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The Effects of Positive and Negative Placebos on Human Memory Performances

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Two experiments investigated the possible effects of memory-enhancing and memory-impairing placebo capsules (which participants believed to contain active drugs) on participants' performance in a delayed free recall task. In both experiments participants were randomly assigned to either control, positive, or negative placebo conditions, and their memory performance was tested prior to (baseline trial) and after (test trial) the administration of the placebo. Different patterns of results emerged for positive and negative placebos for actual memory performance measures. Whereas negative placebo produces standard placebo effects by impairing both free recall and accuracy scores on test trial, positive placebo does not affect either of these measures (null placebo effect). On the other hand, both positive and negative placebos produce standard placebo effects with respect to participants' self-reports of perceived changes in memory performance: those in the positive placebo group tend to report that the ''drug'' improved their performance, and those in the negative group tend to report that it impaired it.

INTRODUCTION

Studies of pharmacologically active drugs, as a rule, include a group of participants who receive a placebo (i.e. inactive substance) in either a single- or a double-blind experimental design. This procedure helps to differentiate the actual pharmacological properties of the drug from the cognitive effects of merely expected it, by keeping expectancy constant (all participants expect to receive the drug) and varying the content of the drug (drug versus placebo). In order to separate these different influences even more effectively a so-called

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balanced placebo design has been successfully used in alcohol studies over the past years (Kirsch, 1990; Rohsenow & Marlett, 1981). It has been found that alcohol expectancy produces strong placebo effects that are independent of actual beverage consumption. However, although these effects appear to be particularly strong for social and affective behaviours (e.g. aggression and sexual arousal) their impact on cognitive and motor performance is much less pronounced or even non-significant (Hull & Bond, 1986; Marlatt & Rohsenow, 1980).

Different explanations have been suggested to account for the absence of placebo effects on cognitive and motor performance. According to attributional–motivational analysis, alcohol expectancy affects aggression and sexual arousal because it provides a proper excuse for one to engage in what would otherwise be considered an inappropriate or illicit act. In other words, participants may be motivated (i.e. secretly wish) to engage in these behaviours, whereas no such motivation exists for cognitive or motor performance—no-one wants their memory or motor performance to deteriorate (Hull & Bond, 1986; Marlatt & Rohsenow, 1980).

On the other hand, it has been suggested that people may hold particularly strong and culturally shared expectancies about the effects of alcohol on social and affective behaviours, whereas they may be much less certain about its effects on their motor and cognitive performance. With respect to memory processes, for example, Miller et al. (1978, p.249) have noted that participants ''are not likely to have had much drinking experience in situations in which free recall of lists of words is the relevant behaviour, nor is it likely that there is much folklore dealing with such situations.'' In fact, members of different subcultures have been reported to vary greatly in their opinions (expectancies) about the possible effects of alcohol on cognitive and motor performance (Brown, Goldman, & Anderson, 1980; Goldman, Brown, & Christiansen, 1987; both cited in Fillmore & Vogel-Sprott, 1992).

Despite a growing emphasis on the importance of expectancies in alcohol and drug studies (see e.g. Kirsch, 1990) there are few experiments that investigate placebo effects on behavioural outcomes in their own right, i.e. in the absence of an experimental group receiving an active substance. In one such study, for example, participants expected to receive caffeine (a cup of strong coffee) but instead were given a placebo (a cup of decaffeinated coffee) (Fillmore & Vogel-Sprott, 1992). Prior to administration of the placebo, participants were informed that caffeine either enhances (positive placebo condition) or impairs (negative placebo condition) fine motor co-ordination.

The results of this study showed that placebos do affect motor performance if participants are provided with explicit instructions about the expected effects of the to-be-administered ''substance'' or ''drug'' (see also Frankenhaeuser, Jarpe, Svan, & Wrangsjö, 1963). Thus, the positive placebo group displayed greater improvement and the negative placebo group less improvement of a motor skill

when compared to a group of control participants who did not have to consume any beverage at all.

