*Research Article*

# Alcohol and Aggression

## A Test of the Attention-Allocation Model

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ABSTRACT—*This article presents the first systematic test of the* attention-allocation model *for alcohol-related aggression. According to this model, alcohol has a "myopic" effect on attentional capacity that presumably facilitates aggression by focusing attention on more salient provocative, rather than less salient inhibitory, cues in hostile situations. Aggression was assessed using a laboratory task in which mild electric shocks were received from, and administered to, a fictitious opponent. Study 1 demonstrated that a moderate-load cognitive distractor suppressed aggression in intoxicated subjects (to levels even lower than those exhibited by a placebo control group). Study 2 assessed how varying the magnitude of a distracting cognitive load affected aggression in the alcohol and placebo conditions. Results indicated that the moderate-load distraction used in Study 1 (i.e., holding four elements in sequential order in working memory) suppressed aggression best. Cognitive loads of larger and smaller magnitudes were not successful in attenuating aggression.*

Acute alcohol consumption is related to aggressive behavior, as evidenced by both correlational and experimental studies (reviewed in Bushman & Cooper, 1990, and Chermack & Giancola, 1997). Research has shown that alcohol is involved in about 50% of violent crimes (reviewed in Murdoch, Pihl, & Ross, 1990; Pernanen, 1991). It has also been noted that it is the acute effects of alcohol, rather than its chronic effects, that have the largest impact on aggressive behavior (Chermack & Blow, 2002; Fals-Stewart, 2003).

One of the most well-accepted models of alcohol-related aggression was put forth first by Taylor and Leonard (1983). The model was then further elaborated on by Steele and Josephs (1990), as a more general theory of alcohol's effect on behavior; they termed it the *attention-allocation model*. According to this model, acute alcohol intoxication disrupts cognitive functioning, thus creating a "myopic," or narrowing, effect on attentional capacity. Consequently, alcohol presumably facilitates aggression by focusing attention on more salient provocative, rather than less salient inhibitory, cues in a hostile situation. Other researchers, such as Pernanen (1976), have alluded to similar processes as accounting for alcohol-related aggression.

The attention-allocation model is general in scope and has been utilized to explain a number of alcohol-related behaviors. Specifically, studies testing the model found that following an anxiety-induction manipulation, alcohol significantly decreased subjective anxiety for persons whose attention was distracted away from stressful thoughts by performing a cognitive task. However, for subjects assigned to a no-distraction condition, alcohol actually increased anxiety (Josephs & Steele, 1990; Steele & Josephs, 1988). Other studies have shown that alcohol reduces intentions to engage in risky sexual behavior in the presence of inhibitory or low-sexual-arousal cues, but increases such intentions in the presence of permissive or highly sexually arousing cues (MacDonald, Fong, Zanna, & Martineau, 2000; MacDonald, MacDonald, Zanna, & Fong, 2000). Intentions to engage in risky sexual behavior were at an intermediate level in persons given a placebo beverage instead of alcohol. Furthermore, the attention-allocation model has also been used to help explain behaviors such as disinhibited eating (Mann & Ward, 2004; Ward & Mann, 2000) and drinking and driving (MacDonald, Zanna, & Fong, 1995).

A number of established alcohol researchers have invoked the attention-allocation model, in one form or another, to explain alcohol-related aggression (Abbey, 2002; Aviles, Earleywine, Pollock, Stratton, & Miller, 2005; Chermack & Taylor, 1995; George & Norris, 1991; Giancola, 2000; Leonard, 2002; Murphy, Winters, O'Farrell, Fals-Stewart, & Murphy, 2005; Pernanen, 1976; Pihl & Peterson, 1995; Sayette, 1999; Taylor & Leonard, 1983; Testa, Livingston, & Collins, 2000). Thus, it is surprising that in the approximately 25 years since its genesis, the model has never been tested with respect to this particular behavior. However, it is noteworthy that one study did assess the

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impact of attentional processes on aggression in intoxicated individuals (Zeichner, Pihl, Niaura, & Zacchia, 1982). Results indicated that forced attention on a laboratory aggression task increased aggression in subjects who consumed alcohol, whereas distraction from the task had the opposite effect. These findings are consistent with the hypotheses put forth in the present article.

