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Task demand and mood repair: The intervention potential of computer games

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Abstract
It is argued that computer game play has great potential to intervene in noxious mood states because it is a more demanding task than consuming other forms of media. From mood management theory, this increased intervention potential should make computer games particularly adept mood repair agents. To test this assertion, a study was conducted that varied levels of task demand (our operationalization of intervention potential) in a computer game to examine mood repair for bored and stressed individuals. Results show that increasing the amount of control an individual has over a mediated environment significantly increases that medium's intervention potential. This increase in intervention potential results in an enhanced ability to relieve boredom and stress, but too much task demand is detrimental to mood repair.

Keywords
boredom, control, interactivity, mood management, stress, task demand, video games

The ability of media to regulate one's mood was first proposed by Zillmann and Bryant (1985), explaining that individuals are motivated to dissipate noxious mood states whenever possible and will make media choices in line with this motivation. The result of this selective exposure to different media is mood repair: a marked shift in mood state from noxious to optimal. This process has been tested with a variety of different media,

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including television and film (Bryant and Zillmann, 1984), music (Knobloch and Zillmann, 2002), and Internet browsing behavior (Mastro et al., 2002). However, it has not been examined in any great detail with computer games.

The experience of computer game play is unique among other media forms; this uniqueness affords computer games great mood management potential. Grodal (2000) suggests that computer games differ significantly from more passive media such as film and television in part because of the increased cognitive attention and, more notably, physical engagement required for game play. To play a computer game, users have to pay careful attention to the game, make mental maps of game environments, note objects and landmarks for future reference, and coordinate visual attention with motor behavior – all cognitively-taxing processes (Grodal, 2000). Unlike more passive media such as film and television, computer games proceed only through the player's motivation to continue, and this continuation requires a user's focused attention and action (Tamborini and Bowman, 2010). Notably, this notion of action as a demarcation of interactivity in computer games is important as it focuses attention on the physical process of manipulating on-screen content through a control interface as a feature wholly unique to the medium.

Our study begins by asserting that the unique task demand thought to occur during computer game play is in part responsible for the increased mood management potential of computer games. This assertion is used as the foundation for our expectation that individuals in a noxious state who play computer games with greater task demand will experience greater mood repair.[1] Importantly, our study focuses on mood states, not traits.

Mood management theory

Mood can be understood as a temporal state susceptible to environmental influence and potentially under an individual's control, or management. Bryant and Davies (2006) recognize four dimensions of control central to the mood management process: arousal regulation, behavioral affinity, hedonic valence, and intervention potential. In general, the logic underlying mood management theory explains how these dimensions of mood control can produce optimal post-consumption mood states.

Arousal regulation refers to the tendency of individuals to choose media that will help them achieve an optimal level of arousal. The concept argues that states of low and high arousal are indicative of suboptimal and noxious mood states of boredom (low arousal, or understimulation) and stress (high arousal, or overstimulation). In terms of media selection, we make choices in an effort to avoid these states by balancing our arousal levels. Bryant and Zillmann (1984) showed evidence of this by experimentally inducing boredom or stress in a group of undergraduate students before affording them an opportunity to watch television programs. Consistent with their predictions, bored participants chose to watch exciting programming (e.g. highlights from a football game, an action-adventure show, or a game show) whereas stressed participants chose to watch more relaxing programming (e.g. segments of a travel documentary, an orchestra concert, or a nature program).

Behavioral affinity refers to similarity between message content and one's current affective state, or mood. For example, to an individual in a high state of aggravation after getting into a domestic dispute, a violent boxing match would be understood as having a high level of behavioral affinity whereas a romantic comedy would have a relatively low level of behavioral affinity. Mood management logic would suggest that watching programming with high behavioral affinity to one's current mood would result in prolonging the current mood, which might or might not be optimal. Work by Zillmann et al. (1980) found support for this claim, reporting that participants who were provoked prior to viewing television avoided watching comedies that specifically featured tendentious humor.

Hedonic valence is defined as the general pleasurable or unpleasurable tone of a message. One can point to the prototypical Hollywood 'buddy comedy' (e.g. *Turner and Hooch*) as a film genre with a generally pleasurable tone, and the blood-soaked 'slasher' film (e.g. *Friday the 13th*) as a film genre with a generally unpleasurable tone. In general, we might expect media with a negative hedonic valence to be ill-equipped to aid in mood repair processes, particularly when negatively-valence films also contain content with high behavioral affinity to one's mood state (such as our domestic dispute example above). Studying music choices stemming from noxious mood states, Knobloch and Zillmann (2002) found evidence of this process as individuals in bad moods preferred 'energetic-joyful' music over other more negatively-valenced forms.

Although the above dimensions are important to understanding the mood management process as a whole, the most central dimension to the current study is *intervention potential*, defined as a medium's ability to capture an individual's attentional resources (Bryant and Davies, 2006). Generally, it is argued that messages with higher intervention potential are more likely to distract an individual from the root cause of their noxious mood state, thus hastening the mood repair process. Prior research has demonstrated that intervention potential is influenced in part by attributes found in message content, such as the hedonic valence of news photography (Knobloch et al., 2003; Zillmann et al., 2001), but no known research has examined how exposure's intervention potential might be influenced by specific attributes of different media forms – in this case, attributes that differ inherently between computer games and television. In our study, intervention potential is operationalized as task demand, or the amount of attention and mental effort required to physically interact with a medium.