The aim of the present study was to investigate the expectancy effects of positive and negative placebos in a cognitive domain. Specifically, we wanted to examine the changes that might occur in the memory performance of people who are led to believe that they have been administered a psychoactive drug with either proven memory-enhancing or memory-impairing qualities. To this end, participants in Experiment 1a and Experiment 1b were individually tested on a delayed free recall of word lists (baseline trial), and then randomly assigned to either a positive placebo, negative placebo, or control group. Experimental groups received a placebo capsule which they were led to believe would either enhance or impair their memory performance. The control group did not receive any placebo. After being engaged in a couple of filler tasks for 20 minutes all participants' delayed free recall was tested again on a second (matched) set of word lists (test trial).[1]

The first and most obvious prediction that one can make within this design is that both positive and negative placebos are likely to produce *standard placebo effects* (Hypothesis 1). Indeed, the results reported by Fillmore and Vogel-Sprott (1992) suggest that a positive placebo is likely to enhance, and a negative placebo to impair, memory performance on the test trial compared to the performance displayed by the control group. However, in view of the equivocal findings on placebo effects in cognitive tasks, other alternative but equally plausible suggestions exist. Two possibilities are considered next.

Both positive and negative placebos may produce *reverse placebo effects*, i.e. a positive placebo may impair, and negative placebo improve, participants' memory performance through decreased or increased effort at encoding, respectively (Hypothesis 2). This prediction can be derived from the findings of a study conducted by Jemal Kvavilashvili (1992) in which 9-year-old children who were administered a yellow placebo pill with the suggestion that it was a new drug from America with proven memory-enhancing qualities remembered fewer words in a free recall task than the children in the control group who did not receive the placebo. J. Kvavilashvili (1992) accounted for this finding by suggesting that children in the placebo group put less effort into the memory task because they expected that, due to the effects of the memory-enhancing drug, their memory would improve anyway. Similarly, one could argue that if participants are administered a memory-impairing drug they will probably try to compensate for its detrimental effects by putting more effort into the task, which is then likely to result in enhanced performance (cf. Williams, Goldman, & Williams, 1981).

[1] A test of delayed free recall was chosen because the earlier pilot research suggested that, compared with immediate free recall, it provided more sensitive test of memory performance in response to different placebo instructions.

The final possibility that we consider here, based on the results of some alcohol and caffeine studies (see e.g. Hull & Bond, 1986; Kirsch & Weixel, 1988; Nelson, McSpadden, Fromme, & Marlatt, 1986), is that both positive and negative placebos may produce *null placebo effects* on participants' memory performance (Hypothesis 3). However, one would also bear in mind that there are three possible ways of assessing the changes that occur after the administration of placebos, namely, obtaining self-reports of these changes, observing/measuring behaviour, and monitoring physiological reactions (Ross & Olson, 1981). Therefore, there may be a discrepancy between the effects of positive and negative placebos on overt performance and subjective experience. Thus, it may be the case that negative and positive placebos do not change actual performance levels, but do produced marked placebo effects in participants' self-reports on perceived changes (see Spangenberg, Obermiller, & Greenwald, 1992).

In order to explore the aforementioned possibilities it was necessary to obtain, apart from free recall scores, various self-report measures such as perceived amount of effort put into the memory tests and extent to which changes in one's memory performance were attributed to the operation of ''drugs''. In addition, it was desirable to check the participants' beliefs (i.e. expectations) about the effectiveness of administered ''drugs''. Finally, because some participants believed they were taking a memory-impairing ''drug'', which could elicit enhanced levels of worry and anxiety, it was decided to measure participants' anxiety levels prior to each memory test.

EXPERIMENT 1A

Method

Participants. A total of 36 male and 36 female undergraduate students from UWCC between 18 and 36 years of age ($M = 22.53$) participated in Experiment 1a. Psychology students received one hour course credit plus token payment for their participation. Non-psychology students received token payment. Participants were randomly assigned to one of three groups: control, positive placebo, and negative placebo. There were 24 participants (12 male and 12 female) in each group.

Materials and Procedure. The main difficulty of conducting the present study was to convince the participants that pharmacologically active drugs were being tested. The study was advertised as a Drugs and Memory Study in which 5HT agonist and antagonist drugs were allegedly to be tested. Participants were informed that these drugs had memory-enhancing and memory-impairing qualities, respectively and that no side or long-lasting effects had been recorded (when taken in small doses) over the past few years. To enhance the belief that

real drugs were to be used, the students were warned not to sign up for an experiment if they were (1) pregnant, (2) on any temporary or permanent medication (except contraceptive pills), (3) usually allergic to drugs, or (4) suffering from epileptic fits. In addition, those who had decided to participate were asked to make sure that they had not consumed any alcoholic drinks and/or food (even snacks!) within at least an hour of the beginning of an experiment.

