De Relatie tussen Visuele Verbeelding, Tetris en Intrusies

The relationship between Visual Imagery, Tetris, and Intrusions

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Abstract

Intrusions have been linked to the development and maintenance of Post-Traumatic Stress Disorder (PTSD; Andrade et al., 1997). These intrusions are typically comprised of mental images related to the traumatic event (James et al., 2016a) and are distressing (Holmes et al., 2009). As these intrusions comprise of mental images, it is plausible that there may be a link with visual imagery. Visual imagery is the process that allows for the creation of mental images (Pearson, 2019). One way to possibly reduce the frequency of intrusions is playing Tetris (Holmes et al., 2009), by disrupting the process of memory consolidation in the VWM (Holmes et al., 2009). Visual imagery also relies on the VWM (Andrade et al., 1997). Therefore, in this thesis it is hypothesised that (1) there is a relation between higher visual imagery and number of intrusions, and that (2) playing Tetris in combination with higher visual imagery relates to fewer intrusions. Two exploratory studies were performed to provide further inside into the topic. Both studies have an experimental design, including a trauma film to induce intrusions, and a diary to measure intrusion frequency. In the second study, participants were randomly assigned to play Tetris, or to the vigilance control task. Statistical interference did not show a significant relation between visual imagery and intrusions, means between the experimental and control group on intrusion frequency were not significantly different, and visual imagery was not found to moderate the relation. Therefore, we did not find evidence in support of a relation between visual imagery, intrusions, and playing Tetris.

Key words: visual imagery, intrusions, trauma, Tetris, trauma film paradigm, PTSD

The Relationship between Visual Imagery, Tetris, and Intrusions

A crucial part of a trauma response is experiencing intrusions. These intrusions typically contain visual images related to the traumatic event (James et al., 2016a), are considered to be distressing (Holmes et al., 2009), and are linked to the development and maintenance of Post-Traumatic Stress Disorder (Andrade et al., 1997). Post-Traumatic Stress Disorder (PTSD) is a psychiatric disorder that can develop after experiencing a traumatic event (Holmes et al., 2009), and is defined as "exposure to actual or threatened death, serious injury, or sexual violence" (DSM-5; American Psychiatric Association, 2013, p. 143). Although effective treatment for PTSD is already available, the majority comprise of pharmacological means and is provided weeks or even months after the traumatic event took place (Holmes et al., 2009). Therefore, further research may be useful to acquire a deeper comprehension of the relation and underlying characteristics of intrusions, and easily accessible, and quick applicable interventions for PTSD.

In order to study intrusions in an experimental setting a commonly used tool is the trauma film paradigm (James et al., 2016). A trauma film generally contains scenes of accidents and interpersonal violence and is considered to mimic responses to real traumatic events and induce intrusions. Usage of the trauma film paradigm creates an opportunity to induce and measure intrusions and investigate possible interventions and underlying associations (James et al., 2016).

Visual Imagery

So, what is visual imagery? Visual imagery is a cognitive process that allows for the creation of sensory experiences within the mind (Pearson, 2019). This process can range from non-existent (aphantasia) to photorealistic (hyperphantasia), and can be voluntary and involuntary. Visual imagery relies on the visual cortex, with the ventral stream processing object properties and the dorsal stream processing spatial properties (Pearson, 2019; Kosslyn, 2005). Both the visuospatial working memory and long-term memory (LTM) are involved in visual imagery (Baddeley & Andrade, 2000). Visual imagery has been linked to reflective thinking in the way that previously established associations stored in the LTM can trigger the process of visual imagery in the visuospatial working memory (Kosslyn, 2005). Furthermore, higher visual imagery has been related to more detailed and realistic memory of past events (Pearson, 2019).

Visual imagery is more vivid when mental images are meaningful (Baddeley & Andrade, 2000), and intrusions often contain mental images related to the experienced traumatic event (James et al., 2016). Furthermore, visual imagery has been associated with different psychopathologies, for example in depression lower visual imagery has been linked to a difficulty to imagine a future, while in addiction higher visual imagery has been linked to increased cravings (Pearson, 2019). It is thus plausible that there may also be a link between visual imagery and trauma intrusions.

A paper written by Kosslyn (2005) surmises that visual imagery relates to the severity of PTSD symptoms. This relation was speculated as that either higher and more vivid visual imagery creates a predisposition for more life-like and stressful intrusions, or that PTSD intrusions affect visual imagery. The first was speculated that individuals with higher visual imagery would imagine the traumatic event more often. Therefore, increasing stress levels. The latter was deduced as that as that long-term memory improves after repeated exposure, and repeated intrusions would therefore improve memory, and additionally create more intrusions triggers as a result of associative learning. Lastly, the paper concluded that it would most likely be more like a feedback loop, in which a predisposition increases the chance of developing intrusions, and intrusions become more frequent as a result of this predisposition. Though, the paper did not perform a study in order to provide evidence for these hypotheses.

Not a lot of research has been done to investigate the relationship between visual imagery and intrusions, and the results are mixed. Krans et al. (2011) investigated the relationship using the trauma film paradigm, the SUIS, and a diary to report both image- and thought-based intrusions. Evidence in support of a relationship between visual imagery and intrusions was found, however they found that higher visual imagery correlates with fewer image- and thought-based intrusions. Morina and colleagues (2013) used the trauma film paradigm to investigate the relationship between visual imagery and intrusions. They found that individuals with higher visual imagery reported a greater number, and more vivid intrusions. Intrusions were also more easily triggered in these individuals. Additionally, these individuals reported higher levels of distress. Yet, one study did not find any relation between visual imagery and intrusions (David & Clack, 1998, as cited in Marks et al., 2019).

More vivid and realistic intrusions have been linked to more severe PTSD symptoms (Michael et al., 2005), and there may be a relationship between visual imagery and more vivid, and more frequent intrusions (Morina et al., 2013). Baddeley & Andrade (2000) found that interference in the visuospatial working memory pertains to less vivid mental images. One way to lower both the vividness in visual imagery, and the vividness of intrusions are visuospatial tasks (Andrade et al., 1997).

Playing Tetris

One visuospatial task that can be used is the computer game Tetris. There is some support that playing Tetris may help to reduce intrusions. Holmes et al. (2009) used a trauma film to induce intrusions, then later exposed them to reminders of the trauma film later, followed by participants either playing Tetris or sitting quietly. Participants had to keep a diary for a week to report their intrusions. The participants that played Tetris reported fewer intrusions than the participants that sat quietly both directly after playing Tetris and during the week following the experiment. Memory of the trauma film was equivalent for both groups, suggesting that only intrusions were reduced and not memory as a whole.