Intervention potential in different media forms

When discussing video games, both Bryant and Davies (2006) and Grodal (2000) maintain that the highly interactive nature of computer games demands more of the user's attentional resources than other media forms. If this is true, mood management logic would suggest that the increased cognitive demand associated with game play should result in greater intervention potential and therefore aid in the mood repair process. Vorderer (2000) offers a similar claim, arguing that computer games demand greater cognitive and tactile engagement from the user, with a specific focus on the tactile as a distinguishing characteristic of gaming from other media forms. Likewise, Klimmt and

Hartmann (2006) note that computer games are specifically designed to demand physical input from the user in order for the game to progress, increasing their intervention potential relative to less demanding media such as television. Tamborini and Bowman (2010) advance similar logic with regard to the presence-enhancing attributes of computer game technology, arguing that the vividness and interactivity inherent in computer games makes playing them an engaging and absorbing experience. This engagement – particularly, physical engagement – not only prompts experiences of presence, but also results in a high capacity for the computer game to intervene in rumination, thus increasing its intervention potential.

While these fronted arguments seem logical, they have not been empirically demonstrated. Toward this end, our study varies the intervention potential of a computer game by adjusting its level of task demand and examining the resultant effect on mood repair. The study tests the claim that computer games are superior to other forms of media in their mood repair capacity, and that this superior capacity results from the increased task demand created by the need to physically and actively engage in computer game play. At the same time, we must recognize that while our focus is on interactive media, traditional media forms certainly have intervention potential, including aspects of task demand as conceptualized in our study. For example, understanding the character motives and nuances of a psychological 'whodunit?' thriller is likely a far more cognitively demanding task than watching a Saturday morning cartoon. Beyond mere content differences, these two products have varying levels of narrative complexity; for example, the psychological thriller should require more attentional resources than the cartoon in order to understand and enjoy the content. Moreover, this increased attentional demand should result in the thriller having a greater capacity to intervene in rumination and repair noxious mood than the cartoon. Although not a focus of our study per se, the potential for non-interactive media to also influence mood repair via task demand is incorporated into our experimental design.

Hypotheses

Our logic begins with the assumption that computer games have a higher task demand than television. From this, we examine existing claims that the heightened task demand in computer games increases their mood repair capacity, controlling for other factors relevant to the mood management process. As a result of the intervention potential created by demand on a user's attentional resources, we predict that:

> H1: For people in noxious mood states, an increase in task demand will have a positive effect on mood repair.

When examining the effect of increased task demand on mood repair, it would be imprudent to ignore the possibility for other recognized dimensions of mood management to affect mood repair. Hedonic valence and behavioral affinity, as content-specific attributes of mood management theory, are controlled in our study by presenting all users with the same content. However, the potential influence of physical engagement and its influence on arousal regulation should not be overlooked. Game play that requires more actions should also be expected to increase an individual's felt arousal. As such, we will measure and control for felt arousal in tests of H1. This becomes important specifically when considering the nature of boredom and stress, the two noxious moods states under investigation in the current study. As boredom is a noxious state caused by extremely low levels of arousal, we expect that any increase in felt arousal resulting from the higher levels of physical engagement produced by a game requiring an increased number of actions should produce a more positive effect on mood repair for those in a state of boredom than for those in a state of stress. Thus, bored individuals will experience mood repair resulting both from increased task demand as well as increased arousal. Conversely, as stress is a noxious state characterized by extremely high levels of arousal, task demand should help dissipate noxious mood but increase arousal which would likely be counteractive to the mood repair process. Thus, we predict that:

> H2: Mood repair will be greater for those in a boredom condition than for those in a stress condition.

Notably, H2 predicts only a main effect for noxious state such that mood repair is greater for bored individuals than it is for stressed individuals. Because the comparatively greater mood repair predicted for those in the boredom condition results from elevated arousal, the degree to which mood repair in the boredom condition surpasses mood repair in the stress condition should mirror levels of arousal created by the game play conditions. As physical activity and resultant arousal should increase as task demand increases, the extent to which mood repair in boredom conditions exceeds repair in stress conditions should also increase. As a result, the difference in mood repair between bored and stressed individuals at high levels of task demand should be significantly greater than the difference in mood repair between bored and stressed individuals at low levels of task demand. Thus, we predict that:

> H3: For those in a noxious mood state condition (i.e. boredom or stress), there will be a disordinal, nonsymmetrical interaction between mood state and task demand on mood repair. The predicted positive effect of increased task demand on mood repair will be greater for those in the boredom condition than for those in the stress condition.

Our hypotheses are represented graphically in Figure 1.

Finally, there is reason to suspect that the beneficial effect of task demand on mood repair will peak at the point where a game becomes too demanding and frustration starts to set in (see Wolf and Perron, 2003). If this is the case, we might expect extreme levels of task demand to counteract the mood repair process. However, the point at which task demand becomes noxious and starts to outweigh the mood repair benefits of intervention is difficult to predict without available research to consult. As such, we began our research with the above model predicting positive linear effects of task demand, but recognize and test for the potential curvilinear influence of task demand on mood repair.

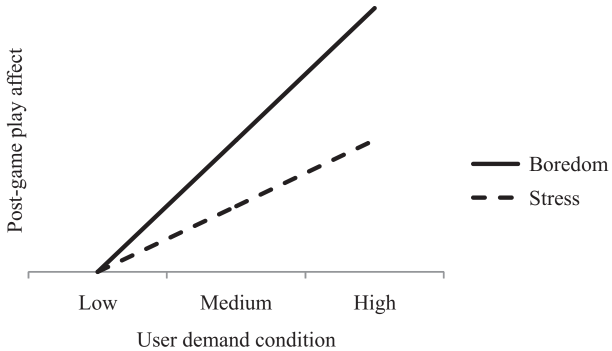

Figure 1. Predicted pattern of mood repair scores for bored versus stressed players as a function of task demand condition.