General instructions. Participants were tested individually by a female experimenter (the first author). Each session lasted an hour. Upon their arrival at the experimenter's office all participants received very detailed information, with bogus names and facts, about the background and the aims of the study. They were also informed about the succession of procedures involved in the study, together with the fact that they would be randomly assigned to one of the following groups: a TRIPTOLAN group (i.e. a group that has to take a memory-enhancing drug, Triptolan); a SERONUL group (taking a memory-impairing drug, Seronul); and a CONTROL group (taking no drug).[2] If they had any doubts about the drugs and/or details of experimental procedure the experimenter willingly answered all their questions. This was followed by signing a consent form.

Self-evaluation Questionnaire (STAI). After signing the consent form participants were given instructions for a free recall task. However, before starting the memory test participants were asked to fill in Form X1 and Form X2 of the State-Trait Anxiety Inventory—STAI (Spielberger, Goruch, & Lushene, 1970) which measure state and trait anxiety, respectively (minimum and maximum scores for both forms are 20 and 80).

Memory Test 1 (Baseline Trial). Two lists of 30 words were presented (out of possible four lists). Each word appeared for two seconds in the centre of the computer screen with a one-second interval between the words. At the end of each presentation, after counting backwards in threes from a given three-digit number for 30 seconds, participants were given two minutes to write down, in any order, all the words they remembered.

Drawing Lots. Although participants had already been randomly assigned to groups, the experimenter showed them a small box full of yellow paper rolls and informed them that it contained an equal number of three different lots. Participants drew one roll at random and unfolded it to see whether they had to take a ''drug'' (either enhancing or impairing memory) or not.

[2] A detailed description of these instructions can be obtained from the first author on request.

Administration of Placebo. Participants in either the positive or negative placebo group were given a cup of still mineral water and asked to swallow one capsule of the relevant ''drug'' (Contag 400 capsule filled with cornflour). The capsules were produced in the presence of participants from one of two identical light-resistant jars with clearly visible labels ''Triptolan'' and ''Seronul''. Each of these labels also contained other bogus information such as, for example, the warning ''Light sensitive!'', dosage, etc.

Filler task 1—IQ Test. After taking the ''drug'', participants were informed that it was necessary to wait at least 15–20 minutes before the drug started its action. In order to fill in this period participants in all three groups were given the Culture Fair IQ test (Scale 3, Form A). The completion of this test together with instructions took approximately 15 minutes.

Filler task 2—STAI (Form XI only). Next, participants were asked to fill in STAI again. This time, however, they had to fill in only the form X1 (measuring state anxiety). Participants were asked to try not to remember how they filled in this form on the first occasion. Instead, they had to rely on their current feelings.

Memory Test 2 (Test trial). After filling in Form X1 of STAI, participants' memory was tested again with the remaining two lists of words. The procedure was the same as in Memory Test 1. In each group, the order of presentation of all four lists in Memory Tests 1 and 2 were counterbalanced across participants. Words in all four lists were matched for their meaning and frequency (medium to high).

Cognitive Failures Questionnaire (CFQ). After the memory test, participants were asked to fill in the CFQ (Broadbent, Cooper, FitzGerald, & Parkes, 1982) which was included in the experiment to study issues not relevant to the present study.

Self-report Measures. Various self-report measures were also obtained at different stages of the experiment. For example, at the end of both memory tests participants were asked to rate how hard they had tried to remember the words, on a 7-point scale where 1 = no effort at all, 3 = slight, 5 = considerable, and 7 = maximum effort. Furthermore, prior to Memory Test 2 participants in both the positive and negative placebo groups had to rate their belief in the effectiveness of the ''drug'' they had taken on a 7-point scale where 1 = not at all effective, 3 = slightly, 5 = quite, and 7 = very effective. In addition, immediately after Memory Test 2 these participants were asked if, in their opinion, the drug they had been administered had any effect on their memory performance. Participants had to answer on a 7-point scale in which 4 corresponded to the statement ''Drug did not affect my performance at all''. All the points below 4

indicated that the drug had worsened memory performance (1 = dramatically, 2 = considerably, and 3 = slightly), and those above 4 indicated that the drug had improved it (5 = slightly, 6 = considerably, and 7 = dramatically).