The purpose of this article is to present the first test of the attention-allocation model for alcohol-related aggression. In Study 1, we tested the hypothesis that compared with a placebo beverage, alcohol will increase aggression in persons who are not distracted from a provocative stimulus and will suppress aggression in those whose attention is distracted away from this stimulus. We reasoned that inasmuch as a placebo beverage should not impair attentional capacity, people who consume a placebo will have sufficient cognitive resources to attend to both distracting and provocative stimuli, and the latter will incite some aggression. Thus, we expected subjects in the no-distraction placebo group to exhibit some aggression, but not as much as subjects in the no-distraction alcohol group, whose attention would be focused on the provocative cues. We expected distraction combined with alcohol consumption to reduce aggression because distraction should avert individuals' attention away from provocative cues.

Study 2 was designed to assess the effect of the magnitude of a distracting cognitive load on aggression after consumption of alcohol. In accordance with Josephs and Steele's (1990) theorizing, we hypothesized that the greatest suppressive effect on aggression will be observed when the cognitive load is moderate. Whereas a mild distractor might not reallocate sufficient attentional resources away from provocative cues, distractors that are too strong might engender more aggression due to frustration or other effects caused by the task's excessive difficulty.

## STUDY 1

### Method

#### *Subjects*

Subjects were 48 healthy male social drinkers between 21 and 33 years of age ($M = 24.06$, $SD = 3.44$). They were recruited through advertisements placed in newspapers in Lexington, Kentucky. Respondents reporting any drug- or alcohol-related problems or any serious mental illnesses were excluded from participation, as were those with a positive breath alcohol-concentration (BAC) reading or a positive urine drug test. The sample consisted of 35 Caucasians, 10 African Americans, and 3 persons of other ethnicities.

#### *Aggression Task*

Aggression was measured with a modified version of the Taylor aggression paradigm (TAP; Taylor, 1967). Subjects were told that they would receive electric shocks from and administer electric shocks to an opponent (actually, a confederate) during a competitive reaction time (RT) task. Physical aggression was operationalized as the shock intensities and durations selected by the subjects. The TAP and similar laboratory paradigms have been repeatedly shown to be safe and valid measures of aggressive behavior (Anderson & Bushman, 1997; Giancola & Chermack, 1998).

For the TAP, each subject was seated at a table in a small room. On the table facing the subject was a computer screen and a keyboard. White adhesive labels marked "1" through "10" were attached to the number keys running across the top of the keyboard. The labels "low," "medium," and "high" were placed above the "1," "5," and "10" keys, respectively, to indicate the subjective levels of shock corresponding to the keys.

At the beginning of each session, two finger electrodes were attached to the index and middle fingers of the subject's non-dominant hand using Velcro straps. In order to determine the intensity of the shocks subjects would receive during the TAP, we administered a pain-threshold testing procedure before the task. Next, subjects were informed that shortly after the words "Get Ready" appeared on the screen, the words "Press the Space Bar" would appear, at which time they had to press, and hold down, the space bar. Next, when the words "Release the Space Bar" appeared, they had to lift their fingers off of the space bar as quickly as possible. A win (i.e., a trial on which the subject was supposedly faster than the competitor) was signaled by the message, "You Won. You Get to Give a Shock," and a loss was signaled by the message, "You Lost. You Get a Shock." A winning trial allowed the subject to deliver a shock to his opponent, by pressing the number key corresponding to the intensity the subject chose, and a losing trial resulted in receiving a shock from this individual. After winning a trial and pressing a shock button, subjects' shock selection was indicated on a specially designed "volt meter" and by the illumination of 1 of 10 "shock lights" on the computer screen. Subjects were given similar feedback regarding the level of the shocks they received after losing trials.

The entire task consisted of two successive blocks of trials. During the first block, subjects received shock intensities between 1 and 4 after they lost a trial. This was the low-provocation condition. During the next block, they received shock intensities between 7 and 10 after they lost a trial. This was the high-provocation condition. Each block consisted of 16 trials (8 wins and 8 losses). The high-provocation condition always followed the low-provocation condition. Taylor and Chermack (1993) have argued that this sequence adds an increased degree of external validity to the task because this ordering best reflects how an escalation in interpersonal provocation leads to increased violence in real-life situations.