Method

Participants

Participants were recruited from a large Midwestern university and offered course credit and entry in a $100 cash prize raffle for their participation. A priori effect size using similar data from Chen and Raney (2009) provided an average effect size of $f = .31$; this effect size measure was used to determine an optimal sample size N = 157 needed for the current study, and we ended with N = 172 participants. The sample contained 79 males and 93 females, with an average age of 21 years, five months. Data collection was restricted to a convenience sample of college students, and appropriate sample for our study as this population represents a substantial portion of the gaming community (Jones, 2003)

Design and procedure

The study experimentally manipulated the intervention potential of media exposure by varying task demand and subsequent observed differences in mood repair for respondents placed in noxious mood states of boredom or stress. In a 2 (mood state) x 4 (task demand) between-subjects experimental design, participants were randomly assigned to mood conditions and asked to play a flight simulator computer game programmed to vary in task demand.

Upon entering the lab, participants reviewed and signed an informed consent form, completed a questionnaire measuring perceived computer game skills and demographic characteristics, and then played or viewed the flight simulator for five minutes to become familiar with the game. Following this session, participants were subjected to either the boredom or stress mood induction. After the induction, participants completed a mood measure (as an induction check) and then played (or viewed) the computer game for approximately two to three minutes. During game play, task demand was measured with a distracter task. Once game play was finished, participants completed another set of mood measures (to measure change in mood since induction). Finally, participants completed a questionnaire containing measures of perceived task demand and overall game evaluation before being fully debriefed; the game evaluation measures were part of a separate data collection and thus are not discussed further in this manuscript. Each session lasted about one hour.

Distinct levels of task demand were created by varying the number of actions required to play the computer game. In the low demand condition, game play was set at auto-pilot on to simulate watching a television program (i.e. no actions required). In the medium demand condition, play was set at auto-pilot half on (i.e. some actions required). In the high demand condition, play was set at the auto-pilot off (i.e. full actions required). Finally, concern that participants in the low task demand condition would simply ignore the computer game entirely led to the inclusion of a fourth condition labeled low+ task demand, in which a cognitive demand element was added to the low demand condition described above. The goal of the low task demand condition was to simulate the level of demand found in television viewing as closely as possible without introducing undesirable content differences into the current study.

Moreover, if participants exposed to computer game play in demonstration mode simply ignored the game, this would not be an accurate corollary to television viewing, which surely contains a cognitive or information processing element (see Lang et al., 1999). Thus, the inclusion of the low+ condition was intended to add such a cognitive processing element to the low demand condition. Table 1 lists in more detail the different controls made available to the participant in each of the task demand conditions.

Stimuli/materials

Mood inductions. Consistent with prior research (Bryant and Zillmann, 1984; Mastro et al., 2002), participants were induced into either boredom or stressful affective states. Each induction required participants to perform a particular task for 20 minutes. For the

Table 1. Controls available to the user in each task demand condition, at the start of game play.

Low task demand*	Medium task demand	High task demand
Flight controls • [none]	Flight controls • Joystick • Throttle • Rudders	Flight controls • Joystick • Throttle • Rudders
Avionics • [none]	Avionics • [none]	Avionics • Airbrake • Landing flaps • Landing gear • Drogue chute • Wheel brakes

*The low+ task demand condition replicates the controls of the low task demand condition, with the addition of the memorization task.

boredom induction, participants were given a large box of metal washers and asked to thread them onto a length of string for the entire session. For the stress induction, participants were asked to complete a booklet of difficult logic puzzles designed to exceed their talents. Furthermore, participants in the boredom induction were left to their own volition whereas participants in the stress induction were under constant pressure from an experimenter to perform better. Participants were only provided 45 to 90 seconds per puzzle before being forced to move to the next question while instructing the participants that incorrect or missing questions would result in negative score evaluations that might impact their eligibility for the study.

Computer game. The computer game played in this study was *Lock-On: Modern Air Combat*, an 'ultra-realistic [combat flight] simulator with faithfully rendered physics, weather, and avionics' (Gametap, 2009). The game was played using the Saitek X36F flight stick and X35T throttle in tandem with a standard PC keyboard and mouse. *Lock-On* was particularly well-suited for this study for two reasons: the game has fully programmable flight controls (which allow the experimenter to turn on or off any number of game controls) and variable auto-pilot capability (which allow the experimenter to vary the amount of control given to the player or computer during game play).

Task demand induction. All participants began the flight simulator at the same starting point, with the aircraft paused in flight ready for a final approach toward a landing strip. For the low task demand condition, participants played the game with full auto-pilot engaged and all user controls turned off; that is, the game did not require any input from the user in order to progress from flight to landing, akin to television viewing. For the medium task demand condition, participants were in command of the flight controls used to control the speed and direction of the plane (the joystick, throttle, and rudder), while the simulator automatically controlled all other avionics for the participant. These avionics include the landing gears (used to safely land the plane on a landing strip), landing flaps (used to help increase drag to bring the plane to a safe landing speed), airbrakes (used to help bring the plane to a safe ground speed by increasing drag), wheel brakes (used to help slow the speed of the plane once on the landing strip), and drogue chute (a small parachute used to aid in slowing the plane on the ground). For the high task demand condition, participants were in control of all simulator flight controls and avionics, with no assistance from the computer. As discussed earlier, the low+ task demand condition was simply a replication of the low task demand condition with the addition of a memorization task intended to increase cognitive demand without having participants increase their interaction with the computer game. This memorization task required participants to take mental note of all of the avionic settings in the aircraft to prepare for an exam on aircraft landing techniques to be taken at the end of the study; the exam was never actually administered.

