European Psychologist

Context Aversion, Pavlovian Conditioning, and the Psychological Side Effects of Chemotherapy

Geoffrey Hall
University of York, York, UK

Patients who have undergone several sessions of chemotherapy for cancer will sometimes develop anticipatory nausea and vomiting (ANV), these unpleasant side effects occurring as the patients return to the clinic for a further session of treatment. Pavlov's analysis of learning allows that previously neutral cues, such as those that characterize a given place or context, can become associated with events that occur in that context. ANV could thus constitute an example of a conditioned response elicited by the contextual cues of the clinic. In order to investigate this proposal we have begun an experimental analysis of a parallel case in which laboratory rats are given a nausea-inducing treatment in a novel context. We have developed a robust procedure for assessing the acquisition of context aversion in rats given such training, a procedure that shows promise as a possible animal model of ANV. Theoretical analysis of the conditioning processes involved in the formation of context aversions in animals suggests possible behavioral strategies that might be used in the alleviation of ANV, and we report a preliminary experimental test of one of these.

Keywords: Pavlovian conditioning, context, aversion, chemotherapy, ANV.

Pavlov himself made great claims for the general relevance and importance of the learning process he discovered. He wrote, for instance, "It is obvious that the different kinds of habits based on training, education and discipline of any sort are nothing but a chain of conditioned reflexes" (Pavlov, 1927, p. 395). This article does not hope (even if such a thing were possible) to attempt to substantiate such a wide-ranging assertion. It does try to establish, however, that the form of conditioning developed by Pavlov can help us understand one particular learning phenomenon that is, at first sight, rather different from what was studied by him, and also to show that the insights generated by the Pavlovian analysis might lead to practical measures that would be of help in the alleviation of human suffering.

ANV and Conditioning

In spite of the increasingly widespread use of antiemetic medication, cancer chemotherapy is a notoriously unpleasant experience — nausea and vomiting are still a common consequence of drug infusion. For those who experience these effects, a further problem may ensue. After four or five sessions of treatment, the patient may find that simply being present in the clinic can evoke distress — its sights, sounds, and smells will produce high levels of anxiety and anticipatory nausea and vomiting (ANV) (Andrykowski & Redd, 1987). Such psychological side effects (as they are called) are a relatively common occurrence; after reviewing a range of studies, Burish and Carey (1986) came to a best estimate of 45% for the prevalence rate in adult chemotherapy patients. And they can be sufficiently severe that they induce patients to interrupt their course of treatment, or even to withdraw from it altogether, with potential life-threatening consequences (Boakes, Tarrier, Barnes, & Tatter-

Geoffrey Hall is Professor and Head of the Department of Psychology at the University of York, and Editor of the *Quarterly Journal of Experimental Psychology*.

Correspondence concerning this article should be addressed to Geoffrey Hall, Department of Psychology, University of York, York YO1 5DD, UK (tel. +44 1904 433144, fax +44 1904 433181, e-mail gh1@york.ac.uk).

European Psychologist, Vol. 2, No. 2, June 1997, pp. 118–124

sall, 1993). To understand the nature of the phenomenon is thus a matter of prime clinical importance.

Classical conditioning, as conducted in Pavlov's laboratory, is clearly something very different from what goes on in the chemotherapy clinic*. But at a theoretical level, a parallel is easy to discern. The modern consensus (e.g., Hall, 1994; Mackintosh, 1983; Rescorla, 1988) is that classical conditioning reflects the formation of an association between the (central representations of) stimuli that occur together. One consequence of the formation of such an association is that one of these stimuli (the conditioned stimulus, CS) may become able to evoke a response (the conditioned response, CR) that is similar, or even identical, to that elicited by the other (the unconditioned stimulus, US). From this point of view, ANV is readily interpreted as an instance of classical conditioning in which the complex of stimuli that constitute the clinic come to act as a CS evoking the complex CR that is nausea and vomiting.

