Received: 3 March 2025 | Revised: 15 May 2025 | Accepted: 3 June 2025

DOI: 10.1002/jts.70000

ISTSS International Society for Traumatic Stress Studies WILEY

RESEARCH ARTICLE

Testing a dose-response effect of the visuospatial game Tetris on intrusive memories

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Abstract

Tetris has been shown to reduce intrusions following exposure to experimentally induced and actual traumatic events. However, no study has systematically investigated whether multiple sessions of Tetris produce greater reductions in intrusions than a single session. In this study, 94 participants (58.5% female) watched a trauma film in the laboratory and were then randomly assigned to one of three groups: no Tetris (inactive control), a single session of Tetris (15 min on Day 1), or multiple sessions of Tetris (15 min per day on Days 1, 2, and 3). Participants recorded film-related intrusions in a daily diary over 1 week. The results showed that the trauma film effectively induced intrusions. In terms of group differences, a single Tetris session was associated with a 22.0% reduction in intrusions compared to the control group, Exp(B) = 0.78; and multiple Tetris sessions were associated with a 13.3% increase in intrusions compared to the control group, Exp(B) = 1.13, and a 45.4% increase compared to the single-session group, Exp(B) = 1.45. However, none of these differences were statistically significant, p = .380. These findings may be partially explained by methodological factors, such as administering Tetris remotely via smartphones without researcher supervision and the repeated use of reminder cues. Alternatively, Tetris may not effectively reduce intrusions when played unsupervised in uncontrolled settings.

Many individuals experience intrusive memories after a traumatic event. Intrusions are recurring, involuntary, and often distressing recollections of a past event (American Psychiatric Association [APA], 2022), typically manifesting as vivid mental images (Ehlers et al., 2002). Intrusions are suggested to predict the onset and severity of posttraumatic stress disorder (PTSD) symptoms, especially when experienced in the first days following trauma exposure (Bryant et al., 2017; O'Donnell et al., 2007; Solberg et al., 2016). Consequently, ways to prevent or mitigate posttrauma intrusions have been the subject of much research.

One widely used method for eliciting and studying intrusions in a laboratory setting is the *trauma film paradigm* (TFP). The TFP involves participants viewing fictional film clips depicting traumatic events that are impactful enough to induce film-related intrusions for several days outside of the laboratory (Lau-Zhu et al., 2018). The TFP has been employed in over 100 studies and has been shown to reliably produce intrusions while adhering to minimal-risk research standards (Holmes & Bourne, 2008; James et al., 2016; Stirling et al., 2023). Using this method, studies have assessed various ways to reduce the frequency

of intrusions, with meta-analytic studies showing that visuospatial interference tasks are particularly effective (e.g., Asselbergs et al., 2023; Varma et al., 2024).

Tetris is one such visuospatial game that has been extensively tested (Asselbergs et al., 2023; Varma et al., 2024). Tetris requires players to rotate descending objects of various shapes, sizes, and colors to form complete horizontal lines, placing significant demands on visuospatial working memory resources. Some research has suggested that playing Tetris shortly after a traumatic event (i.e., during memory consolidation) or following reminders of the event (i.e., during memory reconsolidation) competes for the same cognitive resources responsible for consolidating or reconsolidating the trauma memory, ultimately disrupting trauma memory processing and, thereby, reducing the likelihood of subsequent intrusions (Holmes et al., 2009, 2010; James et al., 2015).

In a seminal study, Holmes et al. (2009) investigated whether playing Tetris 30 min after a trauma film would lead to fewer intrusions compared to no task. The Tetris group reported significantly fewer intrusions during the following week and lower PTSD intrusion symptom scores at the conclusion of the week. Additionally, the authors found that recognition of the film did not differ between the groups, indicating that Tetris reduced involuntary memory while leaving voluntary recall of the film intact. In two follow-up experiments, Holmes et al. (2010) tested the timing of task administration (30 min and 4 hr postfilm) and the nature of the task (visuospatial vs. verbal). In both experiments, playing Tetris led to significantly fewer intrusions than a verbal task or no task, suggesting that the timing of the task did not matter, but the nature of the task did. Badawi et al. (2020) replicated and extended these findings by testing Tetris against an alternative visuospatial task and no task. They found that Tetris led to significantly fewer intrusions compared to both conditions, but no differences between the alternative visuospatial task and no task were observed. Similarly, Asselbergs et al. (2018) developed two alternative visuospatial tasks but found no beneficial effects when compared to no task. These studies suggest that Tetris may be uniquely effective for reducing intrusions compared to both verbal and alternative visuospatial tasks.

Although the aforementioned studies examined the effect of Tetris during memory consolidation (i.e., within the first few hours postfilm), James et al. (2015) tested its effectiveness during memory reconsolidation. Across two experiments, they found that playing Tetris 24 hr postfilm led to significantly fewer intrusions compared to no task but that reminder cues were necessary to produce an effect. Further evidence of the importance of reminder cues was evidenced by Brühl et al. (2019), who omitted reminder cues and found no reduction in intrusions after playing Tetris. Subsequent studies extended these findings (e.g., Asselbergs et al., 2024; Lau-Zhu et al., 2019, 2021), with some showing that Tetris can effectively reduce intrusions when used 3 (Kessler et al., 2020) or 4 (Hagenaars et al., 2017) days after exposure to a trauma film, provided reminder cues were used.