All shocks delivered to the subjects were 1 s in duration. The sequence of wins and losses was predetermined and controlled by the computer program that executed the task. Wins and losses were presented in a fixed random order with no more than three consecutive wins or losses. The trials were separated by 5-s intervals. The initiation of trials, administration of shocks to the subjects, and recording of their responses were controlled by a computer. The experimenters, other electronic equipment, and the computer that controlled the task were located in an adjacent control room out of the subjects' view.

### *Deception Manipulation*

A fictitious cover story disguised the aggression task. Subjects were informed that the purpose of the study was to determine how a person's "thinking style" influences alcohol's effects on RT in a competitive situation. A male confederate played the part of the competitor, in order to convince subjects that they were actually competing against another person. The confederate was seated in a room adjacent to the testing room, and as the experimenter led the subject into the testing room, she identified the confederate as the "opponent." Immediately before the subject's pain thresholds were assessed, he was informed that the opponent would undergo the assessment first. The subject was also informed that he would be able to hear the opponent's responses to the procedure over an intercom that ostensibly served the two testing rooms and the control room. In actuality, the confederate answered the experimenter's questions regarding the testing of his pain thresholds in accordance with a list of predetermined responses. All subjects heard the same verbal exchange between the experimenter and the confederate.

### *Beverage Administration*

Subjects in the alcohol condition were administered a dose of 1g/kg of 100% alcohol mixed at a 1:5 ratio with Tropicana orange juice. The dosing was also calculated for the placebo condition, but subjects in this condition received an isovolemic beverage consisting of only orange juice. Four cc of alcohol were added to each placebo beverage, and 4 cc were layered onto the juice in each glass. Immediately before the placebo beverages were served, the rims of the glasses were sprayed with alcohol. Subjects were not given any information regarding what to expect from their beverages. However, during the explanation of the consent form, they were told that they would consume the equivalent of about three to four mixed drinks.

### *Distraction Task*

While performing the TAP, subjects in the distraction condition were simultaneously engaged in a computerized task that taxed working memory resources. Specifically, subjects were asked to attend very carefully to a 3 × 3 matrix of 2-cm × 2-cm light-gray squares on a white computer screen. During each block of this task, four of these squares were illuminated (in black) in a random sequential order, and subjects were told that they had to remember the sequence. Immediately after the sequence terminated, they had to use a computer mouse to click on the squares in the order in which they had been illuminated. Blocks were presented continuously, and subjects were engaged in this task for the entire duration of the TAP (approximately 15 min). To increase the salience of the task, we told subjects that if they performed better than 80% of subjects already tested, they would win an extra $30. They were not given any performance feedback during the distraction task in order to avoid any confounding emotional reactions. All subjects were given the same monetary remuneration at the end of the study (i.e., $60), regardless of whether they were assigned to the distraction or no-distraction condition.

### *Experimental Design*

Subjects were randomly assigned to one of four groups: alcohol plus distraction, alcohol plus no distraction, placebo plus distraction, and placebo plus no distraction. Each group consisted of 12 subjects. Following the TAP, subjects were asked questions that assessed whether or not they believed the cover story (e.g., questions about their subjective perceptions of their opponent, whether their opponent had tried hard to win, whether they thought the task was a good measure of RT, and how well they believed they had performed on the task). They were also asked questions used to assess the effectiveness of the placebo manipulation.

## Results

### *Manipulation Checks*

*Task Deception.* Subjects' responses to the task-deception checks indicated that the deception manipulation was successful.

*Placebo Checks.* All subjects in the placebo condition indicated that they believed they had consumed alcohol. In response to a question inquiring about how drunk they felt, persons in the alcohol condition reported an average pre-TAP rating of 4.7 ($SD$ = 1.9) and an average post-TAP rating of 5.2 ($SD$ = 2.3; scale from 0, *not drunk at all*, to 11, *drunker than I have ever been*). The average ratings of persons in the placebo condition were 1.9 ($SD$ = 1.4) and 2.0 ($SD$ = 1.4), respectively. The pre-TAP and post-TAP ratings differed significantly between the alcohol and placebo conditions, $t(46) = 5.7$, $p_{\text{rep}} > .99$, $d = 1.3$, and $t(46) = 5.8$, $p_{\text{rep}} > .99$, $d = 1.3$, respectively. In response to a question about whether the alcohol they drank caused any impairment, persons in the alcohol condition reported an average rating of 5.8 ($SD$ = 2.4), and those in the placebo condition reported an average rating of 2.2 ($SD$ = 1.3; scale from 0, *no impairment*, to 10, *strong impairment*), $t(46) = 6.3$, $p_{\text{rep}} > .99$, $d = 1.4$).