This interpretation has been offered several times before (e.g., Nesse, Carli, Curtis, & Kleinman, 1980; Redd & Andrykowski, 1982) and, with elaborations, has come to command wide acceptance (for a review see, e.g., Carey & Burish, 1988). One line of evidence cited in its support comes from studies of food aversion learning in laboratory animals. It is well established that animals given a novel flavor prior to receiving some nausea-inducing treatment (such as irradiation, or the injection of certain drugs or of a solution of a lithium salt) will develop an aversion to that flavor. It is clear, therefore, that the induction of nausea can support learning. What is more, such flavor aversion learning can develop during chemotherapy: Bernstein and Webster (1980) have shown that patients who consume a novel food prior to treatment will acquire an aversion to its flavor. It seems a small step to assume that ANV differs from flavor aversion learning only in that it happens, for most patients, to be contextual cues rather than flavor that acquire aversive properties. Then, to the extent that flavor aversion learning is taken to be an instance of classical conditioning, so may ANV be interpreted. Unfortunately both of the steps in this argument are open to dispute.

One of the earliest demonstrations of illness-induced aversion learning in rats was that reported by Garcia and Koelling (1966). They produced the striking finding, since widely replicated, that although a flavor cue could readily acquire aversive properties in this training paradigm, auditory and visual cues did not. Such results led some to the conclusion that classical conditioning selectively favors the formation of some associations over others; thus, according to Seligman, "rats are prepared, by virtue of their evolutionary history, to associate tastes with malaise [but] ... are contraprepared to associate exteroceptive events with nausea" (Seligman, 1970, p. 409). Garcia himself (e.g., 1989; Garcia, Brett, & Rusiniak, 1989) developed a more extreme position, holding that illness-induced aversion learning is not to be regarded as classical conditioning at all. Pavlovian conditioning, he argued, applies to the operation of a "skin-defense system" concerned with exteroceptive cues and painful events. A separate "gut-defense system," concerned with tastes and nausea, operates by different rules, and exteroceptive events can gain access to this system only in rather special circumstances. Evidently, before claiming a parallel with ANV, it is necessary first of all to determine whether illness-induced context aversions can in fact be established in animals, and if so, under precisely what conditions.

Illness-Induced Contextual Aversion in Rats

The first, apparently clear, demonstrations of the acquisition of contextual aversions in rats came from a set of studies by Best and his colleagues (e.g., Best, Brown, & Sowell, 1984; Best, Batson, Meachum, Brown, & Ringer, 1985). In their basic procedure (subsequently adopted by others, e.g., Boakes, Westbrook, & Barnes, 1992; Mitchell & Heyes, 1996) thirsty rats were placed for half an hour or so in a novel cage, distinctively different from that used as the home cage, and allowed to consume some water (usually with an added novel flavor). On being removed from this context they were given an illness-inducing treatment, such as an injection of lithium chloride (LiCl). When animals were subsequently tested in the training context it was found that their willingness to consume even familiar and usually palatable fluids was suppressed. This was interpreted as reflecting the acquisition of aversive properties by the contextual cues.

There are, however, some problems with this experimental procedure. Although it is certainly plausible that an aversion to the context might make an animal

* This is true if we restrict attention to the standard salivary conditioning preparation. But Pavlov (1927, pp. 35–36) reports the intriguing observation that after 5 or 6 injections of morphine, a dog will begin to show the range of reactions (including vomiting), normally produced by the drug itself, in response to the mere preliminaries of the injection.

unwilling to consume fluid in that context, another, and simpler, interpretation of the finding is possible. It is that the suppression of consumption seen on test is the consequence of direct generalization to the test fluid of an aversion conditioned to the fluid presented in training (the two fluids will, after all, hold many features in common). This is not to say that the training context plays no role — suppression of consumption of the test fluid has been shown to occur only when the test is given in the pretrained context, and not when it is given elsewhere (Mitchell & Heyes, 1996). But this result does not require us to assume that the test context itself is aversive. It is well established that flavor aversions can show context dependence, being fully expressed only in the presence of the relevant contextual cues (e. g., Bonardi, Honey, & Hall, 1990). This process could explain the context-specificity demonstrated by Mitchell and Heyes (1996) without any need to assume that the context itself had acquired aversive properties.