Building on this laboratory-based research, several studies have shown that playing Tetris can reduce intrusions following exposure to actual traumatic events in real-world settings (e.g., Deforges et al., 2022; Hardarson et al., 2024; Horsch et al., 2017; Iyadurai et al., 2018, 2023; Kanstrup, Kontio, et al., 2021; Kanstrup, Singh, et al., 2021; Kanstrup et al., 2024; Kessler et al., 2018). Some of these studies reported reductions in intrusions after a single session of Tetris (e.g., Horsch et al., 2017; Iyadurai et al., 2018), whereas others reported reductions after multiple Tetris sessions (e.g., Hardarson et al., 2024; Kessler et al., 2018). Interestingly, no study has yet compared whether playing Tetris on multiple occasions produces larger reductions in intrusions compared to playing on a single occasion, either in a laboratory or real-world setting. If Tetris is causally related to reductions in intrusions, a higher dose might be expected to produce a larger effect (Hill, 1965).

In this study, we sought to determine if, after exposure to a trauma film, (a) playing Tetris outside of a laboratory setting significantly reduced film-related intrusions compared to no task and (b) multiple sessions of Tetris had a significantly larger effect on reducing film-related intrusions than a single session. Under the assumption that Tetris is an effective task for disrupting trauma memory processing and reducing intrusions, we hypothesized that playing Tetris outside of a controlled laboratory condition would lead to significantly fewer intrusions compared to a control group and that engagement in multiple Tetris sessions would lead to significantly fewer intrusions compared to engagement in a single session.

METHOD

Participants

Participants were recruited using convenience sampling methods (i.e., a mix of in-person and online recruitment). No remuneration was used to recruit participants, although some participants were university students who received course credit for their participation. The only inclusion criteria were that participants were aged 18 years or older, provided informed consent, had normal or corrected-to-normal vision, and had access to a smartphone to complete the online surveys. Although given the option, no participants chose to stop the film during viewing or withdraw from the study during the film portion.

Ethical approval was obtained from Maynooth University's Social Research Ethics Committee (SRESC-2024-38156).

In total, 114 people were enrolled in the study. However, 16 participants did not play Tetris for at least 10 min as instructed, and four participants did not complete the daily surveys. Thus, the final sample comprised 94 adults (58.5% female) aged 18–60 years (M = 27.04 years, SD = 11.10). With 94 participants, the study was sufficiently powered (80%) to detect a large Cohen's d effect size of 0.65, in line with the large effects reported in previous studies (e.g., Badawi et al., 2020; Holmes et al., 2010). Figure 1 outlines the flow of participants through the laboratory and online components of the study.

Procedure

Study overview

On Day 1, participants attended the psychology computer laboratory at Maynooth University between 11 a.m. and 3 p.m., where they were assigned to a desktop with headphones. The researcher reiterated the nature of the study, and participants read the information sheet and provided informed consent. All participants practiced playing Tetris for 2 min. The researcher explained the purpose of the game and how it should be played. Then, participants completed the prefilm battery, which included basic demographic questions, measures of anxiety and depressive symptoms and trauma exposure, and prefilm mood scales. Next, the researcher darkened the room (i.e., closed the blinds and turned off the lights) and gave instructions for film-viewing, and participants watched the film. Immediately afterward, participants completed postfilm mood, distress, and attention rating scales. The researcher then gave each participant an intrusion diary and provided instructions for the rest of the week. Participants left the laboratory, and the rest of the study took place online.

At 7 p.m. each evening, participants were sent a Qualtrics survey link via email. All participants, regardless of the condition to which they were assigned, were asked to tally and report the total number of intrusions they had experienced that day, based on the record they kept using the intrusion diary. The rest of the survey differed depending on the group to which the participant was assigned and the specific day of the study. Participants were randomly allocated to groups based on a predetermined schedule that assigned each participation slot to one of the conditions (no Tetris play, a single Tetris session, or multiple Tetris sessions). Participants selected from the available slots based on their availability, without any knowledge of the associated condition. They were informed of their group allocation via email at 7 p.m. on the first day of the study, after they had attended the laboratory and watched the trauma film.

On Days 1–3, all participants reported their intrusion frequency and viewed 10 reminder images. Participants in the no Tetris group finished the survey at this point, whereas those in the two Tetris groups followed a link to play Tetris online for 15 min. The single-session group played Tetris on Day 1 only. The multiple-session group played Tetris three times: once per day on Days 1, 2, and 3. On Days 4–6, all participants reported their intrusion frequency only. They did not view any reminder images or play Tetris. On Day 7, all participants reported their intrusion frequency, rated the accuracy of their intrusion recording for the week, and completed the film-related PTSD symptom scale.