Debriefing. Participants were debriefed only after the completion of the whole study by sending them a letter describing the true purpose of the study together with some preliminary results.

EXPERIMENT 1B

Method

The aim of Experiment 1b was to enhance the generalisability of findings obtained in Experiment 1a by replicating its results on a different sample of students with some minor modifications in the experimental procedure. As greater placebo effects had been obtained with larger apparent doses (see Blackwell, Bloomfield, & Buncher, 1972; Kirsch & Weixel, 1988; Ross & Olson, 1981), the participants in Experiment 1b received an increased dose of placebo (two capsules instead of one). In addition, their weight was measured before drawing lots, which, according to the experimenter, would help her to calculate an appropriate dosage for the to-be-administered drug. Finally, in order to control for experimenter bias, the experimenter was unaware of the participants' group allocation until drawing lots, i.e. drawing lots was no longer a bogus procedure.

Participants. Experiment 1b was conducted on 96 (46 male and 60 female) undergraduates at the University of Hertfordshire (mean age 21.57; range 18–34). Psychology students received an hour and a half course credit and non-psychology students token payment for their participation. There were 32 participants in each group.

RESULTS

Several dependent measures were obtained from participants throughout the experimental session both at baseline and test trials. We first report the results of analyses on two memory performance measures (recall and accuracy scores)[3] followed by the analyses conducted on various self-report measures. Experiment (1a vs. 1b) was initially entered as an independent factor in all the analyses that we conducted on the data. However, as none of these analyses revealed a main effect of experiment or an interaction between the latter and the other

[3] See Koriat and Goldsmith (1994, 1996) for a strong case in favour of distinguishing the quantity (the amount of correctly recalled words) and the accuracy (the proportion of correctly recalled words out of a total number of words retrieved) of measures of memory performance.

independent variable (i.e. groups), the final analyses reported in this paper were conducted on the data pooled across the two experiments unless otherwise indicated.

Memory Quantity

Participants' memory scores both at baseline and test trials were obtained by averaging the number of correctly recalled words in the two lists of words presented on each trial (see upper panel of Table 1). The highly significant regression of test scores on baseline scores, $F(1,166) = 245.35$, $P < .0001$ indicated that individual differences on baseline trial accounted for 60% of variability in memory performance on test trial. In order to control the differences in baseline recall scores, they were entered as a covariate into a one-way analysis of variance with groups as a between-subjects factor and the mean recall scores on test trial as a dependent variable. Baseline scores showed no significant interaction with groups ($F < 1$) indicating that the assumption of homogeneity of slopes was tenable and a one-way analysis of covariance valid. This analysis revealed a significant effect of groups, $F(2,164) = 4.10$, $P < .02$. The adjusted means of correctly recalled words on test trial in control, positive, and negative placebo groups were $M_1 = 13.54$, $M_2 = 13.19$, and $M_3 = 11.91$, respectively (see Table 1 for unadjusted means). Using the mean square error from the covariance analysis, comparisons of these adjusted mean recall scores showed that the negative placebo group recalled significantly fewer words compared to both the control, $t(164) = -2.71$, $P < .01$, and positive placebo

TABLE 1
Dependent measures (pooled across Experiments 1a and 1b) on baseline and test trial as a function of groups (control vs. positive placebo vs. negative placebo). Standard deviations in brackets.

