	3	4	5
My responses were quicker than normal	1	2	3	4	5
I was able to concentrate more easily	1	2	3	4	5
I had a hard time paying attention	1	2	3	4	5

Additional Comments:

Appendix D: Word Lists based on Battig and Montag (1969) norms used in Experiment 4

List A

iron	METAL	tuna	FISH
cotton	CLOTH	oak	TREE
Chair	FURNITURE	dollar	MONEY
apple	FRUIT	ball	TOY
rifle	WEAPON	opera	MUSIC
water	BEVERAGE	tulip	FLOWER
robbery	CRIME	tui	BIRD
medic	PROFESSION	bus	VEHICLE
chemistry	SCIENCE	corn	VEGETABLE
football	SPORT	pepper	SEASONING
Skirt	CLOTHING	french	LANGUAGE
piano	INSTRUMENT	sandals	SHOES
winter	SEASON	python	SNAKE
Mars	PLANET	cat	PET
checkers	GAME	aluminium	METAL
penguin	ANIMAL	flannel	CLOTH
fly	INSECT	table	FURNITURE
tango	DANCE	pear	FRUIT
trout	FISH	knife	WEAPON
elm	TREE	coffee	BEVERAGE
dollar	MONEY	murder	CRIME
doll	TOY	teacher	PROFESSION
jazz	MUSIC	physics	SCIENCE
rose	FLOWER	basketball	SPORT
robin	BIRD	shirt	CLOTHING
car	VEHICLE	violin	INSTRUMENT
carrot	VEGETABLE	summer	SEASON
salt	SEASONING	earth	PLANET
english	LANGUAGE	blocks	BIRD
boots	SHOES	botany	CLOTH
cobra	SNAKE	carnation	CLOTHING
dog	PET	chess	CRIME
copper	METAL	clarinet	DANCE
Linen	CLOTH	knife	FISH
Desk	FURNITURE	crow	FLOWER
orange	FRUIT	dentist	FRUIT
pistol	WEAPON	autumn	FURNITURE
Soda	BEVERAGE	german	GAME
arson	CRIME	giraffe	INSECT

lawyer	PROFESSION	jeep	INSTRUMENT
biology	SCIENCE	jitterbug	LANGUAGE
baseball	SPORT	loafers	METAL
pants	CLOTHING	maple	MONEY
trumpet	INSTRUMENT	mosquito	MUSIC
spring	SEASON	neptune	PET
venus	PLANET	paprika	PLANET
rummy	GAME	cent	PROFESSION
zebra	ANIMAL	rock 'n' roll	SCIENCE
ant	INSECT	salmon	SEASON
waltz	DANCE	socks	SEASONING
shoplifting	SHOES	sword	MONEY
table	SNAKE	jandals	MUSIC
spinach	SPORT	flannel	PET
copperhead	TOY	fish	PLANET
coffee	TREE	earth	PROFESSION
tennis	VEGETABLE	dog	SCIENCE
tin	VEHICLE	dime	SEASON
wool	WEAPON	daisy	SEASONING
violin	ANIMAL	tea	SHOES
truck	BEVERAGE	classical	SNAKE
teacher	BIRD	bluejay	SPORT
sofa	CLOTH	bee	TOY
summer	CLOTHING	bass	TREE
spanish	CRIME	basketball	VEGETABLE
shirt	DANCE	ballet	VEHICLE
rattler	FISH	aluminium	WEAPON
puzzle	FLOWER	pepper	ANIMAL
pine	FRUIT	waltz	BEVERAGE
potato	FURNITURE	venus	BIRD
physics	GAME	tuna	CLOTH
pear	INSECT	tulip	CLOTHING
oregano	INSTRUMENT	trumpet	CRIME
murder	LANGUAGE	spring	DANCE
monopoly	METAL	soda	FISH
sandals	FLOWER	orange	INSTRUMENT
rummy	FLOWER	opera	LANGUAGE
python	FRUIT	shotgun	TREE
pistol	FURNITURE	sneakers	VEGETABLE
zebra	GAME	soccer	VEHICLE
pants	INSECT	thyme	WEAPON