More support can be found in the study by Badawi et al. (2020). They used a trauma film to induce intrusions, and had participants either play Tetris, perform the Corsi tapping task, or sit quietly. Participants kept a diary for a week and the participants that played Tetris reported the lowest number of intrusions, while participants in the Corsi tapping task and participants that sat quietly reported a comparable number of intrusions. Furthermore, James et al. (2015) had participants either play Tetris or sit quietly 24 hours after exposure to a trauma film. Before applying the experimental or control condition, no difference in the number of intrusions was reported, but afterwards participants that played Tetris reported fewer intrusions than the participants that sat quietly. A combination of a reminder and playing Tetris resulted in the lowest number of intrusions reported.

So, how is playing Tetris supposed to help reduce the number of intrusions? As disrupting the visuospatial sketchpad has showed to reduce the vividness of mental images (Baddelay & Andrade, 2000), it may also reduce the number of intrusions. Intrusions often contain visuospatial images about an experienced traumatic event (James et al., 2016; Holmes et al., 2009) and the brain has a limited ability to store information (Baddeley, 2003, as mentioned in Holmes et al., 2009). Thus, it is theorised that a visuospatial task may compete with visuospatial images during the process of memory consolidation (Holmes et al., 2009; James et al., 2016; Badawi et al., 2020), and therefore reduce the number of intrusions.

Hypotheses

To recapitulate, trauma intrusions can be induced in an experimental setting with help of the trauma film paradigm, and these intrusions are generally composed of mental images (James et al., 2016). In addition, visual imagery is the cognitive process that allows for the creation of sensory experiences within the mind and this process can range from non-existent to photorealistic between individuals (Pearson, 2019). Furthermore, disrupting the process of memory consolidation with a visual spatial task, namely Tetris, may reduce the number of intrusions experienced. Two research questions were formed: (1) “What is the relationship between visual imagery and number of intrusions?”, and (2) “Does visual imagery moderate the relationship between playing Tetris and number of intrusions?”.

Two studies were used in order to explore and seek answers to these research questions. Both studies followed an experimental design. Study 1 compared two different trauma films, assessed visual imagery, and used a diary to measure intrusions. Study 2 used a trauma film, the same visual imagery assessment as study 1, a diary to measure intrusions, however participants were either randomly assigned to the playing Tetris condition or the vigilance control condition. Two hypotheses are tested: (1) “higher visual imagery relates to more intrusions”, and (2) “playing Tetris in combination with higher visual imagery relates to fewer intrusions”. Study 2 was set up as a close replication of the study of Holmes et al., (2009), therefore the relationship between playing Tetris and number of intrusions will also be explored.

Method

The thesis contains data obtained from two large studies. In this method section aspects from both studies will be discussed. A full description of the methods used in these studies can be found in their respective preregistration (Study 1; Study 2). The first study is an exploratory study using two different trauma films. The second study is a replication of the Holmes et al. (2009) study. Both studies follow an experimental design with participants randomly assigned to either one condition.

Participants

Participants study 1

A total of 169 psychology students were recruited for the study. After screening 147 participants were eligible for participation, 86 from the University of Groningen, the Netherlands and 61 from Saarland University, Germany. Of the 86 participants, 34 males, 51 females, and 1 non-binary were admitted in the study with ages ranging between 18 and 33 (*m* = 20,5, *SD* = 2,8). Most participant are of Dutch (*n* = 27) or German (*n* = 23) nationality. Participants were randomly allocated to either watch the old (*n* = 43) or new film (*n* = 43).

Participants study 2

Before screening, a total of 78 participants were recruited at the University of Groningen, the Netherlands. After screening, 59 eligible participants were admitted into the study, of which 43 females and 16 males. The ages range between 18 and 26 years old (*m* = 20,2, *SD* = 1,8), with Dutch (*n* = 39) being the most common nationality. Participants were randomly allocated to either the experimental condition (*n* = 29) or the control condition (*n* = 30).

Materials

Both study 1 and study 2 incorporate similar materials. For study 2 the only the additional materials and tasks are mentioned.

Materials study 1

Eligibility screening. Participant screening contained two questionnaires. The Quick Inventory of Depressive Symptoms (QIDS-SR) includes 16 self-report items (Rush et al., 2003). The QIDS-SR measures depressive symptoms within the past 7 days and is scored on a 4-point scale with 0 “absence of symptoms”, and 3 “severe symptoms”. Participants can score between 0 and 27. A cut-off score of 11 was set, and scores of 11 or lower were considered eligible. To assess post-traumatic reactions The Trauma Screening Questionnaire (TSQ; Brewin et al., 2002) was included. Participants had to indicate if they experienced a certain traumatic reaction in the past week with 0 on an item meaning not experienced and 1 had experienced that traumatic reaction. Participants could score between 0 and 10, with a cut-off score of 6 for eligibility.

Pre- and post-film mood rating (VAS). Participants had to indicate to what extent they felt sad, hopeless, fearful, horrified, anxious, and depressed on six separate slider scales before and after watching the trauma film. There ratings adapted from James et al. (2015). Scales ranged between 0 = “not at all” to 100 = “extremely”.

Trauma film. The trauma films are both approximately 12 minutes and contain footage of blood, physical and sexual violence or injury, and death. Both films start with a black screen, followed by the instruction to watch on full screen. Then after each scene, a black screen is displayed for 6 seconds. An adapted version of the instructions given by James et al. (2015) was used, highlighting the importance of watching the scenes as a bystander and to fully immerse themself in watching.

The first trauma film was also used by Holmes et al. (2009) and contains scenes of motor vehicle accidents, drowning, medical procedures, an animal attack, and the aftermath of the genocide in Rwanda. The other film used is a newer film and contains footage of interpersonal violence, for instance a stabbing, and accidents/disasters, for instance a motor vehicle accident. Both films contain real and acted footage.

Film ratings. Three questions about the film were asked in which participants had to rate how distressing they found the film, how much attention they paid to the film, and to indicate to what extent they closed their eyes or looked away during the film. Slider scales were used with 0 = “not at all”, to 100 = “extremely /total attention/ the whole film”.