	Control		*Placebo+*		*Placebo–*	
	Baseline	*Test*	*Baseline*	*Test*	*Baseline*	*Test*
Memory Performance						
Delayed free recall	12.03	13.16	12.38	13.14	12.90	12.34
	(4.06)	(4.66)	(4.36)	(5.54)	(4.34)	(4.95)
Recall accuracy	.940	.959	.946	.950	.959	.939
	(.07)	(.05)	(.06)	(.05)	(.05)	(.06)
Self-reports						
Effort	5.05	5.21	5.30	5.18	5.02	5.40
	(1.02)	(1.02)	(1.04)	(1.22)	(.90)	(.97)
Anxiety	36.47	34.29	35.87	33.72	36.36	32.69
	(7.07)	(7.37)	(5.99)	(6.49)	(8.94)	(6.80)

groups, $t(164) = 2.14$, $P < .05$, whereas the difference between the latter and the control group was not statistically significant, $t(164) = -.59$, $P > .05$.

Memory Accuracy

Although extra-list intrusions are relatively rare in single-trial free recall paradigms (e.g. Roediger & Payne, 1985; but see Roediger & McDermott, 1995 for different results), our participants still produced some intrusions, especially when recalling the second lists of baseline and test trials. In order to see if positive and negative placebos had any reliable effect on participants' accuracy of recall, for each participant we calculated the mean proportions of correctly recalled words (out of the total number of words produced after each list of words) in baseline and test trials. Test trial accuracy scores were then entered into a one-way analysis of covariance with groups as a between-subjects factor and baseline accuracy scores as a covariate. However, an interaction between the covariate and independent factor was statistically significant, $F(2,165) = 9.95$, $P < .001$, indicating that the requirement of homogeneity of slopes was not tenable. Moreover, the requirement of homogeneity of variance was also violated due to high statistical significance of the Levene Test for homogeneity of variances, $F(2,165) = 5.59$, $P < .005$.

However, closer inspection of accuracy data revealed several outliers with extreme values. When we excluded from the analysis the data of those four participants whose free recall output contained more than 30% of extra-list intrusions either on baseline or test trial (or both), the covariate by group interaction was no longer significant, $F(2,158) = 2.06$, $P > .05$, indicating an unusually high impact by these outliers on regression slopes.[4] In addition, the results of the Levene Test also became satisfactory, $F(2,161) = 1.04$, $P > .05$).

The analyses of covariance conducted on test trial accuracy scores revealed a significant main effect of groups, $F(2,160) = 3.36$, $P < .05$. The mean accuracy scores at test trial were presented in the upper panel of Table 1. The adjusted means for control, positive, and negative placebo groups were $M_1 = .961$, $M_2 = .951$, and $M_3 = .936$, respectively. Planned comparisons of these adjusted means showed that the negative placebo group's accuracy was reliably worse than that of the control group, $t(160) = -2.58$, $P < .05$, whereas the difference between the latter and the positive placebo group was not statistically significant, $t(160) = -.1.09$, $P > .05$).

[4] Out of these four cases that were excluded from the analysis one participant was in the positive and three were in the negative placebo groups. The participant in the positive group fell above the 30% cut off point at baseline trial. Two participants in the negative group fell above this point at both baseline and test trials, and the third at test trial only.

Self-report Measures

A number of different self-report measures were obtained at various stages of the experiment. Initially, we analysed the data on participants' self-reports of the amount of perceived effort put into the memory task on baseline and test trials (for means see the lower panel of Table 1). The ratings of effort were entered as a dependent variable into a 3(group) $\times$2(memory trial) mixed ANOVA with the repeated measures on the last factor. This analysis revealed a reliable main effect of trial $F(1,165)=4.95$, $P<.05$ indicating that participants reported exerting more effort in the second memory trial ($M_2=5.26$) than in the baseline trial ($m_1=5.12$). However, this effect was qualified by highly significant group by trial interaction, $F(2,165)=5.48$, $P<.01$. A test of simple main effects showed no reliable effect of trial in the control and positive placebo groups, $F=2.18$, $P>.05$ and $F=1.32$, $P>.05$, respectively), but a highly significant effect in the negative placebo group, $F(1,165)=12.42$, $P<.005$.

Next, participants' *state anxiety* scores (i.e. Form XI only), obtained prior to each memory trial, were entered into a 3(groups) $\times$ 2(trial) mixed ANOVA. The only significant effect revealed by this analysis was the main effect of trial, $F(1,162)=30.09$, $P<.0005$.[5] Overall, participants reported that they were less anxious on the test ($M_2=33.56$) than on the baseline trial ($M_1=36.23$). In other words, there was a significant decrease in state anxiety levels across the two memory trials in all three groups of participants.