Survey software

Qualtrics survey software was used to design separate surveys for each part of the study. Each survey contained the appropriate questionnaires and materials (e.g., film reminder images; link to play Tetris). Participants accessed each survey via a weblink which was sent to their email address at 7 p.m. each evening.

Trauma film

Similar to previous studies (e.g., Badawi et al., 2020; Holmes et al., 2009, 2010; James et al., 2015), a trauma film functioned as an experimental analog of viewing a traumatic event in real life to generate intrusions. The film used in this study lasted for 12 min and consisted of 10 separate public safety advertisements (PSAs), which were freely available on YouTube (links available in the Open Science Framework). PSAs are typically shown during television advertisement breaks to raise awareness of safety issues; the PSAs used in this study were short, fictional clips (less than 2 min each) depicting different traumatic events (e.g., car accidents, gun violence, fire safety). Trauma film studies often use PSAs because they are sufficiently distressing to induce intrusions, but they are not designed to cause significant or lasting harm (Lau-Zhu et al., 2018). The 10 PSAs used in this study were run together in a continuous video format (.mp4) and viewed on 24-in monitors. Participants were tested in groups of five to 10 per session in a large computer laboratory. Each participant was assigned to their own desktop facing a wall, with overhead noise-cancelling headphones. The room was darkened (lights off and blinds closed) during the film, and participants were asked to give their full attention to the film and not look away unless they found it too distressing.

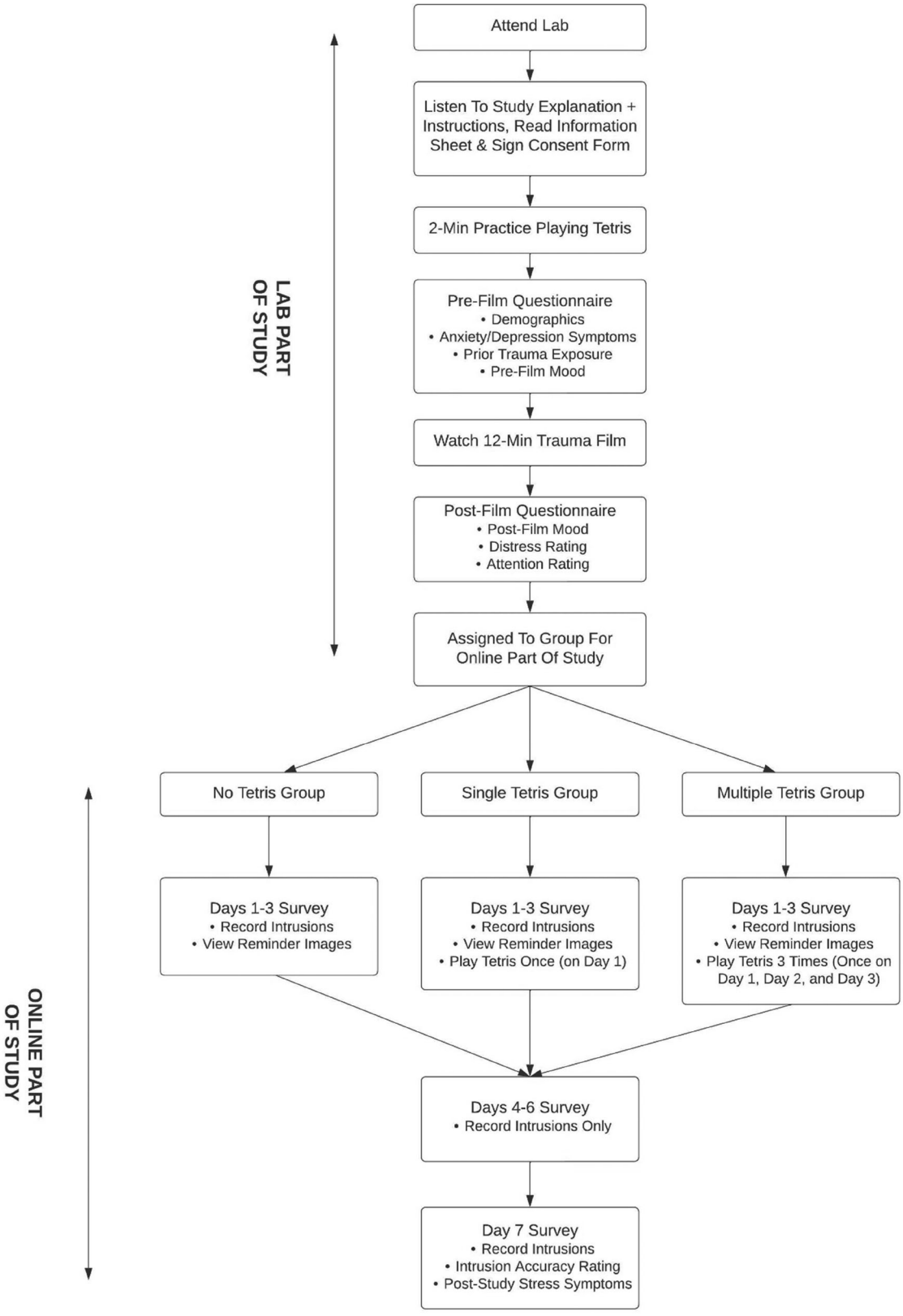

FIGURE 1 Flowchart outlining the flow of participants through the laboratory and online components of the study.