Music task. The music task (James et al., 2015) was used as a filler after watching the trauma film. Participants were asked to listen to 15 excerpts of classical music while wearing headphones. After each excerpt participants had to indicate how pleasant they found the music on a 9-point scale, ranging from 1 = “extremely unpleasant” to 9 = “extremely pleasant”. The program JATOS (Lange et al., 2015) was used to execute the task.

Reminder task. Participants were exposed to images of the trauma film. One picture of each scene was presented for three seconds in the same order as in the trauma film. All images were created of the least graphic material of the scenes. An adapted version of the instructions used by James et al. (2015) were given and accentuate the importance of immersing themself into viewing the pictures.

Sitting quietly task. Participants had to sit quiet for ten minutes and report any experienced intrusions. Verbal instruction were given (adjusted version: Holmes et al., 2009, and James et al., 2015), and later summarised on their computer screen. Image-based intrusions were explained as “taking the form of pictures in the mind’s eye”, and thought-based intrusions were explained as taking the form of “words and phrases” (James et al.

2015). After the instructions, a black screen appeared for ten minutes. To report an intrusion, participants had to press the F-key for any image-based intrusion, or J-key if they experienced a thought-based intrusion. The JATOS program (Lange et al., 2015) was used for the task.

Involuntary Memory Diary. The diary (adjusted version: James et al., 2015) is a word file that participants download onto their own system, and includes instructions, tables to tally experienced intrusions, and an area to note the content of the experienced intrusions. To tally intrusions, shorthand was used, with I for image, T for thought, and IT if it was a combination. Verbal instructions were also given after participants downloaded the diary. A daily email was sent at 8 am to remind participant to fill in the diary.

Diary compliance. Diary compliance was assessed using three slider scales questions and one open ended question, with the first two questions obtained from James et al. (2015): 1. "*To what extent is the following true: I have been unable (or have forgotten) to record my unpleasant thoughts and images in the diary.*" (0 = *not at all true of me* - 100 = *extremely true*), 2. *"Please indicate how accurately you think you completed the diary"* (0 = *not at all accurate* - 100 = *completely accurate*). 3. *"To what extent did the daily email trigger intrusions of the film?"* (0 = *not at all* - 100 = *extremely*). 4. *"Do you have any suggestions or comments regarding the diary?"*

Spontaneous Use of Imagery Scale. The Spontaneous Use of Imagery Scale (SUIS) includes 12 items to measure visual imagery (Reisberg et al., 2003). Each item describes a situation and specific action and participants were asked to indicate if this action is appropriate for them, for example "I prefer to read novels that lead me easily to visualize where the characters are and what they are doing instead of novels that are difficult to visualize." Each item was answered on a 5-point scale, with 5 = "always appropriate", 3 = "half of the time", and 1 = "never appropriate". Total scores range between 12 and 60. Higher scores indicate a higher level of visual imagery ($\alpha = .715$).

Materials study 2

For study 2 the sitting quietly task was replaced with either the playing Tetris task or the Vigilance control task.

Tetris. Tetris (special research version, Tetris Company Inc., 2021) was the experimental condition for the study and an adjusted version for research purposes was used. The aim is to rotate the blocks falling down to form a complete horizontal line. Upon completion of a horizontal line, the line disappears and points are granted. The level of difficulty increases after a total of ten lines were completed by boosting the speed of the blocks falling down, with the highest being level 5. If the screen is completely filled with uncomplete rows, the top 10 rows disappear to ensure that the participant can continue playing. A preview of the next three blocks was displayed on the top right side next to the playing field. Participants were instructed to focus on the blocks in the preview, and create a plan within their minds eye. The task was set for 10 minutes of playing time with no sound.

Vigilance task. An adjusted version of the Perceptual Vigilance Task (Wilkinson & Houghton, 1982) is used as the control condition. The task starts with a black screen and when a red circle appears participants had to press the space bar on their keyboard as fast as possible. The red circle appeared in random intervals once every 30 seconds. This task takes 10 minutes.

Retrospective ratings. After completion of one of the conditions, participants were asked two questions about the task. The first question called ‘intrusions’ was “How often did mental images of the film spontaneously pop into your mind while playing the game / during the task you just did you?”. A scale with 0 = “not at all”, and 100 = “the whole time” was presented to participants to indicate their experience. The second question ‘difficulty’ was “How difficult or easy did you find the game you just played / the task you just did?”. The question was answered on a scale with 0 = “not difficult at all/easy” and 100 = “extremely difficult/hard”.

Procedure

The procedure was similar for both studies and includes three online Google Meet sessions, with minor differences in sessions 2 and 3. A script was used for the study to ensure equal treatment of participants. In session 1 participants received detailed information, both spoken and written, about the study after which informed consent was asked. After consent was given, participants were screened for eligibility using the QIDS_SR and the TSQ. Not eligible participants were excluded from the study, and eligible participants proceeded with session 2.

Session 2 followed immediately after session 1. In study 2 participants started with a 3-minute Tetris practice. Then, in both studies participants received instructions for the trauma film, and in study 1 participants were randomly assigned to one of the trauma films. Before and after the trauma film the VAS was given. After watching the trauma film and filling out the VAS, participants completed the music filler task. In study 1, participants first did the sitting quietly task before the reminder task, while in study 2 participants directly do the reminder task. At this point in study 2 participants were randomly assigned to either the experimental condition or the control condition, and are given the appropriate instructions. After completion of the tasks, participants were provided with the retrospective rating scales. Then in both studies, participants received instructions on how to fill out the diary, and the diary was given.

Session 3 took place one week after the completion of session 1 and 2. Between session 2 and 3 participants completed the diary. In the beginning of the session, participants were asked to fill out the SUIS and the diary compliance questions, and a range of questionnaires unrelated to the thesis. Next, participants emailed the completed diary to us. In study 1 participants carried out a 3-minute Tetris practice, while in study 2 participants carried out the Corsi task. Lastly, participants were debriefed, and a participant experience questionnaire was administered.

Data Analysis

A Priori Analysis Study 1

The study is part of an international project spanning over 3 sites. An a-priori power analysis with a power of 80%, and a one-tailed alpha of .01 had been calculated, yielding a sample size of 76 participants per condition, thus a total sample size of 152.