In addition to studying the placebo effects on overt memory performance, the present study permits examination of the placebo effects, if any, on participants' retrospective reports of perceived changes in performance. Immediately after finishing the second memory test (i.e. the test trial) participants in the positive and negative placebo groups were asked to evaluate how the drug they had taken (Triptolan and Seronul, respectively) affected their memory, i.e. whether it increased, decreased, or did not affect their performance on a memory test. A one-way between-subjects ANOVA conducted on ratings of perceived drug effectiveness on a 7-point rating scale revealed a reliable effect of group, $F(1,110)=11.54$, $P<.001$. The positive placebo group gave higher ratings ($M=4.21$) than negative placebo group ($M=3.46$).[6]

[5] Note that, due to the experimenter error, the data from three participants were missing.

[6] Note that ratings above point 4 on this scale indicated improvement, and ratings below this point impairment. Therefore it was also necessary to see if the ratings of the positive and negative placebo groups significantly differed from this number. One-sample *t*-tests conducted separately on the ratings of the positive and negative placebo groups revealed a highly significant effect for the negative placebo group, $t(55)=-3.66$, $P<.0005$, one-tailed, but not for the positive placebo group, $t(55)=1.20$, $P>.05$. However, this non-significant result in the positive placebo group was due to extreme ratings (point 1 on the rating scale) by two participants, who thought that ''Triptolan'' dramatically impaired their performance. When their ratings were excluded from the analysis the mean rating of the positive placebo group increased to 4.32 which was statistically significant from point 4 of the scale, $t(55)=2.09$, $P=.02$, one-tailed.

The fact that the perceived effectiveness of the ''drugs'' was in the expected direction was further corroborated by the analyses of frequency data. In the positive placebo group, the number of participants who reported that the ''drug'' improved (points 5, 6, or 7 on a 7-point rating scale), impaired (points 1, 2, and 3), or did not change (point 4) their performance on test trial was 25, 16, and 16, respectively. The respective numbers in the negative placebo group were 7, 27, and 22. Thus, the positive placebo group tended to report that the ''drug'' improved their performance, whereas the negative placebo group tended to report that it impaired it ($\chi^2 = 14.50$, df = 2, $P < .001$).

Finally, in order to see if the procedural changes introduced in Experiment 1b managed to increase participants' expectations about the effectiveness of the ''drug'', the participants' ratings of the *expected effectiveness* taken prior to the test trial were entered into a 2(experiment) $\times$ 2(group) ANOVA where experiment (1a vs. 1b) and group (positive vs. negative placebo) were both between-subjects variables. This analysis did not reveal any reliable main effects or interaction between the independent variables. Although the participants in Experiment 1b were administered two placebo capsules instead of one, mean ratings of expected effectiveness were 3.19 and 3.69 in the positive and negative placebo groups respectively, which do not significantly differ from the corresponding ratings obtained in Experiment 1a (3.67 and 3.33).[7]

DISCUSSION

A major finding of the present study is that positive and negative placebos appear to have different effects on actual memory performance measures and similar effects on self-reports of perceived changes in memory performance. The analyses showed that positive placebo does not enhance or decrease memory quantity and/or accuracy as predicted by Hypotheses 1 and 2 in the introduction. Negative placebo, however, appears to produce strong *standard placebo effects* on both number of items recalled and accuracy of recall. Thus, participants who believed they had been administered a memory-impairing drug remembered fewer items in a delayed free recall task and produced more false alarms on test trials than those in the control group.

On the other hand, the present study provides unequivocal support for the idea that both positive and negative placebos do produce significant (but not large) *standard placebo effects* on participants' self-report measures of

[7] Nevertheless, it should be pointed out that the levels of expectation reported in the present study seem to be comparable or even better than those obtained for such well known and trivial ''drugs'' as caffeine and sedatives (see Fillmore & Vogel-Sprott, 1992; Jensen & Karoly; 1991). Moreover, only eight participants out of 112 in the positive and negative placebo groups of Experiment 1a and 1b (four in positive and four in negative placebo groups) thought that the ''drug'' would not have any effect on their performance (rating 1 on a 7-point scale).