Measures

Task demand. Task demand was measured two ways. During the game, it was measured with a distracter task consisting of a small black box with a red button and red LED.

Participants were asked to press a red button in response to an audio cue to activate the LED, and their response time was measured to a precision of .001 s; slower reactions were indicative of greater task demand. Similar distracter tasks have been used in research on driver safety (Nunes and Recarte, 2002; Strayer and Johnston, 2001) in which research participants respond to a visual distraction, such as a blinking light. However, as computer game play has been shown to increase one's ability to pay attention to visual distracters (e.g. Green and Bavelier, 2003), participants in our study were asked to respond to an audio cue. The audio cue technique has been used successfully in research on cognitive capacity in response to media messages (e.g. Lang et al., 2006). The audio cue was played eight times during game play, and the reliability of measurement for these reaction time responses was $\alpha = .812$.

Along with the behavioral measure of task demand, the NASA-Task Load Index was used as a self-report measure of subjective workload assessment. This six-item, 21-point scale is designed for use in measuring workload in human-machine interactions (NASA-TLX, n.d.), and has been used in prior research on flight simulations (c.f. Moroney et al., 1993; Rueb et al., 1992; Schweingruber, 1999). Sample items from the scale were: 'How much mental and perceptual activity was required?' and 'How much physical activity was required?' One item from the scale designed to measure perceived performance had a negative effect on scale reliability and thus was dropped from subsequent analysis. The reliability of the remaining five-item scale was $\alpha = .811$.

Mood repair. Mood repair was measured using a pre-test/post-test administration of an adapted version of the Affect Grid (Russell et al., 1989). The scale asks participants to visually map their current mood state in the semantic space between positive and negative affect (the x-axis) and high or low arousal (the y-axis) using a 9x9 grid, with the square the center of the grid representing a 'neutral, average, everyday feeling' (Russell et al., 1989: 501). The scale has been validated in prior research as a measure of mood (Killgore, 1998; Swindells et al., 2007), and the pre-test/post-test implementation of the scale has been established as a valid measure of mood change (e.g. De Petrillo and Winner, 2005; Eich and Macaulay, 2000).

Computer game skill. Participants' perceived computer game skill was assessed using the 10-item, seven-point Likert-scaled Game Playing Skill scale (GaPS; Bracken and Skalski, 2006). Sample items from this scale were: 'I am a good computer game player' and 'I often win when playing computer games against other people.' The reliability of this 10-item scale was $\alpha = .967$.

Results

Induction checks

Mood. The mood inductions used in this study were found to significantly affect arousal and affect levels in the predicted direction. For participants in the boredom condition, the induction produced the expected significant shift in both arousal, $t(109) = 12.0$, $p < .001$, and affect, $t(109) = 11.4$, $p < .001$. Bored participants' post-manipulation mood

(M = 3.09, SD = 1.62) was significantly lower than their pre-manipulation mood (M = 5.90, SD = 1.98), while their post-manipulation arousal (M = 2.84, SD = 1.64) was significantly lower than their pre-manipulation arousal (M = 5.19, SD = 1.85). For participants in the stress condition, the induction again produced the expected significant shift in both arousal, $t(112) = -3.88$, $p < .001$, and affect, $t(112) = 12.1$, $p < .001$. Stressed participants' post-manipulation mood (M = 2.86, SD = 1.68) was significantly lower than their pre-manipulation mood (M = 5.53, SD = 1.88), while their post-manipulation arousal (M = 6.24, SD = 2.17) was significantly higher than their pre-manipulation arousal (M = 5.23, SD = 2.01). Thus we conclude that our mood manipulations were successful in inducing feelings of boredom and stress in our participants. Notably, there was no significant difference in either pre-induction arousal, $t(221) = -.118$, *ns*, or pre-induction affect, $t(221) = 1.46$, *ns*, between mood conditions.

Task demand. An induction check was performed on the task demand conditions using scores from the distracter task measure. For the distracter task, ANOVA reported a significant difference between task demand condition and response time, $F(3,168) = 20.2$, $p < .001$, $\eta^2 = .27$. As expected, participants in the low task demand condition had the fastest reaction times to the distracter task (M = 1.74 seconds, SD = .41), followed in order by those in the low+ (M = 2.58, SD = 1.48), medium (M = 2.81, SD = 1.69), and high task demand conditions (M = 4.48, SD = 2.48); this trend followed a linear pattern, $F_{linear}(1,168) = 53.2$, p < .001. Data from the mission feedback scale told a similar story, as participants in the low task demand (M = 7.13, SD = .533) and low+ task demand (M = 7.32, SD = .546) conditions evaluated these conditions as less demanding as those participants in the medium task demand (M = 10.3, SD = .55) and high task demand (M = 11.8, SD = .493) conditions, $F(3,167) = 19.3$, $p < .001$, $\eta^2 = .26$. Combined, these results are used to conclude that the a priori task demand conditions indeed differed significantly in the predicted direction.

Although differing significantly from the low and high task demand conditions, Tukey's HSD post-hoc analysis found that reaction times for participants in the low+ and medium task demand conditions did not differ significantly from each other for the distracter task measure, which suggest no perceptible difference in task demand between watching television with a cognitive task or playing a moderately-demanding computer game. In contrast, further post-hoc analysis showed a significant difference in self-reported task demand between the low+ and medium task demand conditions, indicating that participants felt that a moderately-demanding computer game was significantly more demanding than watching television with a cognitive task. Notably, these two measures of task demand shared significant correlation (r = .241, p = .001). Thus, as results regarding the relative difference in task demand resulting from the low+ demand condition were not made clear from the induction check, all four task demand conditions were retained in data analysis.