A Priori Analysis Study 2

The study is part of an international project spanning over 6 sites. An a-priori power analysis with a power of 95% and a one-tailed $\alpha = .0167$ yielded a minimum of 72 participants per site with a total sample size of 432. This should be adequate to find a Cohen's $d = .36$. The data in this thesis does not contain all 72 participants recruited as there was a time limitation, and data preparation had started when some participants still had to complete session 3.

Data Preparation

Both studies contain quantitive data processed in SPSS (IBM Corp, version 27). In study 1 data was already anonymised and descriptives were provided for demographics. For study 2 data was anonymised by replacing participant number with random ID codes. The random ID codes were generated online. After replacing the participants numbers descriptives were calculated for demographics, and then demographics were removed from the dataset. Diaries were also anonymised by replacing the participant numbers with the random ID codes, and personal information was blacked out. Intrusions from the diary were counted and an interrater-reliability assessment was performed. Then these scores were merged into the SPSS file.

In both studies a logbook to note any irregularities was kept. An exclusions criteria code was created containing no-shows, drop-outs, not eligible, incomplete or missing diary, session 3 after day 7, and no consent given. The datasets were checked for any missing values. A sum variable for SUIS scores was created for both study 1 and study 2 data. Lastly, the datasets were inspected for outliers based on the 1.5*IQR rule.

Hypotheses Testing

In order to test the first hypothesis a linear regression model on image-based intrusions predicted by total SUIS scores was created. First, data from both study 1 and 2 were examined to confirm that assumptions were met. The histograms and scatterplots can be found in Appendix A. As data does not meet the criteria for linear regression with the outliers included, analysis with and without outliers were executed. Then, the regression models were inspected based on an $\alpha = .05$. Several more regression models were created, controlled for the film ratings and diary compliance.

To test the second hypothesis only the data from study 2 was used. Correlations between total SUIS scores and image-based intrusions were calculated for the different conditions. Then these correlations were compared to each other in order to check for a difference between conditions.

Exploratory Analysis

Exploratory analysis was performed on total intrusions and predicted by visual imagery, as Krans et al. (2011) found a relationship between visual imagery and thought-based intrusions. Several regression models were created, using the data from both study 1 and 2, corrected for film ratings and diary compliance.

To examine if the replication of Holmes et al. (2009) was successful and if similar results were found in study 2, a *t*-test was performed on the mean scores of image-based intrusions for each condition. A similar *t*-test was performed on the mean scores of total intrusions for each condition to explore if there is for an overall difference in intrusions per condition.

Results

Preliminary Analysis Study 1

A total of 916 intrusion were reported, of which 257 were thought-based, and 653 image-based, before removal of outliers. After removal of the outliers 71 thought-based intrusions, 375 image-based intrusions, and a total of 585 intrusions were included in the analysis. Descriptive statistics for SUIS total scores, the different intrusions scores, film rating scores, and diary compliance scores can be found in table 1.

Preliminary Analysis Study 2

A total of 297 intrusions were reported, with 58 thought-based intrusions, and 239 image-based intrusions, before removal of the outliers. After removal of the outliers a total of 209 intrusions were included in the analysis, of which 50 were thought-based, and 155 were image-based intrusions. Descriptives for SUIS total scores, the different intrusions scores, film rating scores, and diary compliance scores can be found in table 2.

Table 1

Mean, SD, Median, and range for Visual Imagery, intrusions, film rating, and diary compliance in Study 1

Variable	N	Mean	Standard Deviation	Median	Minimum	Maximum
SUIS Total	131 *(147)**	38.7 *(39.9)*	6.0 *(7.2)*	40 *(40)*	16 *(16)*	54 *(54)*
Intrusions Thought	127 *(147)*	0.6 (1.8)	0.9 *(3.9)*	0 *(0)*	0 *(0)*	4 *(30)*
Intrusions Image	133 *(147)*	2.8 *(4.4)*	2.5 *(6.8)*	2 *(3)*	0 *(0)*	9 *(48)*
Intrusions Total	131 *(147)*	4.2 *(6.2)*	3.6 *(9.6)*	4 *(4)*	0 *(0)*	14 *(63)*
Film rating:						
Distress	147	49.6	23.8	49	0	100
Attention	147	93.8	8.4	96	50	100
Eyes closed	147	7.5	14.7	3	0	99
Diary Compliance:						
Unable/Forgot	147	9.3	16.4	1	0	90
Accuracy	147	83.9	15.0	86	2	100
Reminders	147	23.6	27.7	11	0	99

Note: * Statistics for mean, SD, Median, and range before removal of outliers.

Table 2

Mean, SD, median, and range for Visual Imagery, intrusions, film rating, and diary compliance in Study 2

Variable	N	Mean	Standard Deviation	Median	Minimum	Maximum
SUIS Total	59	39.5	7.6	41	23	53
Intrusions Thought	54 *(59)**	0.9 *(0.9)*	1.4 *(1.5)*	0 *(0)*	0 *(0)*	4 *(7)*
Intrusions Image	54 *(59)*	2.7 *(3.7)*	2.6 *(4.3)*	2 *(2)*	0 *(0)*	10 *(18)*
Intrusions Total	54 *(59)*	3.6 *(4.7)*	3.2 *(4.8)*	3 *(4)*	0 *(0)*	14 *(18)*
Film rating:						
Distress	59	56.9	22.0	60	7	92
Attention	59	94.8	7.6	97	64	100
Eyes closed	59	6.8	9.8	2	0	51
Diary Compliance:						
Unable/Forgot	59	11.2	17.3	6	0	100
Accuracy	59	84.7	10.6	86	60	100
Reminders	59	22.0	25.3	11	0	80

Note: * sample size, mean, SD, median, and range before removal of outliers.

Relationship between Visual Imagery and Intrusions

To test hypothesis 1 “higher visual imagery relates to more intrusions” a regression analysis was performed on the data from study 1 with image-based intrusions as the outcome variable and visual imagery as the predictor. The regression model was nonsignificant, $\beta = 0.03$, $R^2 = .00$, $F(1, 116) = 0.54$, $p = .464$. The regression model is illustrated in figure 1. Regression analysis on the data with the outliers included was also nonsignificant, $\beta = 0.04$, $R^2 = .00$, $F(1, 140) = 0.21$, $p = .648$.