Cued images

Reminder images were used to cue participants' memory of the film before playing Tetris. Ten static images were used with one taken from each film clip. Each image displayed the moment right before the most traumatic aspect of the clip (e.g., a boy just before he falls from a tree) to enhance the likelihood that participants would recall memories of the film clip (James et al., 2015). All participants viewed the images during the first 3 days of the study to maintain consistency across the groups. The images were presented on Qualtrics one by one in the same fixed order as the film for 5 s each. Immediately after viewing the images, participants in the experimental groups played Tetris, whereas those in the control group finished at that point. Cued images were not presented beyond Day 3.

Interference task

Tetris (Tetris Holding, 1985–2005) is a computer game that is free to play online. The game requires players to move and rotate seven uniquely shaped and colored blocks (e.g., red square, orange line) to align them into complete horizontal lines. The blocks descend from the top of the screen one at a time in a randomized order. When players form complete horizontal lines, the lines disappear, and the player earns points. The objective is to earn as many points as possible before the screen fills with blocks. In this study, participants played Tetris on their smartphones, using finger taps and swipes to rotate the blocks and adjust their descent speed. A web link to access Tetris was provided on the Qualtrics survey, and participants were instructed to play for 15 min. If a game attempt ended, participants were instructed to restart immediately. The survey was timed to ensure adherence to the gameplay duration. Participants who played for less than 10 min were excluded from the analysis, as previous studies found this duration sufficient to significantly reduce intrusions (Holmes et al., 2009, 2010). Participants were instructed to play on Level 1 only and to focus on the upcoming blocks to determine where best to place them to make complete horizontal lines and score as many points as possible; this was done to encourage mental rotation (see James et al., 2015). Participants were also asked to report their highest score after each session to enhance motivation and engagement with the game.

Measures

Intrusive memory recording

Participants were given a simple pen-and-paper diary to record film-related intrusions over 1 week. Consistent with previous studies (Badawi et al., 2020; Holmes et al., 2010; James et al., 2015), participants received verbal and written instructions on the nature of intrusions and how to record them. At 7 p.m. each evening, starting on the day they attended the laboratory session, participants were sent a Qualtrics survey link and instructed to tally and report the total number of intrusions experienced that day. All participants responded to the same question: "How many intrusive memories of the film have you experienced today? Remember, an intrusive memory is any random/involuntary image or thought associated with the trauma film." Responses were selected from a drop-down menu. Due to prior findings indicating that Tetris does not reduce the distress or intensity of intrusions (Badawi et al., 2022), this study focused on intrusion frequency only.

Anxiety and depressive symptoms

The Patient Health Questionnaire–4 (PHQ-4; Kroenke et al., 2009), a brief, four-item screening scale for symptoms of generalized anxiety and depression, was used to assess potential baseline differences between groups. Participants were asked "Over the last 2 weeks, how often have you been bothered by the following problems?," with the listed problems for anxiety being "feeling nervous, anxious or on edge" and "not being able to stop or control worrying," and the listed problems for depression being "little interest or pleasure in doing things" and "feeling down, depressed, or hopeless." Responses were rated on a Likert scale with options of 0 (*not at all*), 1 (*several days*), 2 (*more than half the days*), and 3 (*nearly every day*). Total scores range from 0 to 12, with higher scores indicating higher levels of anxiety and depressive symptoms. The PHQ-4 has been shown to have adequate reliability and validity (Stanhope, 2016). In this study, the internal reliability of the scale scores was good, Cronbach's $\alpha = .80$.

Previous trauma exposure

The Life Events Checklist for *DSM-5* (LEC-5; Weathers, Blake, et al., 2013) assesses exposure to 16 potentially traumatic events (e.g., serious accident, physical assault, witnessing a violent death) that meet PTSD Criterion A per the *Diagnostic and Statistical Manual of Mental Disorders* (5th ed., text rev.; *DSM-5-TR*; American Psychiatric Association, 2022). Participants read a prompt ("Listed below are a number of difficult or stressful things that sometimes happen to people. Please indicate if you were directly exposed to each event at any point in your life") and were asked to indicate whether they had experienced each event ("yes" or "no"). The LEC-5 was used to assess baseline differences between groups; thus, participants were not required to report an index traumatic event. The LEC-5 has

been shown to be a reliable and valid measure of trauma exposure (Weis et al., 2022).

Mood, distress, attention, and intrusion accuracy

Similar to Badawi et al. (2020), visual analog scales (i.e., "slider" scales) were used to measure pre- and postfilm mood, postfilm distress and attention, and intrusion accuracy. To measure mood, five slider scales were presented under a header ("Right at this very moment I am feeling…"), and participants were asked to rate how sad, hopeless, fearful, horrified, and depressed they were feeling on a scale from 0 (*not at all*) to 100 (*extremely*). The average of these ratings represented participants' mood before and after watching the trauma film, with good internal consistency, prefilm: Cronbach's $\alpha = .85$, postfilm: Cronbach's $\alpha = .87$.

