The expected drug and its expected effect interact to determine placebo responses to alcohol and caffeine

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Abstract. This study tested placebo responses in psychomotor performance when caffeine or alcohol was expected. Fifty male university students were assigned to one of four placebo groups or to a no-treatment control group. Two groups received placebo caffeine and two received placebo alcohol. Subjects performed 12 trials on a pursuit rotor task and performance was measured by the percent time on target. Then they received information about the expected drug effect on the task. One caffeine placebo group (C+) and one alcohol placebo group (A+) were led to expect enhanced performance on the task. The other caffeine placebo group (C-) and alcohol placebo group (A-) were led to expect impaired performance. Subjects subsequently performed 12 trials on the task. An interaction was obtained between the expected type of effect and the expected type of drug. The C+ group displayed superior performance compared to the C- group, and the reverse relationship was observed between the A+ and A- group. In addition, subjects led to expect alcohol-induced impairment (A-) performed better than subjects led to expect caffeine-induced impairment (C-). Subjects also reported greater motivation to resist impairment when they expected alcohol rather than caffeine. The research indicates that understanding and predicting placebo responses may require consideration of the drug that is expected as well as its expected effect.

Key words: Expectancy – Placebo – Alcohol – Caffeine – Psychomotor performance – Humans

Research on placebo responses to alcohol using a two-factor balanced placebo design has examined a range of social and psychomotor behaviors, including aggression (Lang et al. 1975), sexual arousal (Wilson and Lawson 1976), mirth (Vuchinich et al. 1979), social anxiety (Wilson and Abrams 1977), simulated driving performance (Rimm et al. 1982), pursuit rotor tracking (Connors and Maisto 1980), finger tapping, stylus monitoring, standing and walking steadiness (Williams et al. 1981) and complex perceptual motor performance (Vuchinich and Sobell 1978). Reviews of this research have concluded that the expectation of receiving alcohol evokes strong, reliable placebo responses in social and affective behavior but this expectancy has little effect on psychomotor performance (Marlatt and Rohsenow 1980; Hull and Bond 1986).

Marlatt and Rohsenow (1980) suggested that reliable placebo responses in social and affective behaviors occur because individuals share common cultural expectations about how alcohol affects these activities. Likewise, others have argued that experiments fail to observe placebo responses in motor performance because individuals may differ in the type and degree of effect that a moderate dose of alcohol is expected to have on these activities (Maisto et al. 1981). This seems plausible because experiments that have tested placebo responses to alcohol in motor behavior have used laboratory tasks that were unfamiliar to subjects (e.g., Williams et al. 1981; Rimm et al. 1982). As a result, subjects may have uncertain, or inconsistent expectancies about the type of effect that alcohol may exert on their task performance. This perspective implies that subjects must expect a common particular effect from a drug before a robust placebo response could be observed.

If subjects all expect the same specific effect from a drug, they should also display the same type of placebo response. No research has yet tested this hypothesis with respect to placebo responses to alcohol. However, some research using a psychomotor task to examine placebo responses to caffeine has obtained evidence consistent with this hypothesis (Fillmore and Vogel-Sprott 1992). These investigators manipulated the type of effect (impairment or enhancement) that caffeine was expected to have on subjects’ performance of a psychomotor task. A
group led to expect enhancement displayed significantly better performance than a group led to expect impairment, and the performance of a no-treatment group was intermediate. Thus it appeared that a placebo response was obtained in motor performance when caffeine was expected, and the type of placebo response was congruent with the expected type of effect on performance. The foregoing research with caffeine placebos may imply that the expected effect of alcohol may also govern the response to an alcohol placebo. However, there are some reasons for suspecting that the placebo responses may not be congruent with the expected effect of alcohol. Unlike caffeine-induced impairment, society has many sanctions against alcohol-induced impairment. Punishments for impaired driving and information on accidents and hazardous consequences of behavior under alcohol are frequently reported in the media. If subjects entering an experiment have learned that alcohol impairment of motor behavior is usually associated with undesirable consequences, they may attempt to compensate for this impairment. Thus when alcohol is expected and a placebo is received, such compensation should result in improved performance. Furthermore, this compensation may result in performance that exceeds that displayed by subjects expecting alcohol to enhance performance. Therefore, the expected type of drug (caffeine or alcohol) and the expected effect (enhancement or impairment) may interact to determine the placebo response.