Several linear regression models on image-based intrusions predicted by visual imagery were created, corrected for film rating scores. The film rating scores were individually added to the regression model. None of the regression models were significant;

Corrected for distress R^2 = .04, F(2, 115) =2.55, p = .082; Corrected for attention R^2 = .01, F(2, 115) = 0.31, p = .732; Corrected for eyes closed R^2 = .01, F(2, 115) = 0.36, p = .698. The complete regression models can be found in table B1 in Appendix B.

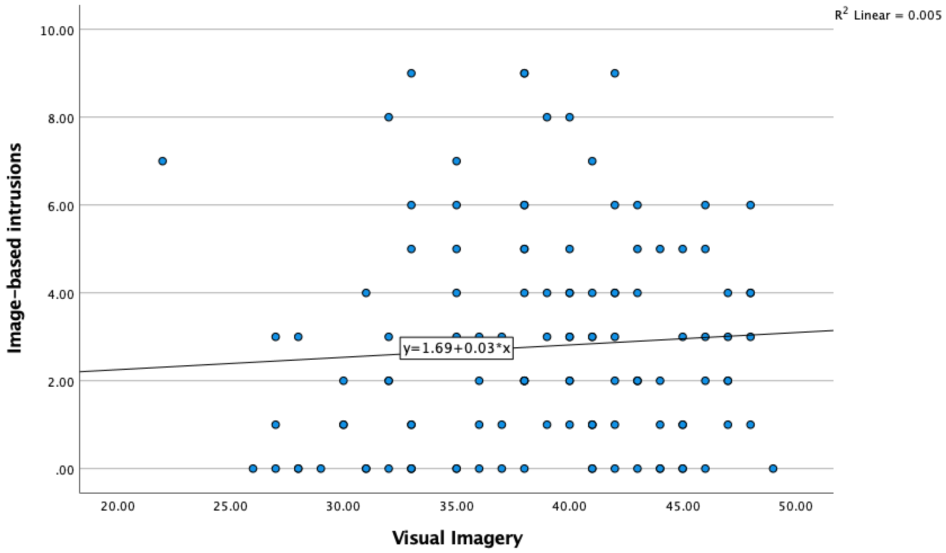
The regression model between visual imagery and image-based intrusions was also corrected for diary compliance scores in the same manner. The regression models corrected for unable/forgot, R^2 = .06, F(2, 115) =3.77, p = .026, and daily reminders are significant, R^2 = .42, F(2,115) = 2.49, p < .001. However, in neither model was visual imagery a significant predictor. The model corrected for accuracy is nonsignificant, R^2 = .04 F(2, 115) = 2.41, p = .095. The complete regression models can be found in table B2 in Appendix B. The regression models corrected for film ratings and diary compliance including the outliers can be found in tables C1 and C2 in Appendix C.

The same regression analyses were performed on the data from study 2. The regression model of visual imagery on image-based intrusions was not significant, β = 0.16, R^2 = .03, F(1, 53) = 1.67, p = .201. The full regression model is illustrated in figure 2. Regression analysis on the data including outliers was also not significant, β = 0.13, *R2* = .02, F(1, 60) = 0.96, p = .332.

The regression model corrected for distress is significant, R^2 = .16, F(2, 52) = 5.03, p = .010. However, only distress is a significant predictor in the model. The other models corrected for the film rating scores for attention, R^2 = .03, F(2, 52) = 0.91, p = .410, and eyes closed, R^2 = .05, F(2, 52) = 1.29, p = .284 are nonsignificant. All models corrected for film rating can be found in table B3 in Appendix B. No significant differences were found in the models including the outliers. The models corrected for film ratings including outliers can be found in table C3 in Appendix C.

Figure 1

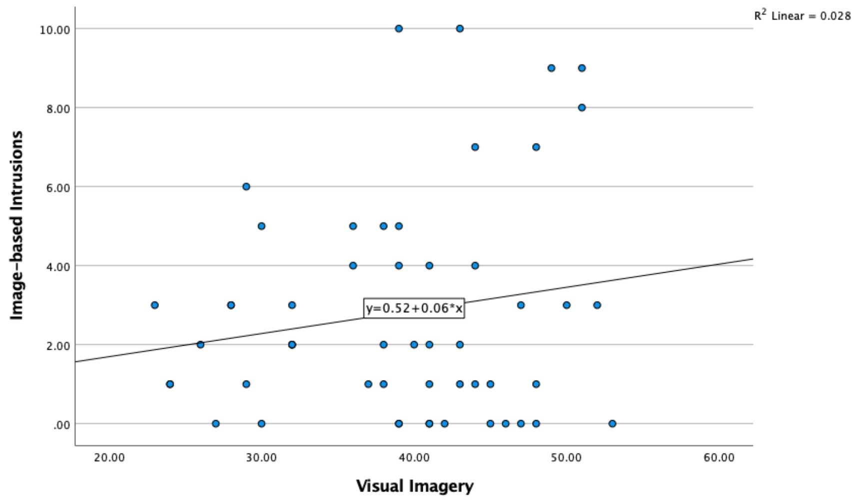
Linear regression of visual imagery on image-based regression study 1



Note. Outliers excluded.

Figure 2

Linear regression of visual imagery on image-based intrusions study 2



Note. Outliers excluded.

The models corrected for the diary compliance scores are only significant for accuracy (R^2 = .17, $F(2, 52)$ = 5.44, p = .007), and daily reminders (R^2 = .32, $F(2, 52)$ = 12.21, p < .001), however visual imagery is not a significant predictor in both models. The model corrected for unable/forgot is nonsignificant, R^2 = .21, $F(2, 52)$ = 1.22, p = .301. The full regression models for diary compliance scores can be found in table B4 in Appendix B. These results are based on the analysis excluding outliers. Results for regression models corrected for diary compliance with outliers included can be found in table C4 in Appendix C.

Exploratory Analysis Visual Imagery on Total Intrusions

A regression analysis on total intrusions with visual imagery as the predictor, using the data from study 1, was performed and no significant effect was found, β = 0.03, R^2 = .00, $F(1, 120)$ = 0.14, p = .709. Similar results were found in the analysis including outliers, β = 0.02, R^2 = .00, $F(1, 145)$ = 0.07, p = .789. None of the models corrected for film rating scores were significant (distress: R^2 = .04, $F(2, 119)$ = 2.57, p = .081; attention: R^2 = .00, $F(2, 119)$ = 0.17, p = .842; eyes closed: R^2 = .02, $F(2, 119)$ = 0.89, p = .412). The full models can be found in table B5 in Appendix B. All models corrected for diary compliance were significant (unable/forgot: R^2 = .07, $F(2, 119)$ = 4.59, p = .012; accuracy: R^2 = .09, $F(2, 119)$ = 5,79, p = .004; daily reminder: R^2 = .23, $F(2, 119)$ = 17.89, p < .001), and can be found in table B6 in Appendix B. Visual imagery did not significantly predict total intrusions. The models including outliers did not differ, and can be found in tables C5 and C6 in Appendix C.