Postfilm distress and attention were measured by asking participants to rate how distressing they found the film and how well they paid attention, using a scale of 0 (*not at all*) to 10 (*extremely*). Intrusion accuracy was measured at the end of the study week by asking participants how accurately their diary entries reflected the true number of intrusions they had experienced, using the same 0–10 scale.

Film-related PTSD symptoms

The PTSD Checklist for *DSM-5* (PCL-5: Weathers, Litz, et al., 2013) is a 20-item measure assessing the *DSM-5* symptoms of PTSD and was administered on the last day of the study (Day 7) to assess participants' PTSD symptoms related to the trauma film. The scale was modified so that all items related to the trauma film specifically. Participants were given a prompt ("In the past week, how much were you bothered by…"), followed by 20 problems (e.g., "feeling upset when something reminded you of the film," "avoiding memories, thoughts, or feelings related to the film"). Responses were rated on a scale of 0 (*not at all*) to 4 (*extremely*). The total possible score range was 0–80, with higher scores indicating more severe film-related PTSD symptoms. The PCL-5 has been shown to have high reliability and validity (Forkus et al., 2023). In this study, the internal reliability of the scale scores was good, Cronbach's $\alpha = .89$.

Data analysis

Data were analyzed using SPSS (Version 29) and R (Version 4.4.1), with an alpha level set at .05 for all statistical tests. To determine that randomization was successful, the three groups were compared on all measures pre-Tetris using one-way analyses of variance (ANOVAs) and Pearson's chi-square tests. The effectiveness of the trauma film to induce intrusions across the week was assessed using a repeated-measures ANOVA with Bonferroni-corrected post hoc tests, and the trauma film's effectiveness to induce mood change pre- and postfilm exposure was assessed using paired-samples *t* tests. Effect sizes were quantified according to eta-squared (η^2) and partial eta-squared ($\eta_p{}^2$), where values up to .05 indicate a small effect, values from .06 to .13 indicate a medium effect, and values .14 or higher indicate a large effect, and Cohen's *d*, where values around 0.20, 0.50, and 0.80 indicate small, medium, and large effects, respectively (Cohen, 1988).

Our primary aim was to examine group differences in intrusion frequency. Preliminary analyses indicated that the data were overdispersed but not zero-inflated, supporting the use of a negative binomial generalized linear model. Both frequentist and Bayesian frameworks were used with group (no Tetris, single Tetris, multiple Tetris) as a categorical predictor, and intrusion frequency (Days 2–7) as a count-based outcome variable. One advantage of the Bayesian approach is that it produces Bayes factors (BFs), which quantify the relative evidence for competing hypotheses. Specifically, a Bayes factor favors the null hypothesis when BF_{10} is less than 1.0, favors the alternative hypothesis when BF_{10} is greater than 1.0, and indicates no preference when BF_{10} is equal to 1. Lee and Wagenmaker's (2013) classification scheme was used to interpret each Bayes factor. The Bayesian analyses were conducted using the *brms* package in R, with default priors (normal[0, 5]) applied to the regression coefficients. As a sensitivity check, models were also run with stronger (normal[0, 2]) and weaker (normal[0, 10]) priors, but the results remained consistent.

Mean levels of film-related PTSD symptoms on Day 7 were assessed using a one-way between-groups ANOVA. Four participants were identified as outliers, as their intrusion frequency exceeded 3 standard deviations above the mean (see Badawi et al., 2020). The data were analyzed with and without these outliers to ensure they did not affect the results. Aside from the participants ($n = 4$) who did not complete the daily intrusion surveys and were, therefore, excluded from the analyses, there were no other missing data in the dataset.

RESULTS

There were no significant differences between the three groups in terms of age, sex, prior Tetris experience, levels of anxiety and depressive symptoms, the number of lifetime

TABLE 1 Demographic characteristics for each group

Characteristic	Condition								
	No Tetris ($n = 31$)		Single Tetris ($n = 31$)		Multiple Tetris ($n = 32$)		Between-group comparison		
	n	%	*n*	%	*n*	%	$\chi^2(2, N = 94)$	*p*	φ
Sex							0.70	.705	.09
Male	14	45.2	11	35.5	14	43.8			
Female	17	54.8	20	64.5	18	56.3			
Tetris experience							3.05	.217	.18
Yes	22	71.0	26	83.9	28	87.5			
No	9	29.0	5	16,1	4	12,5			
	M	*SD*	*M*	*SD*	*M*	*SD*	*F*(2, 91)	*p*	η^2
Age (years)	27.32	10.14	27.16	11.92	26.66	11.50	0.03	.970	.00
Anxiety/depressive symptoms (PHQ-4)	3.97	2.75	4.03	2.73	3.72	2.99	0.11	.897	.00
Trauma exposure (LEC-5)	2.06	1.63	2.26	2.03	2.03	1.43	0.16	.852	.00
Prefilm mood	11.42	15.48	10.79	14.36	12.78	15.15	0.15	.865	.00
Postfilm mood	37.28	20.65	31.92	23.98	39.34	26.04	0.82	.444	.02
Attention to film	9.61	0.67	9.29	0.97	9.59	0.71	1.62	.205	.03
Film-related distress	6.65	2.42	6.58	2.84	6.69	2.67	0.01	.987	.00
Pre-Tetris intrusions	3.87	3.84	3.06	2.39	2.59	2.18	1.57	.214	.03

Note: $N = 94$. PHQ-4 = Patient Health Questionnaire-4: LEC-5 = Life Events Checklist For *DSM-5*.