To provide an unambiguous demonstration of the acquisition of an aversion by a context we need a different test procedure. An effective alternative is to make use of the phenomenon known as *blocking* — the finding that prior training of one event as a CS will interfere with the acquisition of conditioned strength by a further stimulus when the two are presented together and paired with the US. If contextual cues really have acquired aversive properties then they should be able to block further aversive conditioning — for instance, it should be difficult to establish a standard flavor aversion when the conditioning is carried out in the presence of the pretrained contextual cues. With this procedure, a context aversion would show itself in a *failure* of conditioning to the test flavor; direct generalization from the aversion formed to the fluid present during the initial phase of context conditioning could not generate such a result.

The blocking procedure has been employed with success several times (e. g., Best et al, 1984; Westbrook & Brookes, 1988). I will describe here the version of the experiment that we have conducted in my laboratory (Symonds & Hall, 1997, Experiment 1B). The design is summarized as Experiment 1 in Table 1. There were two groups of rats (male hooded Lister). Those in the experimental group received initial training in which on four occasions they were placed in a distinctive novel cage for 30 min and allowed to drink water. On being removed from this context they were given an illness-inducing injection of LiCl (0.15 M at 10 ml/kg of body weight). Subjects in the control condition received similar treatment except that for them the injection was not paired with their experience of the context, but was given 5 h later, the intervening time having been spent in the standard home cages. The second phase of training, given after a 6-day interval during which the animals were left undisturbed in their home cages, involved conditioning with the compound cue of flavor plus context. There were two trials. On each, all animals received access to a novel sucrose solution for 15 min in the home cage and were then transferred immediately to the pretrained context. After 30 min in the context they were given an injection of LiCl. This procedure can be expected to establish an aversion to sucrose in the control subjects, but if the contextual cues have become conditioned in the experimental subjects as a consequence of the first phase of training, then acquisition of the sucrose aversion should be blocked.

Table 1 gives the results of a final test in which all the animals were given access to the sucrose solution in their home cages. It shows that control subjects drank rather little of this normally highly palatable substance, whereas experimental subjects drank considerably more (the difference between the groups was statistically reliable, Mann-Whitney $U = 1$, $p < .05$). We may conclude that context-illness pairings given to the Experimental group in phase 1 endowed the context with properties that resulted in blocking of the acquisition of the aver-

Table 1
Blocking by contextual cues: Experimental designs and results.

Group	Phase 1	Phase 2	Test	Results (ml)
Experiment 1				
E	A (W) → Li	Suc → A → Li	Suc	12.6
C	A(W) / Li	Suc → A → Li	Suc	2.3
Experiment 2				
E	A → Li	Suc → A → Li	Suc	13.3
	&			
C	B → 0	Suc → B → Li	Suc	5.0

E and C are experimental and control groups ($n = 8$ in each case, apart from Group C of Experiment 2, where $n = 7$). A and B designate distinctive contexts, different from each other and from the home cage; Suc refers to a sucrose solution (presented in the home cage); Li indicates an injection of lithium chloride. In Experiment 1, phase 1 consisted of four trials; W indicates that water was available in the context. Group C received its injection 5 hours after exposure to the context. In Experiment 2, phase 1, all subjects experienced four trials with context A and four with B, with water present in neither. In both experiments, phase 2 comprised two trials. The results are group means for sucrose consumption on the single test trial.

European Psychologist, Vol. 2, No. 2, June 1997, pp. 118–124

sion to sucrose — evidently the pairing of exteroceptive contextual cues with an interoceptive US can, in some circumstances, allow those cues to acquire aversive properties.