These regression models were also created on the data from study 2. The regression of visual imagery on total intrusions was not significant, β = 0.19, R^2 = .03, $F(1, 53)$ = 1.92, p = .171. Regression analysis including the outliers did not also yield a significant result, β = 0.08, R^2 = 0.01, $F(1, 60)$ = 0.38, p = .539.

Out of the models corrected for film rating scores, the model corrected for distress was significant (R^2 = .21, *F*(2, 52) = 6.88, *p* = .002), with both visual imagery and distress as significant predictors. The models corrected for attention (R^2 = .26, *F*(2, 52) =1.94, *p* = .155) and eyes closed (R^2 = .05, *F*(2, 52) = 2.47, *p* = .094) were nonsignificant. The models corrected for film rating scores can be found in table B7 Appendix B. Two significant models were found when corrected for diary compliance (accuracy: R^2 = .14, *F*(2, 52) = 4.14, *p* = .022; daily reminders: R^2 = .21, *F*(2,52) = 7.02, *p* = .002), but visual imagery was not a significant predictor in either model. The model corrected for unable/forgot is nonsignificant, R^2 = .06, *F*(2, 52) = 1.67, *p* = .199. The corrected models for diary compliance can be found in table B8 in Appendix B. All models corrected for film ratings and diary compliance including outliers can be found in tables C7 and C8 Appendix C.

Relationship between Playing Tetris, Visual Imagery and Intrusions

First, the relationship between playing Tetris versus control condition was investigated. A *t*-test on the mean score of image-based intrusions in the Tetris condition (*M* = 2.6, *SD* = 2.6) and the control condition (*M* = 3.0, *SD* = 2.9) was performed, and no significant difference between the means was found, *t*(53) = -0.59, *p* = .278. The analysis was also executed on the data including outliers, and no significant difference between the mean scores (m_{tetris} = 3.5, m_{control} = 4.2, SD_{tetris} = 4.1, SD_{control} = 4.7) was found, *t*(60) = -0.67, *p* = .253.

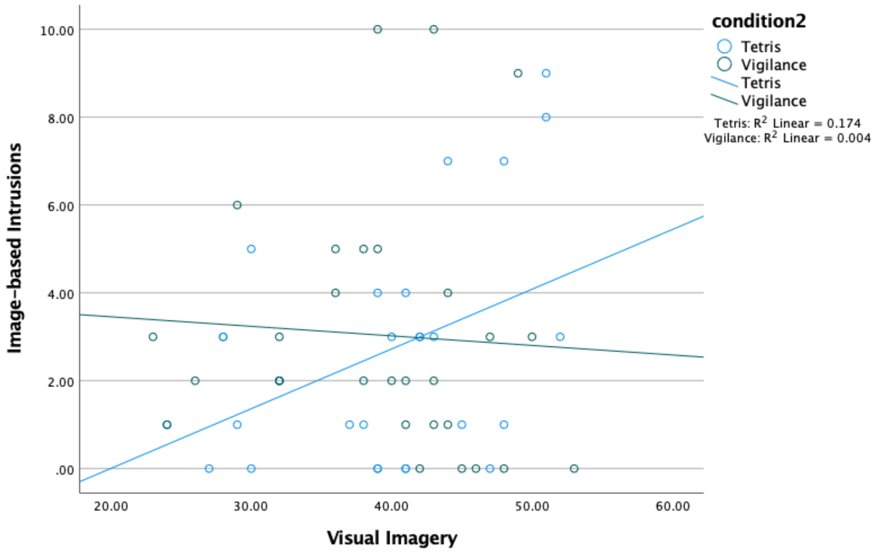
Then, to check if visual imagery moderates the relationship correlations between visual imagery and image-based intrusions per condition were calculated and compared. In the Tetris group a correlation of *r*(25) = .44, *p* = .021 was found, and in the Vigilance control group a correlation of *r*(26) = -.06, *p* = .758 was found. Analysis with outliers included showed a *r*(28) = .32, *p* = .089 in the Tetris group, and *r*(30) = -.05, *p* = .808 in the Vigilance group. The fisher r-to-z transformation did not show a significant interaction effect for both outliers excluded and included (excluded: $z = 1.91$, $p = .028$; included: $z = 1.39$, $p = .082$). The interaction excluding outliers is illustrated in figure 3.

Exploratory analysis was performed to investigate if there was a difference between means scores of total intrusions of the Tetris condition ($M = 3.6$, $SD = 3.6$) and the control condition ($M = 3.9$, $SD = 3.5$). No significant difference between the means was found, $t(53) = -0.34$, $p = .369$. Similar results were found when comparing the mean scores of total intrusions ($m_{tetris} = 4.1$, $m_{control} = 5.4$, $SD_{tetris} = 4.2$, $SD_{control} = 5.2$) when outliers were included, $t(60) = -1.11$, $p = .272$.

Lastly, an interaction effect was investigated between total intrusions and visual imagery, per condition. Correlations were calculated for the Tetris group between visual imagery and total intrusions, $r(26) = .51$, $p = .006$, and for the Vigilance control group between visual imagery and total intrusions, $r(25) = -.16$, $p = .423$. Correlations were also calculated with the outliers included, in the Tetris group $r(28) = .32$, $p = .088$, and in the control group $r(30) = -.11$, $p = .539$. A fisher r-to-z- transformation was performed, and the interaction for the outliers excluded was significant, $z = 2.51$, $p = .006$, but for the outliers included nonsignificant, $z = 1.65$, $p = .05$

Figure 3

Interaction between visual imagery and image-based intrusions per condition



Discussion

Contrary to expectations, no relationship between visual imagery, playing Tetris, and image-based intrusions was found. Both studies did not find evidence to support the first hypothesis that higher visual imagery is related to more intrusions. Some regression models corrected for film watching, and diary compliance did show a significant relationship, however visual imagery was not a significant predictor in any of the models. On the other hand, exploratory analysis on data from study 2 did show a relationship between visual imagery and total intrusions when controlled for how distressing participants found the trauma film. Study 2 did not find evidence to support the second hypothesis that playing Tetris in combination with higher visual imagery is related to fewer intrusions. However, exploratory analysis did show a significant interaction between total intrusions and visual imagery when comparing the Tetris group to the Vigilance control group. Additionally, no difference was found between the mean intrusions in the Tetris group compared to the mean intrusions in the Vigilance group.