Hypothesis testing

Our hypotheses predicted that (H1) increased task demand will result in greater mood repair for those in noxious mood states (H2) mood repair would be greater for bored

Table 2. Results of 2 (mood manipulation) x 4 (task demand) ANOVA on mood repair.*

	SS	*df*	*MS*	*F*	*P*	η^2
Task demand	25.6	3	8.53	2.52	.060	.044
Mood manipulation	16.8	1	16.8	4.96	.027	.029
Task demand* mood manipulation	9.14	3	3.05	.901	.442	.016
Error	554.4	164				

participants than for stressed participants, and (H3) a significant interaction between mood induction and task demand conditions would exist such that the difference in mood repair between bored and stressed participants would be greatest at high levels of task demand. To examine these, an omnibus 2 (mood manipulation) x 4 (task demand condition) ANOVA was performed with post-game play affect as the dependent variables. ANOVA results are presented in Table 2, descriptive statistics for mood repair as a function of mood manipulation and task demand condition are presented in Table 3, and resultant pattern of means by mood manipulation and task demand condition are plotted in Figure 3.

Our first hypothesis predicted that increased task demand will result in greater mood repair for those in noxious mood states. Results from the ANOVA show that the effect of task demand approach significance but fail to meet the $p < .05$ criterion, $F(3,164) = 2.52$, $p = .060$, $\eta^2 = .044$, thus suggesting that support was not found for H1. However, there was reason to suspect that the influence of task demand on mood repair might be nonlinear, as too much task demand might become frustrating (see Wolf and Perron, 2003). To examine this, tests were conducted to investigate the potential for a quadratic relationship between task demand and mood repair. A significant curvilinear relationship was found (k matrix $p_{linear} = .100$, $p_{quadratic} = .031$, $p_{cubic} = .511$). The pattern of means shows that levels of mood repair increased from low ($M = 4.05$, $SD = 1.75$), to low+ ($M = 5.05$, $SD = 1.55$), to moderate levels of task demand ($M = 5.50$, $SD = 2.00$), at which point it peaked and subsequently declined for users in the highest task demand condition ($M = 4.92$, $SD = 1.05$).[2] Thus, while support for H1 as predicted – the linear influence of task demand on mood repair – was not found, the suggested curvilinear relationship was

Table 3. Descriptive statistics for mood repair by mood manipulation and task demand condition.

	Task demand condition							
	Low		Low+		Medium		High	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Boredom	4.38a	1.83	5.40b	1.39	5.83c	2.09	5.54b	1.91
Stress	4.43a	1.72	4.70a	1.66	5.19b	1.91	4.32a	2.04

*means with different subscripts per row differ at p < .05 level or greater.

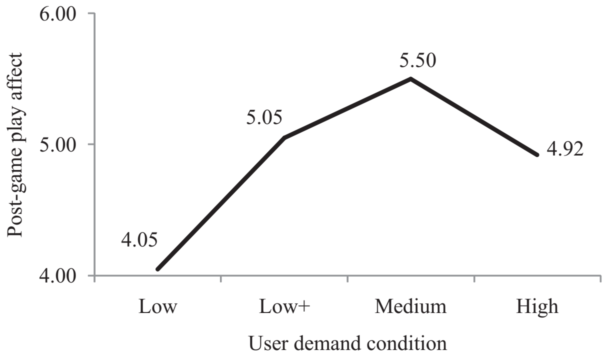

Figure 2. Observed relationship between task demand condition and subsequent mood repair.

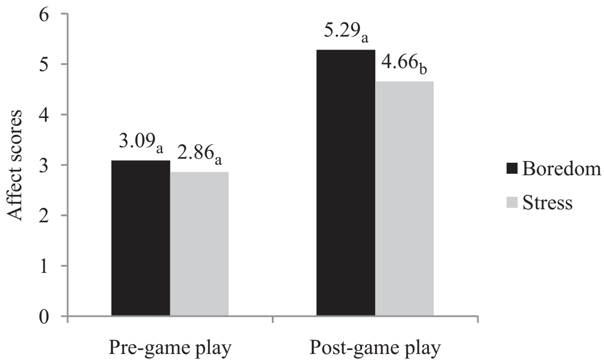

Figure 3. Observed change in post-game play affect across mood manipulation conditions, from baseline.

Note: Means with different subscripts within comparison group differ at p = .05 level or greater.

found. Increased task demand has a significant positive effect on mood repair up to a point before dropping off at the highest level of task demand (see Figure 2).

Our second hypothesis predicted that mood repair would be greater for bored participants than for stressed participants. Analysis of covariance controlling for video game skill and felt arousal show support for this hypothesis, as a significant difference was found in mood repair between mood manipulation conditions, $F(1,164) = 4.97$, $p = .027$, $\eta^2 = .029$. Although post-game play affect ($M = 4.96$, $SD = 1.88$) was significantly greater than pre-game play affect ($M = 3.02$, $SD = 1.65$) for all participants, $t(171) = -11.9$, $p < .001$, the increase for bored participants ($\Delta M = 2.20$) was greater than the increase for stress participants ($\Delta M = 1.80$), and these differences were significant from one another, $t(170) = 2.27$, $p = .024$. Overall, mood repair was greater for bored participants than it was for stressed participants when controlling for arousal and computer game skill, thus showing support for H2 (also see Figure 3).