*BAC Levels.* All subjects had BACs of 0% upon entering the laboratory. Individuals in the alcohol condition had a mean BAC of 0.10% ($SD$ = 0.01) just before beginning the TAP and a mean BAC of 0.11% ($SD$ = 0.02) immediately after the task. Those given the placebo had a mean BAC of 0.01% ($SD$ = 0.03) just before the TAP and a mean BAC of 0.01% ($SD$ = 0.02) immediately after the task.

*Aggression Data*

Data for shock intensity and duration (in milliseconds) were transformed into $z$ scores and then summed. This was done to increase the reliability of the aggression measure and because previous research has demonstrated that shock intensity and duration are part of a more general construct of aggression (Carlson, Marcus-Newhall, & Miller, 1989). The scores were then analyzed using a 2 (beverage: alcohol, placebo) × 2 (distraction: yes, no) × 2 (provocation: low, high) mixed-model analysis of variance (ANOVA) with provocation as the repeated measure. This analysis revealed a significant Beverage × Distraction interaction, $F(1, 44) = 5.53$, $p_{rep} = .93$ (see Fig. 1). Aggression was significantly suppressed in the alcohol-plus-distraction group compared with the alcohol-plus-no-distraction group, $t(22) = -3.07$, $p_{rep} = .97$, $d = 1.4$. Furthermore, aggression in the placebo groups was intermediate to aggression in the two alcohol groups (the placebo groups, with and without distraction, did not differ from one another). There was also a main effect of distraction, $F(1, 44) = 10.76$, $p_{rep} = .98$, indicating that aggression was lower in the distraction condition compared with the no-distraction condition, $t(46) = -3.09$, $p_{rep} = .98$, $d = 0.82$. The main effect of provocation was also significant, $F(1, 44) = 9.82$, $p_{rep} = .98$, indicating that subjects were more aggressive in the high-, compared with the low-, provocation condition.

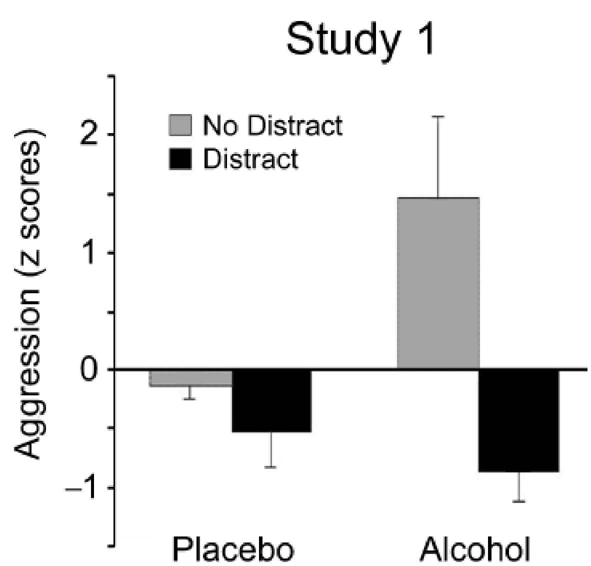


**Fig. 1.** Results from Study 1. Aggression (shock intensity and time duration, standardized and then summed) is plotted as a function of whether subjects drank alcohol or a placebo and whether or not they performed a distraction task simultaneously with the aggression task.

*RTs*

A 2 (beverage: alcohol, placebo) × 2 (distraction: yes, no) ANOVA was conducted on the RTs during the TAP. Results indicated significant main effects for both factors. Subjects in the distraction condition had significantly slower RTs than those in the no-distract condition (distraction: $M$ = 512 ms, $SD$ = 83 ms; no distraction: $M$ = 267 ms, $SD$ = 52 ms), $F(1, 44) = 172.0$, $p_{rep} = .99$, $d = 1.74$. Alcohol also slowed RT (alcohol: $M$ = 416 ms, $SD$ = 144 ms; placebo: $M$ = 363 ms, $SD$ = 136 ms), $F(1, 44) = 8.21$, $p_{rep} = .97$, $d = 0.38$.