List B

bee	INSECT	satin	CLOTH
ballet	DANCE	bed	FURNITURE
bass	FISH	peach	FRUIT
pine	TREE	shotgun	WEAPON
dime	MONEY	beer	BEVERAGE
puzzle	TOY	kidnapping	CRIME
classical	MUSIC	chef	PROFESSION
daisy	FLOWER	geology	SCIENCE
bluejay	BIRD	soccer	SPORT
truck	VEHICLE	dress	CLOTHING
potato	VEGETABLE	guitar	INSTRUMENT
oregano	SEASONING	pluto	PLANET
spanish	LANGUAGE	backgammon	GAME
jandals	SHOES	hippo	ANIMAL
rattler	SNAKE	hornet	INSECT
fish	PET	shag	DANCE
tin	METAL	groper	FISH
wool	CLOTH	magnolia	TREE
sofa	FURNITURE	penny	MONEY
banana	FRUIT	crayons	TOY
sword	WEAPON	country	MUSIC
tea	BEVERAGE	pansy	FLOWER
shoplifting	CRIME	eagle	BIRD
dentist	PROFESSION	bicycle	VEHICLE
botany	SCIENCE	broccoli	VEGETABLE
tennis	SPORT	rosemary	SEASONING
socks	CLOTHING	italian	LANGUAGE
clarinet	INSTRUMENT	sneakers	SHOES
autumn	SEASON	moccasin	SNAKE
neptune	PLANET	hamster	PET
chess	GAME	thyme	SEASONING
giraffe	ANIMAL	oak	MONEY
mosquito	INSECT	nickel	MUSIC
jitterbug	DANCE	linen	PET
salmon	FISH	lawyer	PLANET
maple	TREE	french	PROFESSION
quarter	MONEY	desk	SCIENCE
blocks	TOY	corn	SEASON
rock 'n' roll	MUSIC	copper	SEASONING
carnation	FLOWER	cat	SHOES
crow	BIRD	tui	SNAKE
jeep	VEHICLE	bus	SPORT
spinach	VEGETABLE	biology	TOY
paprika	SEASONING	baseball	TREE
german	LANGUAGE	ball	VEGETABLE
loafers	SHOES	arson	VEHICLE

copperhead	SNAKE	ant	WEAPON
bird	PET	apple	ANIMAL
gold	METAL	boots	BEVERAGE
car	BIRD	salt	SPORT
carrot	CLOTH	skirt	TOY
chair	CLOTHING	tango	TREE
checkers	CRIME	trout	VEGETABLE
chemistry	DANCE	water	VEHICLE
cobra	FISH	winter	WEAPON
cotton	FLOWER	backgammon	ANIMAL
policeman	FRUIT	bed	BEVERAGE
dog	FURNITURE	beer	BIRD
mars	GAME	broccoli	CLOTH
dollar	INSECT	chef	CLOTHING
elm	INSTRUMENT	country	CRIME
doll	LANGUAGE	crayons	DANCE
fly	METAL	dress	FISH
football	MONEY	eagle	FLOWER
iron	MUSIC	geology	FRUIT
jazz	PET	gold	FURNITURE
english	PLANET	groper	GAME
penguin	PROFESSION	guitar	INSECT
piano	SCIENCE	hamster	INSTRUMENT
rifle	SEASON	hippo	LANGUAGE
robbery	SEASONING	hornet	METAL
robin	SHOES	italian	MONEY
rose	SNAKE	kidnapping	MUSIC
magnolia	PET	rosemary	SNAKE
moccasin	PLANET	satin	SPORT
bicycle	PROFESSION	shag	TOY
pansy	SCIENCE	autumn	INSTRUMENT
peach	SEASON	guitar	GAME
penny	SEASONING	soccer	SPORT
pluto	SHOES		

Appendix E: Example of the Post-Experimental Prospective Memory Manipulation Check

Post-Experimental Questionnaire

The purpose of this questionnaire is to check your understanding of the experiment you just completed. Please answer each of the following questions thoroughly.

1. What were you supposed to do during the Word-Category task?
   _____
   _____
   _____
   _____
2. Do you remember being asked to press a specific key when you saw a particular word? (Circle one.)

   YES NO
3. If yes, then:
   a) What was the key? _____
   b) What was the word? _____
4. On a scale from 1 – 5, how important did you perceive the Word-Category task to be?

1	2	3	4	5
Not at all Important		Moderately Important		Very Important

5. On a scale from 1 – 5, how important was the memory task (remembering to press a specific key when you saw your target word)?

1	2	3	4	5
Not at all Important		Moderately Important		Very Important

6. On a scale from 1 – 5, rate the extent to which you thought about pressing the "Q" key during the Word-Category task.

1	2	3	4	5
Never		Occasionally		Constantly