The Generality of Context Aversion

The result just described disconfirms any simple version of the proposal that exteroceptive cues and nausea cannot become associated. But the analysis offered by Garcia (e. g., 1989) is more complex than this, and allows that such learning can occur in special circumstances. In particular, Garcia and his colleagues have put forward the hypothesis that although exteroceptive cues are normally denied access to the gut-defense system, they may gain access if the "gate" guarding the system is opened because the animal is concurrently consuming some substance. The presence of taste cues will be able to *potentiate* learning about other cues that are presented concurrently. Although this interpretation does not command general acceptance, there is plentiful evidence from other training situations that the presence of an effective cue can indeed enhance learning about another cue that would otherwise be ineffective (e. g., Durlach & Rescorla, 1980).

The implication for our present concerns is that a critical feature of the procedure used to establish a context aversion in the previous experiment may have been that the rats were allowed to drink water during the first phase of training — that without this potentiating event, context and illness could not have become associated. If this were so, it would complicate our attempt to analyze context aversion learning in terms derived from studies of orthodox Pavlovian conditioning. And more practically, it would question the status of context aversion learning as a model of ANV — there is no suggestion that patients must eat or drink during treatment if they are to develop ANV. It is important to establish, therefore, whether it is necessary for the rats to be allowed to drink in the training context for an aversion to develop to that context. The next experiment (conducted in collaboration with M. Symonds and I. Loy of the University of Oviedo) was designed to investigate this matter.

The experimental design is shown in Table 1 (Experiment 2). We employed the same basic procedures as were used by Symonds and Hall (1997), except that two distinctive cages (labeled A and B in Table 1) were used in the first phase of training. All the rats experienced both A and B four times in phase 1, but received an injection of LiCl only after they had been in context A. No water was available in the training contexts. For the second phase of training, the subjects were divided into two groups. Those in the experimental condition received two trials in which they were allowed access to sucrose in the home cage and then placed in context A before receiving an injection of LiCl. If context A has acquired aversive properties as a result of phase-one training it should be able to block acquisition of the aversion to sucrose. Control subjects received similar treatment except for them context B was used in this stage. No blocking is to be expected in this group.

The results of the test trial, assessing consumption of sucrose in the home cage, are also shown in Table 1. As in Experiment 1, control subjects showed a marked aversion to sucrose, whereas experimental subjects consumed it relatively readily. The difference between the groups was statistically reliable, Mann-Whitney $U = 6$, $p < .05$). We may conclude that blocking occurred in the experimental subjects, that the treatment given to context A in phase one was sufficient to endow it with aversive properties. This is not to deny the reality of the phenomenon of potentiation. It is quite possible that the magnitude of a context aversion might be enhanced in animals given the opportunity to drink or eat in the presence of the contextual cues (see Best et al., 1984). But with our training procedures such a procedure is not necessary, and simple pairing of the context with illness will suffice.

Latent Inhibition and the Attenuation of Context Conditioning

Appreciation of the psychological basis of ANV has led to attempts to develop psychological treatments that might alleviate it or prevent its occurrence. Carey and Burish (1988) list several (most of them involving some form of relaxation training) that have been employed with some success. For the most part the exact form of these interventions has not been derived from any very well specified psychological theory of the origin of ANV. This should not be construed as a criticism: if a treatment works we should use it — we can find out why it works later. None the less, it will be worth looking more closely at the specific implications of equating ANV with Pavlovian conditioning. The latter has been exhaustively analyzed, both empirically and theoretically, and the results of this analysis could well be of use in devising new and better treatments. Furthermore, these possible treatments could be tried out in the laboratory using as an animal model the context conditioning procedures described above.