Preceding Empirical Findings

Not much research had been done to investigate the relationship between visual imagery and intrusions, and findings from these studies were mixed. Contrary to our findings, Morina et al. (2013) found that more vivid visual imagery is related to more frequent image-based intrusions, and higher levels of distress. Our results are more in line with the study performed by David & Clack (1998, as cited in Marks et al., 2019), whom also found no evidence in support of this claim. We did, however, find a relation between visual imagery and total intrusions when correcting for how distressing the film was perceived. Considering that total intrusions are a combination of image- and thought-based intrusions, this is slightly surprising. This could simply be the result of the large sum of analysis performed. On the other hand, Krans et al. (2011) found a relation between visual imagery and both image- and thought-based intrusions. Nevertheless, at this point no sufficient evidence was found to support the hypothesis that there is a relation between visual imagery and number of intrusions.

Opposing results were found in our replication of the Holmes et al. (2009) study. As Holmes et al. (2009) found evidence for a relation between playing Tetris and fewer intrusions, we did not find any evidence in support of this relation. Our findings are more in line with those of Brennen et al. (2021) and James et al. (2016b), as they also did not find any evidence for a relation between Tetris and number of intrusions. However, multiple studies did find evidence for a relation between Tetris and fewer intrusions (James et al., 2015; Badawi et al., 2020; Hagenaar et al., 2017). Remarkably, most of the studies mentioned (e.g., James et al., 2015, 2016b; Hagenaar et al., 2017; Brennen et al., 2021) were performed by researchers that were also involved in the Holmes et al. (2009) study.

So why did our replication not find similar results? There are a few possible explanations. It could be that there frankly is no relation between playing Tetris and fewer intrusions, however, this explanation would be too crass. Especially considering that there are more studies that did find a relation (Holmes et al., 2009; James et al., 2015, Badawi et al., 2020; Hagenaar et al., 2017) than studies that did not (Brennen et al., 2021; James et al., 2016b). Yet, this could suggest that here might be a publication bias. A publication bias means that studies that find statistical significance are more likely to be published than the studies that did not find any significance (Francis, 2012). Another possibility is that the trauma film used was not sufficient in inducing intrusions, as some participants indicated that they did not find the film stressful.

It was speculated that visuospatial working memory is a critical aspect in memory consolidation, and that playing Tetris, therefore, would result in fewer intrusions (Holmes et al., 2009; Badawi et al., 2020). The visuospatial working memory was also linked to visual imagery (Pearson, 2019), and consequently, in our thesis it was hypothesised that visual imagery would moderate the relation between playing Tetris and intrusions, in that higher visual imagery in combination with Tetris would pertain to fewer intrusions. No evidence was found in support of visual imagery moderating the relation between Tetris and image-based intrusions; however, a significant result was found when analysing the difference in correlations between visual imagery and total intrusions, per condition. This may be by chance, as a large number of analyses were performed. It could be because of the small sample size, and small number of image-based intrusions reported, or there is indeed a relation between visual imagery and thought-based intrusions. Regardless, as there are no other studies to have investigated this relation, further research is necessary to elucidate.

Theoretical and Practical Implications

There are several implications of the findings. Firstly, visual imagery has been linked to other psychopathologies (Pearson, 2019), and Kosslyn (2005) surmised that visual imagery may increase the chance of developing intrusions and PTSD, and that higher visual imagery may increase the number of intrusions and therefore maintaining more severe PTSD symptoms. However, there are only a few studies that have investigated a relation between visual imagery and intrusions, and these results are mixed (Marks et al., 2019). Our study provides further insight into the topic, even though our findings lack evidence in support of a relation between visual imagery and intrusions.

Next, our replication of Holmes et al., (2009) provides a broadening of the research field into the relation between Tetris and number of intrusions, as we did not find evidence in support of this relation. Additionally, our study was executed independent from researchers involved in most of the studies (James, et al., 2015, 2016b; Hagenaar et al., 2017; Brennen et al., 2021), resulting in a widening of researchers involved in the topic. Furthermore, our replication study was carefully documented in a preregistration on Open Science Framework (OSF; https://osf.io/64fuw?view_only=6796c6c34bfb4000bce06a6951bec758), therefore accommodating opportunities for more precise replications. As the study is part of a larger international project, it also provides more insight about possible differences or similarities between individuals with different cultural backgrounds. It also provides more insight into underlying characteristics that may play a role into the effectiveness of playing Tetris by the inclusion of visual imagery measurements.

Limitations

It is important to note that there are also some limitations with our studies. Both studies were carried out online, ergo the possibility of control over the environment of the participant was limited. It is unknown whether participants were distracted by either their phones, background noises or a possible roommate walking in. Less control over the surroundings also caused differences in the overall environment of the participant, for example some rooms were darker than others, and tasks were performed on different style laptops/computers.

Another limitation is that our sample may have a limited ability for generalisation. Our sample solely comprise of university students, taking into account that these are all young individuals enrolled obtaining a higher level of education, this sample is not as representative for the general population. Furthermore, as per request of the ethical committee, during the recruitment of participants extensive warning was given about the stressful nature of the study, which may have resulted in a selective sample that overall is not as sensitive to stressful scenes, and thus are less prone to developing intrusions.

Lastly, a possible limitation may be the use of the SUIS (Reisberg et al., 2003) to assess visual imagery considering it only assesses the frequency of spontaneous visual imagery use (Nelis et al., 2014). Seeing that the level of vividness of visual imagery has been associated with more vivid intrusions (Morina et al., 2013), and that more vivid intrusions have been linked to more severe PTSD symptoms (Michael et al., 2005), while visuospatial tasks have shown to reduce both the vividness of visual imagery and intrusions (Andrade et al., 1997), a visual imagery assessment that also takes vividness, and not just the frequency, into account may provide more insight into the relation between visual imagery, intrusions, and Tetris.