TABLE 2 Negative mood scale differences from prefilm to postfilm

Mood scale	Prefilm		Postfilm		Difference			
	M	*SD*	*M*	*SD*	*M*	*SD*	*t*(93)	*d*
Sad	17.45	22.37	43.24	26.79	25.80	23.93	10.45***	1.08
Hopeless	11.85	20.25	25.03	25.08	13.18	24.56	5.20***	0.54
Fearful	11.69	16.39	34.64	28.27	22.95	27.50	8.09***	0.84
Horrified	1.70	5.89	47.77	33.86	46.06	33.43	13.36***	1.38
Depressed	15.69	23.66	30.39	30.20	14.70	22.07	6.46***	0.67

Note: $N = 94$.
***$p < .001$.

traumatic experiences, pre- or postfilm mood, attention to the film, film-related distress, or pre-Tetris intrusions (see Table 1). Participants reported being highly attentive to the film ($M = 9.50$, $SD = 0.80$) and reasonably distressed afterward ($M = 6.64$, $SD = 2.62$). Negative mood increased significantly from pre- to postfilm, with large effects (see Table 2). Most participants (91.5%; $n = 86$) had at least one intrusion, with an average of 9.45 ($SD = 10.06$) intrusions across the week. As shown in Figure 2, the film initially triggered a mean of 3.17 intrusions on Day 1 ($SD = 2.91$), which gradually declined by Day 7 ($M = 0.36$, $SD = 0.99$). There was a significant and large effect of time, Wilks' $\Lambda = 0.47$, $F(6, 88) = 16.67$, $p < .001$, $\eta_p^2 = .53$. Bonferroni-corrected t tests showed that intrusions on Day 7 were significantly lower, $p < .001$, than on Days 1, 2, 3, 4, and 5. Intrusion recording was also highly accurate based on participants' self-rated accuracy ($M = 9.11$, $SD = 1.26$), with no significant difference between the groups (see Table 1).

A frequentist negative binomial general linear model revealed no significant differences in intrusion frequency between the three groups, $\chi^2(2, N = 94) = 1.93$, $p = .380$. Pairwise comparisons indicated that neither a single Tetris session, $\chi^2(1, N = 94) = 0.81$, $p = .367$, Exp(B) = 0.78, 95% confidence interval (CI) [0.46, 1.34], nor multiple Tetris sessions, $\chi^2(1, N = 94) = 0.22$, $p = .642$, Exp(B) = 1.13, 95% CI [0.67, 1.92], significantly reduced intrusions compared to the control group. Multiple Tetris sessions also did not significantly differ from a single Tetris session, $\chi^2(1, N = 94) = 1.88$, $p = .170$, Exp(B) = 1.45, 95% CI [0.85, 2.48]. Mean intrusion counts were 6.45 ($SD = 6.12$) for the control group, 5.03 ($SD = 6.21$) for the single-session Tetris group, and 7.31 ($SD = 11.59$) for the multiple-session Tetris group. These results remained consistent even after removing the four outliers.

A Bayesian negative binomial general linear model also showed that neither a single Tetris session, $B = -0.25$, 95% credible interval (CrI) [−0.79, 0.30], Exp(B) = 0.78, nor

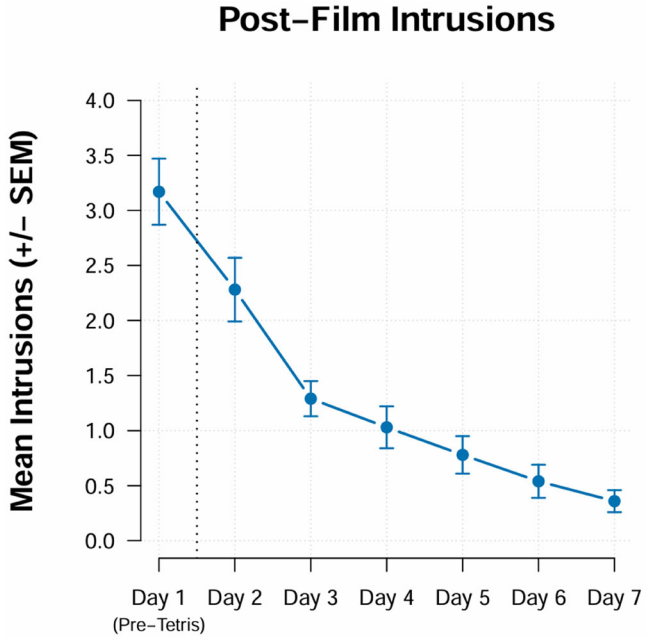

FIGURE 2 Line chart illustrating the mean number of intrusions across all groups, including Day 1.