One of the best established phenomena in classical conditioning is *latent inhibition* — the observation that prior exposure to a stimulus that is later to be used as a CS will dramatically retard the acquisition of the CR (Lubow, 1989). The effect has been found in a wide range of conditioning paradigms, although usually with a discrete simple event used as the CS. In the final experiment to be reported here we asked (the experiment was done in collaboration with M. Symonds) whether the latent inhibition effect could be found in our context aversion conditioning procedure.

The design of Experiment 3 is shown in Table 2. Two groups of rats received training (phases 1 and 2 in the table) identical to that given to the experimental subjects in Experiment 1. It might be expected, therefore, that both groups would form an aversion to the context in phase 1 and that this would block conditioning to sucrose in phase 2. The groups differed only in that experimental subjects received a preliminary phase of training in which, on four occasions, they were simply placed for 30 min in the context that was to be conditioned in phase 1; control subjects remained in their home cages during this part of the experiment. The question of interest was whether this latent inhibition treatment would attenuate the acquisition of aversive properties by the context in the experimental subjects.

The results of the test phase (group mean scores for sucrose consumption in the home cage) are shown on the right of Table 2. Group C, like the equivalent group in Experiment 1, consumed the sucrose readily; that is, the aversion to sucrose was blocked, indicating that an aversion to the training context had been formed in these subjects. Group E drank rather less (and the difference between the groups was significant, Mann-Whitney U = 10.5, $p < .05$). In this latter group, then, blocking was incomplete, implying that the initial phase of pre-exposure to the context had restricted the development of the context aversion. Latent inhibition occurs in context aversion learning, just as in more orthodox forms of conditioning.

Table 2
Latent inhibition of context conditioning: Design and results.

Group	Pre	Phase 1	Phase 2	Test	Results (ml)
E	A(W) → 0	A(W) → Li	Suc → A → Li	Suc	6.3
C	—	A(W) → Li	Suc → A → Li	Suc	11.3

E and C are experimental and control groups (n = 8, in each case). A designates a distinctive context, different from the home cage; Suc refers to a sucrose solution (presented in the home cage); Li indicates an injection of lithium chloride. In preexposure (Pre), animals in group E received four nonreinforced exposures to context A during which they were allowed to drink water (W). Phase 1 consisted of four reinforced trials; W indicates that water was available in the context. Phase two comprised two trials. The results are group means for sucrose consumption on the single test trial.

The implications of this finding for ANV will be obvious. If ANV derives from a classically conditioned response to the clinic then it should be possible to attenuate or even prevent the formation of such an association by giving latent inhibition training. That is, patients who are allowed to become fully familiar with the clinic before the start of treatment should find it difficult to associate the clinic with illness, and the development of ANV would be correspondingly less likely. It would require a full clinical trial to establish the potential of such a procedure but it is interesting to note that there are already some hints in the existing literature that promote optimism about the outcome. In particular, it is well established that one of the factors that determines whether or not a patient is likely to develop ANV is age (e. g., Burish & Carey, 1986). Younger patients are more susceptible than older patients. Of course, old and young people differ in many possibly relevant respects, but among these is the fact that older patients are likely to have had more experience of hospitals and of various forms of medical treatment than are younger patients. This has led some to speculate (e. g., Morrow, Lindke, & Black, 1991) that young patients suffer more ANV simply because relatively unfamiliar stimuli condition more readily; that is, that older patients are protected to some extent as a consequence of latent inhibition.

Conclusions

In a review of the place of Pavlovian conditioning in modern psychology, Rescorla (1988) reassured his readers that those who study the phenomenon nowadays are not nearly as "imperialistic" as those of earlier days. He commented that "Pavlovian conditioning has largely shed its philosophical role. Those who study conditioning have little interest in recapturing all of psychology in the name of behaviorism" (Rescorla, 1988, p. 158). But he went on to add that the study of conditioning contin-

European Psychologist, Vol. 2, No. 2, June 1997, pp. 118–124

ues to make positive, if more modest, contributions to psychology generally, and does so in three main ways:

- First, it provides a sort of "test-bed" in which a given form of learning can be subjected to a rigorous experimental analysis, and thus serve as a model for the study of modification by experience more generally.
- Second, it provides a body of data and theory that informs other related areas of science — connectionist modeling and neuroscience are mentioned in this context.
- Third, Pavlovian conditioning generates practical applications.