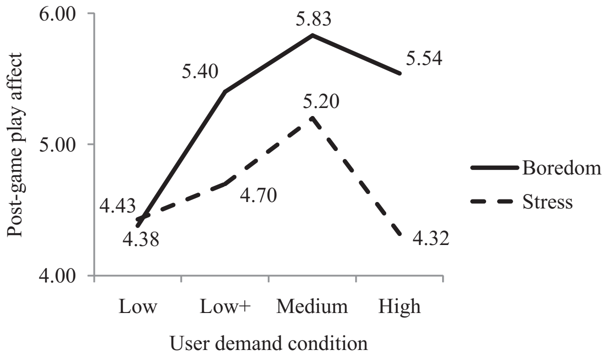

Figure 4. Observed relationship between mood state and task demand on mood repair.

Our third hypothesis predicted that a significant interaction between mood induction and task demand conditions would exist such that the difference in mood repair between bored and stressed participants would be greatest at high levels of task demand. Results from the ANCOVA controlling for video game skill and felt arousal showed that the interaction of task demand and mood manipulation was not significant, $F(3,162) = 1.07$, $p = .362$; thus, H3 is not supported (also see Figure 4).

Additionally, it should be noted that a significant effect was found for computer game skill on mood repair, $F(1,162) = 14.9$, $p = .025$, $\eta^2 = .027$. The partial correlation was calculated between computer game skill on mood repair, controlling for arousal, was $r = .177$, $p = .021$. This small-but-significant correlation suggests that individuals with higher self-reported computer game skill reported greater mood repair regardless of task demand or mood manipulation.[3]

Discussion

Our study examined the effects of increased task demand on mood repair for bored and stressed individuals. While all participants in the study experienced some form of mood repair post-game play, bored individuals experienced significantly more mood repair than stressed participants. Regardless of mood condition, task demand increased mood repair up to a point where increased task demand had a counter-productive effect on mood repair. This was evidenced by a significant curvilinear relationship reported for mood repair scores as a function of increased task demand. Finally, no significant interaction between mood manipulation and task demand condition on mood repair was found. Data from this study show that (a) increasing the amount of control an individual has over a mediated environment – such as increasing the number of control inputs a user has in a computer game – significantly increases that medium's intervention potential, (b) this increase in intervention potential results in an enhanced ability for that medium to relieve boredom and stress, and (c) too much task demand can have a detrimental effect on mood repair.

The curvilinear relationship between task demand and mood repair reported in this study is intriguing because it contrasts somewhat with the assumption that the increased intervention potential will necessarily lend itself toward greater mood repair. Anyone with experience playing computer games is no doubt aware of the potentially frustrating nature of computer games. This being said, the status quo of much of the research on interactive media technology seems to suggest that greater control over the simulated environment leads to generally positive outcomes, such as a heightened sense of presence (Steuer, 1992) and enjoyment (Grodal, 2000). More research is needed to provide data points to identify with greater precision the exact levels of gaming task demand that are considered too demanding, as well as the more specific elements of task demand such as ecological validity and natural mapping that might contribute to the onset of frustration.

Perhaps one of the more notable finding in our study is that the effect of task demand on mood repair was observed after controlling for felt arousal. That is, we found that the ability of computer games to repair negative mood states associated with boredom and stress was a function of increased task demand afforded by the interactive environment, and not simply increased arousal as is commonly suggested in the literature (see Bryant and Davies, 2006; Raney et al., 2006). Of course, this is not to say that the arousal capacity of computer games is not an important contributor to their mood management capacity; in fact, for individuals experiencing low levels of arousal, computer games might prove to be a most attractive media choice for helping one return to an optimal level of arousal. However, it is important theoretically to demonstrate that intervention potential and arousal regulation are separate constructs that can have differential effects on mood repair, even in situations such as computer game play in which it has been previously assumed that both variables are increased as a function of increased control and interactivity. Moreover, binding this added intervention potential to features of interactivity demonstrates how unique features of computer games distinguish user experiences with computer games from television and other less interactive media. Not only do these data show that demand on attentional resources contribute to the mood management process, they also show how unique features of computer games contribute to task demand.

Limitations

This study shows the relative influence of different task demand levels on mood repair processes stemming from media consumption. Although we are confident in these findings, our study examined mood repair resulting from experimentally-controlled levels of task demand, which may lack ecological validity. Recall that the central concern of mood management theory is to explain parts of the selective exposure process (Zillmann and Bryant, 1985). Thus, although we show evidence suggesting that the greatest mood repair will result from an optimal pairing of noxious mood and task demand levels, our study did not allow users to choose their own task demand settings. Future research should replicate these mood repair scores stemming from more naturally-occurring media selection.

Another consideration that should be noted is that the length of game play in this study was rather short – less than five minutes. Although results were found even with this relatively limited length of game play, future research might consider varying lengths of game play to see the how this might affect intervention. For example, one could argue that length of game play might lessen task demand as the player becomes accustomed to the game controls. At the same time, one could also argue that length of game play might increase task demand as the game becomes more complicated as it progresses. Future research should take careful consideration of how time spent playing a computer game might be expected to affect task demand and resultant mood repair. Related to this, we might consider how experience with video games over a longer period of time might influence intervention potential irrespective of video game skill as measured in this study.

We began our study with a concern related to our manipulation of task demand. Our low and low+ task demand conditions simulated television viewing by having participants witness a computer game playing in demonstration mode rather than providing participants with actual television programming to watch. This was done to control for the potential for systematic differences in television and computer game content to account for observed effects, and to increase our ability to attribute any observed effects to manipulations of task demand. For example, controlling content allows us to dismiss claims that observed effects resulted from group differences in the hedonic valence and behavioral affinity of media content. That being said, we acknowledge that a 'pure' television viewing condition was not used in this study, and replication of this study would benefit by incorporating an actual television viewing condition in order to more completely capture nuanced differences between task demand in these media forms. Related to this, future research might consider differences in task demand between other forms of entertainment media beyond television and computer games.