## STUDY 2

Study 2 was designed to assess the effect of the magnitude of a distracting cognitive load on aggression after consumption of alcohol, compared with a placebo control. In accordance with Josephs and Steele's (1990) theorizing, we hypothesized that a moderate distractor load would have the greatest suppressive effect on aggression in the alcohol condition. A mild load would not attenuate aggression because insufficient cognitive resources would be shifted away from the provocative cues generated by the TAP, and very strong distraction would also not suppress aggression because of the stress and frustration, as well as other effects, created by the distraction task's excessive difficulty.

### Method

*Subjects*

Subjects were 120 healthy male social drinkers between 21 and 31 years of age ($M$ = 22.73, $SD$ = 2.07). Recruiting procedures, as well as exclusion criteria, were identical to those in Study 1. The sample consisted of 113 Caucasians, 4 African Americans, and 3 persons of other ethnicities.

*Experimental Design and Procedure*

Subjects were assigned to the alcohol or placebo condition, and within each of these conditions, they were placed into one of five cognitive-work-load groups. Work load (distraction) was operationalized by the number of illuminated squares in the sequence that subjects had to remember and respond to in each block: none (i.e., no distraction; D0), two (D2), four (D4, as in Study 1), six (D6), and eight (D8). There were 12 subjects in each of the 10 groups. Except as just noted, the procedure was the same as in Study 1.

### Results

Results for the manipulation checks were essentially identical to those in Study 1.

*Aggression Data*

A 2 (beverage: alcohol, placebo) × 5 (distraction: D0, D2, D4, D6, D8) × 2 (provocation: low, high) mixed-model ANOVA with provocation as the repeated measure revealed a significant

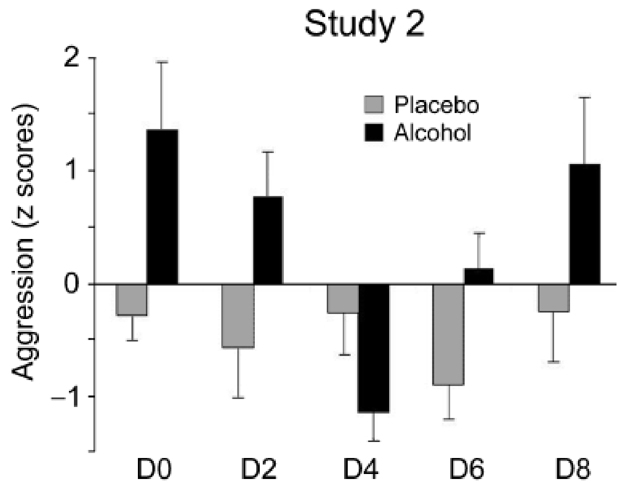


**Fig. 2.** Results from Study 2. Aggression (shock intensity and time duration, standardized and then summed) is plotted as a function of the beverage subjects drank (alcohol or placebo) and the number of illuminated squares in each sequence to be remembered (i.e., distraction condition): none (no distraction; D0), two (D2), four (D4, as in Study 1), six (D6), or eight (D8).

Beverage × Distraction interaction, $F(4, 110) = 2.99$, $p = .02$. As shown in Figure 2, the means for the alcohol condition illustrate a V-shaped pattern. Specifically, in this condition, groups D0 and D8 exhibited the highest levels of aggression, groups D2 and D6 demonstrated intermediate levels, and group D4 showed the least amount of aggression (even lower than that of all the placebo groups). Tukey HSD post hoc tests revealed significant differences between the following groups in the alcohol condition: D0 and D4 ($p_{rep} = .98$, $d = 1.37$), D2 and D4 ($p_{rep} = .88$, $d = 1.05$), and D4 and D8 ($p_{rep} = .93$, $d = 1.20$). There were no differences among the five placebo groups. Analyses also revealed a significant effect of beverage, $F(1, 110) = 11.43$, $p_{rep} = .99$; levels of aggression were higher after consumption of alcohol than after consumption of the placebo. The main effect for provocation was also significant, $F(1, 110) = 16.82$, $p_{rep} > .99$, indicating that subjects were more aggressive in the high-, compared with the low-, provocation condition.