perceived changes in performance, i.e. on the post-test evaluations of the effectiveness of the ''drug''. Thus, participants in the positive placebo group tend to assume that the ''drug'' improved their performance, whereas those in the negative placebo group displayed the opposite tendency. In other words, the expected effect of the ''drug'' predicts the direction of the perceived change in performance that is attributed to the operation of the ''drug'' (cf. Frankenhaeuser et al., 1963).[8]

Taken together, these findings may have important implications for clinical practice. For example, when a memory impairment is suggested by a doctor as a possible side-effect of a drug that is being prescribed to a patient, the doctor should be aware of the fact that a mere expectancy of impairment, rather than the actual properties of the drug, can apparently also lead to a decrease in memory performance. On the other hand, as positive placebos appear to improve people's self-perceptions of their memory performance (i.e. standard placebo effects on self-report measures) it may be worthwhile to prescribe patients with mild memory problems ''memory enhancing" placebo pills in order to improve their self-perceptions of memory performance, and thus boost their confidence.

The present findings also underscore the importance of assessing both objective performance measures and subjective evaluations of perceived changes in performance. To our knowledge there is only one experimental study (Spangenberg et al., 1992) in which the effects of positive placebo on memory were assessed both for actual performance scores and for participants' self-reports of perceived changes in their memory. In this study participants volunteered to listen for a period of one month to subliminal-message self-help audio tapes which, according to the manufacturers, had either memory or self-esteem enhancing properties (Experiment 2). Actual content and labelled content of the tapes was independently varied: for half of the participants tape content and label coincided and for the other half it did not. The latter, for example, were given a self-esteem tape with the label ''memory'' and vice versa. Participants' memory was tested prior to and after listening to the tape (two counterbalanced parallel versions of four subtasks of the Wechsler Memory Scale were used).

The results of this study revealed no effects of expectancy (listening to a tape labelled as ''memory'' irrespective of its actual content) on overt memory performance (Experiment 2). However, marked placebo effects were observed

[8] It is interesting that, even in pharmacological research, placebo effects are more readily revealed with subjective rather than objective measures of symptom change. Thus, the majority of standard placebo effects reported in pharmacological research are actually based on patient and physician's subjective ratings of pain reduction and mood improvement rather than objective behavioural and physiological measurement (see Ross & Olson, 1981). Kirsch (1990, pp. 37–38) has noted in this context that ''placebos, after all, are purely psychological treatments, and although they can produce physiological as well as psychological effects, their effects on psychological states are more reliable and more pronounced.''

when, at the end of the study, participants were asked whether their long-term memory had improved (yes or no) during the tape-listening period. Thus, 41% of participants in the labelled memory condition reported an improvement in memory whereas only 10% of participants in the labelled self-esteem condition indicated increased memory ability.

The results of the present study not only replicate those obtained by Spangenberg et al. but also extend them to negative placebos. In addition, Spangenberg et al.'s participants based their evaluations on unidentified numbers of unspecified observations of their memory in everyday life throughout the tape-listening period (which on average lasted for as long as 35 days). In contrast, participants in the present study arrived at their conclusions by comparing their performance in two relatively simple laboratory tests of memory following each other closely in time (20–25 minutes). The fact that placebo effects on self-reports were obtained over a short time interval between tests is particularly striking and indicates that we may be dealing with a robust phenomenon.

The present study was conducted with the aim of establishing the effects of both positive and negative placebos (i.e. expectancies), if any, on (i) memory performance measures and (ii) self-reports of perceived changes in performance. Obviously, future research should address the issues of underlying mechanisms, i.e. the processes that mediate the placebo responses observed in the present study. At present it seems that different mechanisms are likely to be involved in positive and negative placebo effects obtained on self-report measures, on the one hand, and in the effects of negative placebos on actual memory performance, on the other. The former effects may be more amenable to explanatory models developed in research on interpersonal expectancy effects (see Harris & Rosenthal, 1985; Rosenthal, 1994). Thus, it is likely that participants whose memory performance slightly improved or decreased from baseline to test trial in the positive and negative placebo conditions respectively would be still inclined to attribute these minor changes to the effects of drugs so as to create a self-fulfilling prophesy.