Finally, we do not have an explanation for the unexpected relationship between self-reported computer game skill and mood repair. We had hoped that random assignment to conditions would control for skill differences, but this was not the case. Participants in the high task demand condition had higher self-reported game skill than those in lower demand conditions. Notably, these measures were taken at the start of the study, so this finding is unlikely to be the result of a testing effect. Upon further review, it might not be surprising that game skill and mood repair are positively related, as highly skilled gamers are likely more comfortable with increased task demand and thus more involved in the computer game. At the same time, our analyses controlled for computer game skill. Nonetheless, future studies should carefully consider how computer game skill is related to both task demand and mood repair.

Future research direction

In terms of mood states, our study considered only two noxious moods: boredom and stress. Future research should expand beyond these moods. When considering the intense focus on media violence and aggression, one mood domain rife for replication of this study would be anger. Also, we made no attempt to measure behavioral affinity or hedonic valence as relevant dimensions of mood management. In our study, message content was kept constant in all four conditions by carefully programming and controlling the flight simulator computer game to present the same on-screen content in all experimental trials. However, part of active involvement in computer games involves the user being involved in the creation of dynamic content. In other words, one must consider in any computer game the relative inconsistency of computer game content, when even the slightest user input can drastically affect what is displayed on screen. One example would be an individual who successfully lands the flight simulator as compared to an individual who does not. The successful landing might be thought to have greater hedonic valence and – based on the cause of one's current mood state – might or might not also have greater hedonic affinity. We are confident that content differences across all task demand conditions were kept to a minimum, but this would need to be considered in replication. As well, as our study removed most narrative elements from the computer game environment, we might consider how other elements of the video game experience such as narrative transportation (Green and Brock, 2000) or presence (Tamborini and Bowman, 2010) induced by variables beyond physical interaction with the game might influence intervention potential and resultant mood repair.

Finally, while our study focused on computer games, there is nothing so unique about any of the variables measured in our study to prevent the application of the proposed research questions to other interactive environments. Any mediated environment which requires some level of task demand should produce similar effects on mood repair. As our study focused on control inputs in a computer game, other researchers might consider identifying elements of other mediated communication channels that might place demand on their users, such as information management and distribution systems in social network applications, communication between multiple users in distributed networks, and even the relative task demand of the mediated communication system itself. Each of these areas could be investigated using the concepts identified in our study.

Conclusion

It has been suggested that the experience of playing computer games is qualitatively different from consuming other forms of media. In terms of mood management theory, it has been proposed that computer games – due to their increased task demand – should result in greater mood repair than other forms of media, even when controlling for the effects of arousal and perceived computer game skill. By experimentally assigning bored or stressed individuals to various task demand conditions, data from this study supports the assertion that greater task demand is related to greater mood repair so long as demand is not too high. This study provides empirical support for the assertions regarding the nature of computer game play and intervention potential as applied to mood management theory, and provides direction for understanding the effects of task demand of any mediated communication environment on user's resultant mood.

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Notes

1. In our study, we manipulated task demand with a game played on a desktop computer using traditional computer game controls such as a joystick, keyboard, and mouse. To game scholars, this might seem to limit our study to computer games at the expense of console games. At the same time, we would argue that the mechanisms proposed and tested in our study should operate similarly using all types of video games, including console and hand-held games.
2. In fact, if we remove the high task demand condition from the ANCOVA analysis, the main effect for task demand on mood repair is significant, $F(2,123) = 3.19$, $p = .045$, $\eta^2 = .053$, and linear (k matrix $p_{linear} = .013$, $p_{quadratic} = .864$).
3. We measured arousal and computer game skill because we believed that they might affect the relationship between task demand and mood repair. We used these variables as covariates in our initial analysis, but these initial analyses demonstrated that the relationship between task demand and mood repair was curvilinear. Since ANCOVA is based on a linear regression, use of a covariate is based on the assumption that the relationship between the independent variable and the dependent variable is linear – an assumption violated in our data. Therefore, we removed the covariates and conducted the ANOVA test reported here. At the same time, we realize that researchers familiar with the important influence that these variables have in the gaming experience might question their exclusion from the analysis. Here, we note here that ANCOVA results showed the same effect of task demand on post-game play affect for both mood manipulations, demonstrating a significant linear relationship between game skill and post-game play affect and indicating that individuals with higher self-reported computer game skill experienced greater mood repair across conditions of task demand and mood manipulation. Notably, game skill was unrelated to the measure of perceived task demand ($r = .021$, *ns*), indicating that skilled and unskilled gamers perceived the high task demand as equally challenging. Thus, we might expect that game skill would have no effect on the relationship between task demand and mood repair.

References

Bracken CC and Skalski P (2006) Presence and video games: The impact of image quality and skill level. In: *Proceedings of the Ninth Annual International Workshop on Presence*, 24–26 August, Cleveland, OH: Cleveland State University, pp. 28–29.

Bryant J and Davies J (2006) Selective exposure to video games. In: Vorderer P and Zillmann D (eds) *Playing Video Games: Motives, Responses, and Consequences*. Hillsdale, NJ: LEA, pp. 181–194.

Bryant J and Zillmann D (1984) Using television to alleviate boredom and stress: Selective exposure as a function of induced excitational states. *Journal of Broadcasting* 28: 1–20.

Chen Y and Raney AA (2009) Mood management and highly interactive video games: An experimental examination of Wii playing on mood change and enjoyment. In: *Paper Presented at the Annual Meeting of the International Communication Association*, 21–25 May, Chicago, IL.