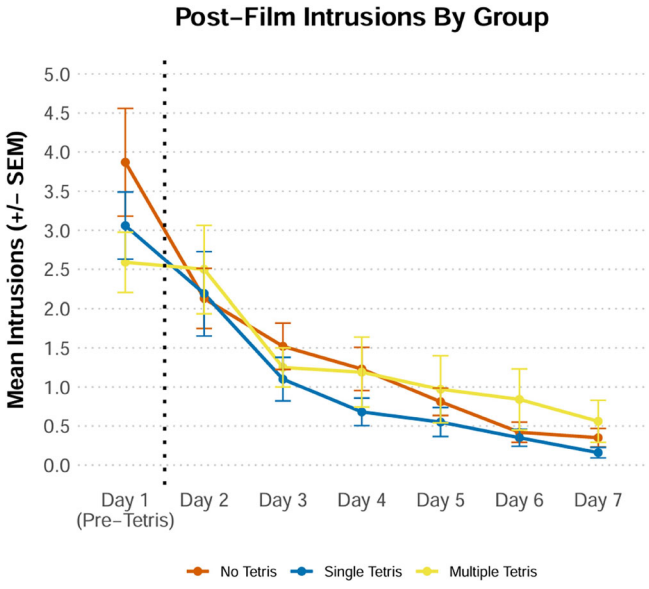

FIGURE 3 Line chart illustrating the mean number of intrusions, by group membership, including Day 1.

multiple Tetris sessions, $B = 0.13$, 95% CrI [–0.40, 0.67], Exp(B) = 1.14, significantly reduced intrusions compared to the control group. Furthermore, a Bayes factor model comparing a full model with group as a predictor and a null model with no predictors revealed very strong evidence in favor of the null model regardless of whether outliers were removed, $BF_{10} = 0.006$, or not removed, $BF_{10} = 0.007$. The distribution of intrusions across groups is illustrated in Figures 3 and 4.

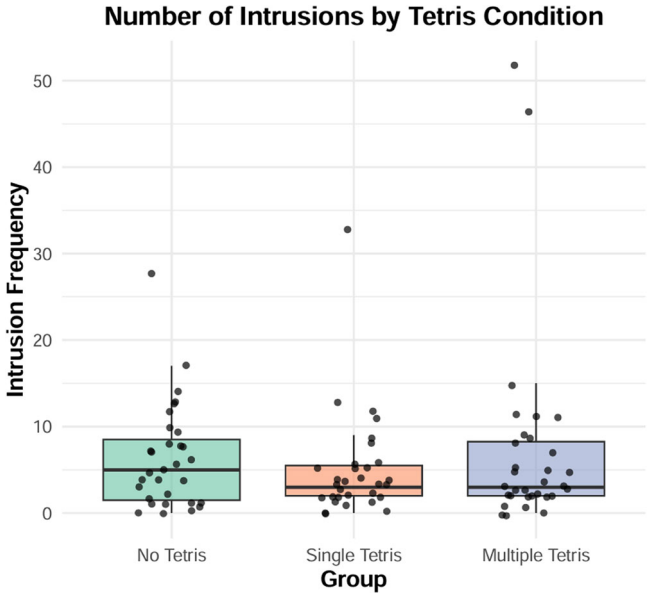

FIGURE 4 Boxplot illustrating group differences in total intrusion frequency (Days 2–7).

Film-related PTSD symptom scores were low on average ($M = 8.27$, $SD = 8.60$), with no significant differences, $F(2, 91) = 0.29$, $p = .747$, between the control ($M = 7.58$, $SD = 7.34$), single-session Tetris ($M = 8.00$, $SD = 9.66$), and multiple-session Tetris ($M = 9.19$, $SD = 8.82$) groups.

DISCUSSION

The primary goal of this study was to determine if playing Tetris outside of a controlled laboratory setting was effective in reducing intrusions and whether multiple sessions of Tetris produced larger reductions in intrusions compared to a single Tetris session. Consistent with prior research (James et al., 2016; Stirling et al., 2023), the trauma film was found to be both safe and effective in that it elicited a substantial change in negative mood and evoked a sufficient number of intrusions relative to prior studies (Hagenaars et al., 2017; Holmes et al., 2009, 2010; James et al., 2015; Kessler et al., 2020). Furthermore, the film had no lasting impact, as no participants withdrew or requested support, intrusions dissipated within 1 week, and self-reported PTSD symptoms related to the film at the end of the study period were minimal.