In arguing for a conditioning analysis of context aversion learning and for the further application of this analysis to ANV, I hope I will not be accused of Pavlovian imperialism. Instead, I see this analysis as exemplifying each of the three types of contribution presented in Rescorla's list.

First, context aversion learning serves as a test-bed providing a convenient and sensitive procedure for the study of a range of learning phenomena. The phenomenon of potentiation, mentioned above, provides an instance. The presence of an added salient stimulus will sometimes potentiate conditioning to the target stimulus, but in other cases an attenuation of conditioning (called overshadowing) is obtained. In the case of context conditioning the outcome most usually observed is potentiation. It may be hoped that an experimental investigation of why this should be will reveal general principles that will contribute to a wider understanding of mechanisms of associative learning.

Next, neuroscientists interested in the cerebral mechanisms of learning have, in recent years, begun to pay particular attention to the role played by the context in which training is given. Some have argued that contextual learning involves different mechanisms from those involved in learning about discrete cues, with certain brain structures (the hippocampus has been a particular focus of interest) being intimately involved in the former but not the latter (e. g., Penick & Solomon, 1991; Phillips & LeDoux, 1992). Whatever the merits of this suggestion, it will be evident that the behavioral study of context aversion learning is likely to produce results of direct relevance to it; and also that studies of the effects of hippocampal lesions on this form of learning might produce findings that will modify the form of our psychological explanation. Such studies are currently under way in the York laboratory.

Finally, there is the matter of applications, and here we return to the main theme of this article. Context aversion learning in the rat, I have argued, constitutes a plausible animal model of ANV. Any procedure (such as latent inhibition training) that is effective in attenuating context conditioning is therefore of special interest because of its possible practical application to the alleviation of ANV. Further basic research is needed (it would be worthwhile, for example, to investigate procedures that might accelerate the development of latent inhibition, thus reducing the amount of pre-exposure required to generate the effect), but there is every reason to think that this work will be helpful in identifying procedures that could be applied in the clinic for the relief of human suffering.

Acknowledgments

This work was supported by a grants from the UK Medical Research Council and the Wellcome Trust. I thank R.A. Boakes, I. Loy, C.J. Mitchell, A. Swinbourne, and M. Symonds for much helpful discussion.

References

Andrykowski, M.A., & Redd, W.H. (1987). Longitudinal analysis of the development of anticipatory nausea. *Journal of Consulting and Clinical Psychology, 55*, 36–41.

Bernstein, I.L., & Webster, M.M. (1980). Learned taste aversions in humans. *Physiology & Behavior, 25*, 363–366.

Best, M.R., Batson, J.D., Meachum, C.L., Brown, E.R, & Ringer, M. (1985). Characteristics of taste-mediated environmental potentiation in rats. *Learning and Motivation, 16*, 190–209.

Best, M.R., Brown, E.R., & Sowell, M.K. (1984). Taste-mediated potentiation of noningestional stimuli in rats. *Learning and Motivation, 15*, 244–258.

Boakes, R.A., Tarrier, N., Barnes, B.W., & Tattersall, M.H.N. (1993). Prevalence of anticipatory nausea and other side-effects in cancer patients receiving chemotherapy. *European Journal of Cancer, 29A*, 866–870.

Boakes, R.A., Westbrook, R.F., & Barnes, B.W. (1992). Potentiation by a taste of toxicosis-based context conditioning: Effects of varying the test fluid. *Quarterly Journal of Experimental Psychology, 45B*, 303–325.

Bonardi, C., Honey, R.C., & Hall, G. (1990). Context specificity of conditioning in flavor-aversion learning: Extinction and blocking tests. *Animal Learning and Behavior, 18*, 229–237.