De Petrillo L and Winner E (2005) Does art improve mood? A test of a key assumptions underlying art therapy. *Art Therapy: Journal of the American Art Therapy Association* 22(4): 205–212.

Eich E and MaCaulay D (2000) Fundamental factors in mood-dependent memory. In: Forgas JP (ed.) *Feeling and thinking: The role of affect in social cognition*. New York: Cambridge.

Green CS and Bavelier D (2003) Action video game modifies visual selective attention. *Nature* 423: 534–537.

Green MC and Brock TC (2000) The role of transportation in the persuasiveness of public narratives. *Journal of Personality and Social Psychology* 79(5): 701–721.

Grodal T (2000) Video games and the pleasures of control. In: Zillmann D and Vorderer P (eds) *Media Entertainment: The Psychology of Its Appeal*. Mahwah, NJ: LEA, pp. 197–212.

Jones S (2003) Let the games begin: Gaming technology and entertainment among college students. Pew Internet and American Life Project. Available at: http://www.pewinternet.org/pdfs/PIP_College_Gaming_Reporta.pdf (accessed 5 May 2008).

Killgore WD (1998) The affect grid: A moderately valid, nonspecific measure of pleasure and arousal. *Psychology Reports* 83(2): 639–642.

Klimmt C and Hartmann T (2006) Effectance, self-efficacy, and the motivation to play video games. In: Vorderer P and Zillmann D (eds) *Playing Video Games: Motives, Responses, and Consequences*. Hillsdale, NJ: LEA, pp. 133–146.

Knobloch S and Zillmann D (2002) Mood management via the digital jukebox. *Journal of Communication* 52(2): 351–366.

Knobloch S, Hastall M, Zillmann D, et al. (2003) Imagery effects on the selective reading of Internet newsmagazines: A cross-cultural examination. *Communication Research* 30(1): 3–29.

Lang A, Bolls P, Potter RF, et al. (1999) The effects of production pacing and arousing content on the information processing of television messages. *Journal of Broadcasting & Electronic Media* 43(4): 451–475.

Lang A, Bradley SD, Park B, et al. (2006) Parsing the resource pie: Using STRTs to measure attention to mediated messages. *Media Psychology* 8: 369–394.

Mastro DE, Eastin MS, and Tamborini R (2002) Internet search behaviors and mood alterations: A selective exposure approach. *Media Psychology* 4: 157–172.

Moroney WF, Reising J, Biers DW, et al. (1993) The effect of previous levels of workload on the NASA task load index (NASA-TLX) in a simulated flight task. In: *Proceedings of the 7th International Symposium on Aviation Psychology*, 26–29 April, Columbus, OH: Ohio State University, pp. 882–885.

NASA-TLX (n.d.) NASA TLX: Task Load Index. Available at: http://humansystems.arc.nasa.gov/groups/TLX/

Nunes L and Recarte MA (2002) Cognitive demands of hands-free phone conversation while driving. *Transportation Research Part F: Traffic Psychology and Behavior* 5(2): 133–144.

Raney AA, Smith JK, and Baker K (2006) Adolescents and the appeal of video games. In: Vorderer P and Zillmann D (eds) *Playing Video Games: Motives, Responses, and Consequences*. Hillsdale, NJ: LEA, pp. 165–180.

Rueb J, Vidulich MA, and Hassoun J (1992) Establishing workload acceptability: An evaluation of a proposed KC-135 cockpit redesign. In: *Proceedings of the Human Factors and Ergonomics Society, 36th Annual Meeting* , 12–16 October, Atlanta, GA: HFES, pp. 17–21.

Russell JA, Weiss A, and Mendelsohn GA (1989) Affect grid: A single-item scale of pleasure and arousal. *Journal of Personality and Social Psychology* 57(3): 493–502.

Schweingruber J (1999) Analysis and evaluation of cockpit concept and crew concept of a two-seater combat aircraft. In: *Proceedings of the Human Factors and Ergonomics Society, 43rd Annual Meeting*, 27 Sep to 1 Oct, Houston, TX: HFES, pp. 36–40.

Steuer J (1992) Defining virtual reality: Dimensions determining telepresence. *Journal of Communication* 42: 73–93.

Strayer DL and Johnston WA (2001) Driven to distraction: Dual-task studies of simulated driving and conversing on a cellular telephone. *Psychological Science* 12(6): 462–466.

Swindells C, MacLean KE, Booth KA, et al. (2007) Exploring affective design for physical controls. In: *Proceedings of Conference on Human Factors in Computing Systems, CHI Letters* 9(1): 933–942.
Tamborini R and Bowman ND (2010) Presence in video games. In: Bracken C and Skalski P (eds) *Immersed in Media: Telepresence in Everyday Life*. New York: Routledge, pp. 87–110.
Vorderer P (2000) Interactive entertainment and beyond. In: Zillmann D and Vorderer P (eds) *Media Entertainment*: *The Psychology of its Appeal*. Mahwah, NJ: LEA, pp. 21–36.
Wolf MJP and Perron B (2003) *The Video Game Theory Reader*. New York: Routledge.
Zillmann D and Bryant J (1985) Affect, mood, and emotion as determinants of selective exposure. In: Zillmann D and Bryant J (eds) *Selective Exposure to Communication*. Hillsdale, NJ: LEA, pp. 157–190.
Zillmann D, Hezel RT and Medoff NJ (1980) The effect of affective state on selective exposure to televised entertainment fare. *Journal of Applied Social Psychology* 10(4): 323–339.
Zillmann D, Knobloch S, and Yu H (2001) Effects of photographs on the selective reading of news reports. *Media Psychology* 3(4): 301–324.

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