Contrary to our hypotheses, we found that there were no significant group differences in the mean number of intrusions experienced across the week. Group equivalency analyses demonstrated that the randomization process was successful, meaning these findings were not due to initial demographic or psychological differences across the control and interference task groups. Moreover, as the film

elicited a sufficient number of intrusions compared to prior studies, floor effects are unlikely to be the reason for the null findings. However, there are two potential limitations that should be noted. One is that Tetris was played after Day 1 when intrusion frequency is typically at its peak. As a result, the 3-day Tetris period may have required a higher baseline level of intrusions to detect significant group differences. Future studies could address this by using a more distressing film to generate a higher intrusion frequency or by administering multiple sessions of Tetris on the first day following exposure to the trauma film (or actual traumatic event) when intrusions are highest. Another limitation is that participants watched the film in a group setting, which differs from the standard trauma film paradigm procedure. Although testing in groups increases the speed of participant recruitment, exposing participants to the film individually may increase intrusion generation.

There are two additional methodological factors to consider. The first is that the timing of the Tetris task did not fall clearly within either the consolidation or reconsolidation window. Instead, Tetris was administered during an intermediate period, more than 4 hr after viewing the trauma film but prior to any overnight delay. However, as laboratory studies have shown that Tetris can reduce intrusions when played during both the consolidation (e.g., Holmes et al., 2009, 2010) and reconsolidation (e.g., James et al., 2015; Kessler et al., 2020) windows, it was assumed that a sufficient delay of at least 30 min combined with reminder cues to reactivate film-related memories would still allow for at least some reduction in intrusions. The second consideration is the repeated use of reminder cues. To ensure consistency across groups, all participants received reminder cues on Days 1–3, though only those in the multiple Tetris group received interference each time. Although this controlled for memory reactivation across conditions, it raises an important theoretical concern: Repeated reactivation without follow-up interference, as experienced by the single Tetris and control groups, may have inadvertently strengthened film-related memories, particularly in the case of the control condition, and reduced any potential benefits of the single Tetris session. These two factors may partially explain the absence of group differences in intrusion frequency.

Nonetheless, these null results still contrast with a substantial body of laboratory-based (e.g., Badawi et al., 2020; Holmes et al., 2009, 2010; James et al., 2015) and real-world (e.g., Deforges et al., 2022; Horsch et al., 2017; Kessler et al., 2018) studies demonstrating Tetris' effectiveness and align with a growing set of study findings (e.g., Hemi et al., 2023; Matura et al., 2025; Wessel et al., 2024) questioning whether Tetris is as effective for reducing intrusions as previous research suggests. One way to interpret the current findings is that Tetris may effectively reduce intrusions but only under strict conditions with researcher oversight. Deviating from the original Tetris protocol (Holmes et al., 2009, 2010; James et al., 2015), such as using alternative versions of Tetris (Asselbergs et al., 2018; Brennen et al., 2021) or omitting reminder cues (Brühl et al., 2019), has resulted in null effects. In this study, Tetris was administered remotely using smartphones outside of a controlled laboratory setting, a procedure that was, nevertheless, successfully used in applied studies (e.g., Iyadurai et al., 2023; Kanstrup, Kontio, et al., 2021; Kanstrup, Singh, et al., 2021; Kanstrup et al., 2024). We cannot rule out that delivering Tetris outside of the laboratory setting may have resulted in it being ineffective. Though participants were timed while playing Tetris, we cannot know for certain that they maintained their concentration on the game for the entirety of the playing period, something that is possible to assess when administered in a laboratory setting. If this is the case, it raises questions about the utility of Tetris as a potential intervention.

This study has several limitations that should be noted. Although we obtained a sample size similar to previous studies (e.g., Badawi et al., 2020; James et al., 2015), the sample was relatively small in absolute terms. Moreover, though participants indicated a high level of accuracy in the recording of their film-related intrusions, we cannot objectively verify the accuracy of these reports. Trauma film studies stimulate intrusive-like memories, which may well differ from the types of intrusions and flashbacks that occur in response to actual traumatic experiences, thus limiting the generalizability of the current findings. Regarding intrusions, future studies could utilize digital approaches to intrusion monitoring, which can improve compliance (Badawi et al., 2020), as well as complementary intrusion measures (e.g., laboratory-based tasks; Lau-Zhu et al., 2018) to provide insights into immediate intrusion development and poststudy intrusion frequency. Despite its limitations, this study also has several strengths, including being the first of which we are aware to test whether multiple sessions of Tetris can increase the task's effectiveness and the development of an effective and safe trauma film using freely available public safety advertisements which may be accessed and used by all interested researchers.

In conclusion, this study found no beneficial effect for the visuospatial game Tetris, though these null findings should be considered in light of several methodological decisions, including administering Tetris remotely via smartphones without researcher supervision and the repeated use of reminder cues. Nonetheless, future studies should carefully consider their study methodology when investigating the conditions under which Tetris reduces intrusions.

AUTHOR NOTE

Marcus Broughill was supported by a National University of Ireland (NUI) Travelling Doctoral Studentship.

OPEN PRACTICES STATEMENT

The study reported in this article was not formally preregistered. However, the data and materials have been made available on the Open Science Framework, accessible at: https://osf.io/znjpm/

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How to cite this article: Broughill, M., Commins, S., & Hyland, P. (2025). Testing a dose-response effect of the visuospatial game Tetris on intrusive memories. *Journal of Traumatic Stress*, *38*, 997–1008. https://doi.org/10.1002/jts.70000