It is much more difficult, however, to account for the processes involved in the impairment of actual memory performance as a result of administering the negative placebo. It is possible, however, that the self-reports of effort put into a memory task may provide some initial answers to this issue. Thus, the results of the present study indicate that although participants in the negative placebo group reported putting an increased amount of effort into a free recall task on test trial, in comparison to baseline trial, their actual performance deteriorated across the two trials.

The concept of effort has been operationalised in memory literature either in terms of the time spent on the task (Eisenberger, 1992) or the amount of attentional and processing resources available at the time of performing an information-processing task (Eysenck & Calvo, 1992; Tyler, Hertel, McCallum,

& Ellis, 1979). Although participants in the present study were not provided with an operational definition of effort at the time of making the relevant rating, it was obvious that effort was understood by them in the latter meaning. Thus, participants in the negative placebo group tended to complain that the ''drug'' had apparently affected their ability to concentrate on the task and that it was due to their attempt to compensate for this lack of mental concentration that they had to put more effort (i.e. allocate increased amount of attentional resources) into the task.

It appears that negative placebos (i.e. the expectation of memory impairment) somehow decrease participants' *processing efficiency* on a free recall task (see Eysenck & Calvo, 1992). Obviously, future research should seek to validate the results of self-report data by also obtaining more objective measures of effort. This could be achieved by, for example, using a ''probe technique'' that measures participants' performance on a secondary task (Eysenck, 1989; Eysenck & Calvo, 1992). If negative placebos really do decrease processing efficiency in the memory task, then performance on the secondary task should be worse for participants in a negative placebo group (cf. Tinklenberg & Taylor, 1984).

In Eysenck and Calvo's (1992) theoretical framework, reduced processing efficiency is attributed to an increased amount of worry and anxiety. However, the results of the present study show that the *state anxiety* levels measured by Spielberger's State-Trait Anxiety Inventory (STAI) were reliably lower at test than baseline trial in all three groups of participants. One way of explaining the discrepancy between the anxiety and effort data in the negative placebo group is to suggest that decreased processing efficiency may be induced not only by high levels of state anxiety but also by other factors such as rumination (Martin & Tesser, 1996) or the occurrence of task-unrelated images and thoughts—TUITs (Giambra, 1995). Thus, although the anxiety levels in the negative placebo group decreased significantly at the test trial, they might still have had difficulties in concentrating on the memory task because of ruminations on the expected effects of a memory-impairing drug. Clearly, these are issues that need to be addressed in future research.

In conclusion, one can draw interesting parallels between the results of the present study and those obtained in pharmacological research in which the effects of real (i.e. psychoactive) drugs on human memory have been explored. The following important points have emerged from the latter. For example, according to Idzikowski (1988, p.196) ''the effects of drugs on memory tend to be very small (often less than 5%) and the variability of responses very high.'' On the other hand Smith (1984, p.170), after reviewing the literature on the effects of various drugs (affecting mainly cholinergic synapses) on human memory, has come to the conclusion that ''it is easier to impair memory with drugs than it is to improve it, at least in normal participants.'' Finally, it has been repeatedly suggested that the majority of currently tested drugs may be affecting

memory only indirectly via increased or decreased arousal and attention (Millar, 1988; Sahgal, 1984; Smith, 1984; Tinklenberg & Taylor, 1984). For example, the participants in Ghoneim and Mewaldt's (1977) study, whose memory performance was impaired as a result of scopolamine administration, complained that they found it difficult to concentrate on tasks because of a tendency for their minds to wander (for a more detailed discussion of similar findings, see Smith, 1984).

The results of the present study indicate that memory-enhancing and memory-impairing placebos produce effects that are similar to those of real psychoactive drugs. First, both negative and positive placebos appear to have only mild effects on self-reports of perceived changes in memory performance. Second, negative placebos produce standard placebo effects on actual memory performance, which is in accordance with the suggestion that it is easier to impair than to improve memory with drugs. Finally, participants in a negative placebo group like those in Ghoneim and Mewaldt (1977), tend to complain that the ''drug'' impaired their ability to concentrate on the task. These comparisons provide clear support for Ross and Olson's (1981) suggestion that the direction and strength of placebo effects usually parallels the effects of the drugs to which these placebos are compared.

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