Burish, T.G., & Carey, M.P. (1986). Conditioned aversive responses in cancer chemotherapy patients: Theoretical and developmental analysis. *Journal of Consulting and Clinical Psychology, 54*, 593–600.

Carey, M.P., & Burish, T.G. (1988). Etiology and treatment of the psychological side effects associated with cancer chemotherapy: A critical review and discussion. *Psychological Bulletin, 104,* 307–325.

Durlach, P.J., & Rescorla, R.A. (1980). Potentiation rather than overshadowing in flavor aversion learning: An analysis in terms of within-compound associations, *Journal of Experimental Psychology: Animal Behavior Processes, 6,* 175–187.

Garcia, J. (1989). Food for Tolman: Cognition and cathexis in concert. In T. Archer & L.-G. Nilsson (Eds.), *Aversion, avoidance, and anxiety* (pp. 45–85). Hillsdale, NJ: Erlbaum.

Garcia, J., Brett, L.P., & Rusiniak, K.W. (1989). Limits of Darwinian conditioning. In S.B. Klein & R.R. Mowrer (Eds.), *Contemporary learning theories: Instrumental conditioning and the impact of biological constraints on learning* (pp. 181–203). Hillsdale, NJ: Erlbaum.

Garcia, J., & Koelling, R.A. (1966). Relation of cue to consequence in avoidance learning. *Psychonomic Science, 4,* 123–124.

Hall, G. (1994). Pavlovian conditioning: Laws of association. In N.J. Mackintosh (Ed.), *Handbook of perception and cognition. Vol. 9: Animal learning and cognition* (pp. 15–43). Orlando, FL: Academic Press.

Lubow, R.E. (1989). *Latent inhibition and conditioned attention theory.* Cambridge: Cambridge University Press.

Mackintosh, N.J. (1983). *Conditioning and associative learning.* Oxford: Clarendon Press.

Mitchell, C., & Heyes, C. (1996). Simultaneous overshadowing and potentiation of taste and contextual cues by a second taste in toxicosis conditioning. *Learning and Motivation, 27,* 58–72.

Morrow, G.R., Lindke, J., & Black, P.M. (1991). Anticipatory nausea development in cancer patients: Replication and extension of a learning model. *British Journal of Psychology, 82,* 61–72.

Nesse, R.M., Carli, T., Curtis, G.C., & Kleinman, P.D. (1980). Pretreatment nausea in cancer chemotherapy: A conditioned response? *Psychosomatic Medicine, 42,* 33–36.

Pavlov, I.P. (1960). *Conditioned reflexes.* New York: Dover. (Original work published 1927)

Penick, S., & Solomon. P.R. (1991). Hippocampus, context, and conditioning. *Behavioral Neuroscience, 105,* 611–617.

Phillips, R.G., & LeDoux, J.E. (1992). Differential contribution of amygdala and hippocampus to cued and contextual fear conditioning. *Behavioral Neuroscience, 106,* 274–285.

Redd, W.H., & Andrykowski, M.A. (1982). Behavioral intervention in cancer treatment: Controlling aversion reactions to chemotherapy. *Journal of Consulting and Clinical Psychology, 50,* 1018–1029.

Rescorla, R.A. (1988). Pavlovian conditioning: It's not what you think it is. *American Psychologist, 43,* 151–160.

Seligman, M.E.P. (1970). On the generality of the laws of learning. *Psychological Review, 77,* 400–418.

Symonds, M., & Hall, G. (1997). Contextual conditioning with lithium-induced nausea as the US: Evidence from a blocking procedure. *Learning and Motivation,* in press.

Westbrook, R.F., & Brookes, N. (1988). Potentiation and blocking of conditioned flavour and context aversions. *Quarterly Journal of Experimental Psychology, 40B,* 3–30.

European Psychologist, Vol. 2, No. 2, June 1997, pp. 118–124