### *RTs*

A 2 (beverage: alcohol, placebo) × 5 (distraction: D0, D2, D4, D6, D8) ANOVA was conducted on the RTs during the TAP. Results indicated a significant main effect of distraction, $F(4, 110) = 32.42$, $p_{rep} > .99$. The D0 group had significantly faster RTs than all the other groups (D0: $M = 269$ ms, $SD = 39$ ms; D2: $M = 493$ ms, $SD = 78$ ms; D4: $M = 486$ ms, $SD = 114$ ms; D6: $M = 549$ ms, $SD = 110$ ms; D8: $M = 525$ ms, $SD = 119$ ms; $d$s ranged between 1.6 and 2.0; all $p_{rep}$s $> .99$ using Tukey HSD post hoc tests). Groups D2 through D8 did not differ significantly from one another.

## GENERAL DISCUSSION

This article has presented the first systematic test of the attention-allocation model for alcohol-related aggression. Study 1 demonstrated that a moderate distractor was effective in suppressing aggression in the alcohol condition below the levels exhibited in the placebo control condition. Furthermore, aggression in the placebo groups was intermediate between aggression in the two alcohol groups (the two placebo groups did not differ from each other). This result for the placebo groups is explained by the fact that the placebo beverage should not have impaired attentional capacity. Therefore, subjects in the placebo condition had sufficient attentional resources to attend to both the distracting and the provocative stimuli, the latter producing some aggression. Study 2 then showed that a moderate level of distraction (D4: holding four elements in sequential order in working memory) best produced a suppressive effect on aggression after the consumption of alcohol (again suppressing aggression below the levels of the placebo groups). As expected, larger and smaller magnitudes of distraction were not as successful in attenuating aggression in the alcohol condition.

In the alcohol condition, the D8 group did not show an attenuation in aggression, compared with the D0 group, and the difference between groups D0 and D6 was not significant. One might expect suppression in groups D6 and D8 to be similar to, or even greater than, suppression in the D4 group. However, as noted by Josephs and Steele (1990), if a distractor task becomes too difficult to perform, it might exceed the capacity of controlled working memory processing and therefore elicit stress and frustration, which might increase aggression. Another possibility is that the distractor task might become so difficult that subjects no longer pay attention to it and refocus their attention on the provocative stimulus. Although it is a limitation of our experiment that we did not collect data to test these alternative explanations, we postulate that Josephs and Steele's reasoning would account for the increased aggression we found in group D8.

The RT data also support our interpretation of the results. Specifically, in Study 1, both distraction groups had significantly slower RTs during the TAP than the no-distraction groups. Moreover, Study 1 revealed a negative correlation between RT and shock intensity for intoxicated subjects, $r = -.42$, $p_{rep} = .89$. These data suggest that the distraction manipulation was effective in transferring attention away from the provocative cues of the TAP, which in turn presumably had an effect on attenuating aggression. In Study 2, all of the groups that performed the distraction task exhibited significantly slower RTs than the no-distraction group (D0), again suggesting that attention was diverted away from the TAP. Although the increased levels of aggression seen in the D8 group in the alcohol condition (and to a lesser degree the D6 group) can be explained by Josephs and Steele's (1990) frustration hypothesis, this hypothesis does not explain why the D2 group had similarly slow RTs unless one postulates that similar working memory resources were taxed to complete even this relatively simple task.

In conclusion, our results indicate that alcohol can both increase and decrease aggression, depending on where one's attention is focused. As already alluded to, the mechanism underlying this myopic effect of alcohol seems to be disruption of working memory (see Finn, 2002). In general terms, working memory involves the ability to encode, maintain, and process and manipulate information (external and internal representations) in the short term. Successful behavioral inhibition and regulation require (a) that one is able to act upon inhibitory representations in working memory and (b) that these inhibitory representations are salient. We propose that working memory helps regulate social behavior by providing the capacity for information processing involved in, for example, hypothesis generation, self-reflection, previewing, outcome evaluation, resistance to distraction, problem solving, abstract reasoning, and strategic planning (i.e., executive functioning). We argue that activating and loading, yet not overloading, working memory with nonprovocative, inhibitory cues can attenuate aggression by allowing behavioral output to be influenced by such cues. In turn, this creates less "cognitive space" to house and process hostile cues.

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