The present research was designed to test the interaction by administering caffeine placebos and alcohol placebos to different groups of subjects. The expectation of enhancement or impairment should yield a placebo response consistent with the expected effect of caffeine. However, when subjects expect alcohol, those expecting impairment should display greater improvement than those who expect enhancement. Also when impairment is expected, placebo responses to alcohol should reveal improved performance as compared to placebo responses to caffeine.

**Materials and methods**

**Subjects**

Ethical approval for the project was obtained from the University Office of Human Research. Male volunteers were asked to participate in a study of the effect of alcohol or caffeine on a motor skill. Subjects were recruited using posted advertisements on campus and through a “subject pool” of student volunteers. All students were of legal drinking age in the province of Ontario and their ages ranged between 19 and 34 years. Fifty subjects were randomly assigned to one of five groups (group n = 10) and were paid 60 dollars for their participation. All subjects were asked to report any medication taken 24 h before the experiment, and to eat no food for 2 h prior to the experiment. In addition, the caffeine placebo groups were asked to abstain from caffeine for 2 h before the experiment and the alcohol groups were asked to abstain from alcohol for 24 h before the experiment. These restrictions aimed to enhance the belief that a drug would be received during the experiment.

**Apparatus and materials**

A computerized pursuit rotor (PR) tracking task requiring psychomotor coordination was used to measure subjects’ performance. The task consisted of a computer and monitor on a table top, 75 cm above the floor. The subjects sat in a chair directly in front of a computer screen that displayed the task. Subjects were required to track an on-screen target (diameter = 1.3 cm) that moved at 23 rev/min clockwise around a rectangular track (14 cm X 11.5 cm) with inclined angles (length = 2.75 cm). To track the target, the subject controlled an on-screen circular sight (diameter = 1.3 cm) with cross-hairs by moving a computer mouse on the table top. The subject was required to keep the sight over the rotating target as long as possible during a trial. The computer measured the performance as the percentage of time on target (%TOT) during each trial and stored the trial scores on a computer disk.

To better ensure that subjects’ expectancies solely influenced behavior, no feedback and no consequences were associated with performance. This was achieved by the computerized PR task. It controlled the entire testing of performance, provided no feedback, and allowed each subject to perform alone in the room thereby eliminating the influence of the presence of the experimenter. Therefore the experimenter was only in the test room with the subject to introduce the task. Previous research has shown that expectancy effects were reliably obtained whether or not the experimenter who explained the task was blind to the subjects’ expectancy treatments (Fillmore and Vogel-Sprott 1992).

**Coffee consumption history.** Subjects in the caffeine placebo groups completed a questionnaire that provided a measure of their daily consumption of coffee (Kirsch and Weixel 1988). Subjects reported the number of cups drank in one typical day.

**Alcohol consumption history.** Subjects in the alcohol placebo groups completed a questionnaire concerning their drinking habits (Vogel-Sprott 1992). Subjects reported information that yielded four measures concerning their drinking behavior: frequency, dose, duration, and rate. Frequency referred to the number of drinking occasions per week. Dose referred to the amount of alcohol (ml absolute alcohol/kg) typically consumed during a single drinking occasion. Duration referred to the time span (hours) of a typical drinking occasion. Rate referred to the dose of alcohol typically consumed per hour during a drinking occasion, and was calculated by dividing the dose by the duration.

**Pre-treatment expectancies.** Subjects’ a priori expectancies about the effect of caffeine or alcohol on their performance were also measured. After subjects were familiar with the task, but before any treatment was administered, caffeine placebo subjects were asked to predict how coffee would affect their performance on the PR task, using a 9-point scale ranging from 1 “largely impair”, to 9 “largely enhance”, and 5 indicating “no effect”. Subjects were also asked to indicate how certain they were of their expectancy using a scale with 5-point increments ranging from 0 “no certainty whatsoever” to 100 “complete certainty”. The placebo alcohol subjects completed identical scales with respect to alcohol effects.

**Motivation to resist the drug effect.** At the conclusion of the experiment but before debriefing, subjects rated the degree to which they felt that it was desirable to resist the effect of the drug. The desirability was rated on a scale ranging from 0 “not at all desirable” to 10 “extremely desirable”. Caffeine placebo subjects provided ratings with respect to caffeine effects and alcohol placebo subjects provided ratings with respect to alcohol effects. It was predicted that subjects led to expect alcohol-induced impairment would report more desire to resist the drug effect than subjects led to expect caffeine-induced impairment.