Future Research

As research into the relation between visual imagery and intrusions is few and showed mixed results (Marks et al., 2019), more research is necessary to explore if, and of what nature this relation might be. As mentioned, the SUIS (Reisberg et al., 2003) may have been a limitation in our study, ergo a different assessment may be more suitable. The Questionnaire upon Mental Imagery (QMI; Sheehan, 1967, as cited in Nelis et al., 2014), for example, might provide more insight as it not only takes into account the frequency of visual image use but also assesses the vividness.

Regarding the significant results found on the relation between visual imagery, distress and total number of intrusions, and the interaction between visual imagery and total number of intrusions in the Tetris group compared to the Vigilance control group, more research is necessary. At this point, it is not clear if these results were found as a consequence of the large number of analyses performed, and future studies may shed some light on these findings.

Future research may benefit from performing the study in a laboratory setting. This way there will be control over any distracting variables, for example cell phones or background noise, while also ensuring that circumstances will be similar for each participant, for example how dark the room is during the trauma film. Lastly, as our sample comprised of university students, using a broader sample may improve the generalisability of the study.

Conclusions

In the thesis it was hypothesised that higher visual imagery is related to more intrusions, however no evidence to support this hypothesis was found. As previous research is scarce, and the results are mixed (Marks et al., 2019), no definitive conclusions can be drawn, but our findings do contribute to literature. Furthermore, our replication of Holmes et al., (2009) did not provide similar results as our study did not show that playing Tetris is related to fewer intrusions. Yet, these results are important in the search for an intervention that can be applied quickly, and is easily accessible. As our study was performed independent from some of the leading researchers in this topic (Holmes et al., 2009; James et al., 2015), and our study was preregistered, it will help improve further research into the topic. Lastly, we hypothesised that higher visual imagery in combination with playing Tetris is related to fewer intrusions. Our study did not find sufficient evidence in support of that hypothesis. No significant moderation between visual imagery, image-based intrusions, and playing Tetris was found, however a moderation was found when using total intrusions. As there is no previous research investigating this moderation, and a large number of analyses were performed, further research is necessary to investigate if there is, and if so, what the nature of the relation is.

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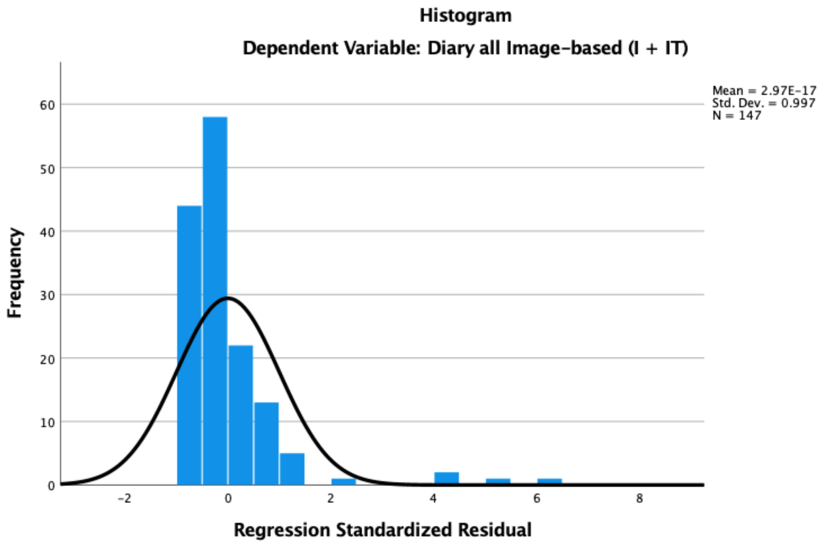
Appendix A

Linear regression assumptions

Figure A1.

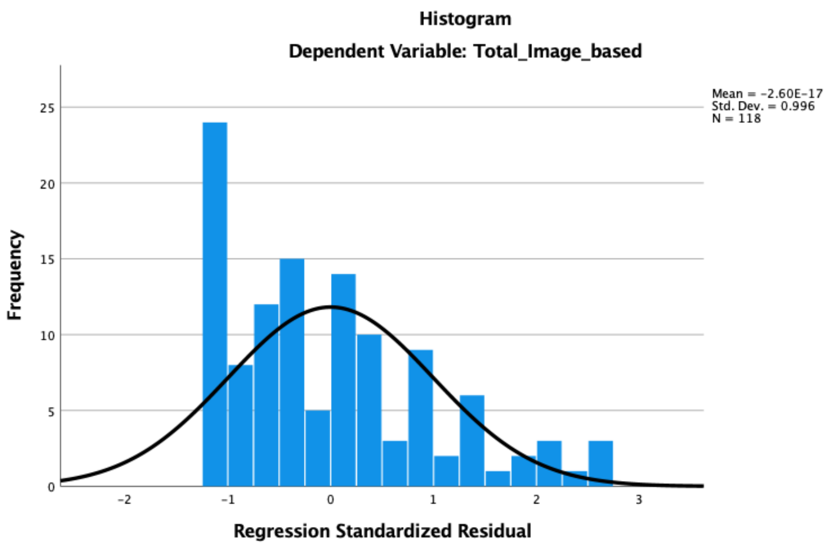
Histogram of image-based intrusions study 1



Note. Check for normal distribution in study 1 sample with outliers included.

Figure A2.

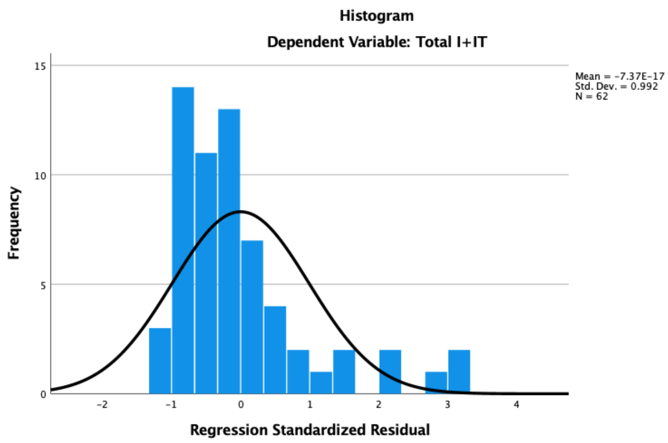
Histogram of image-based intrusions study 1



Note. Check for normal distribution in study 1 sample with outliers excluded.

Figure A3.

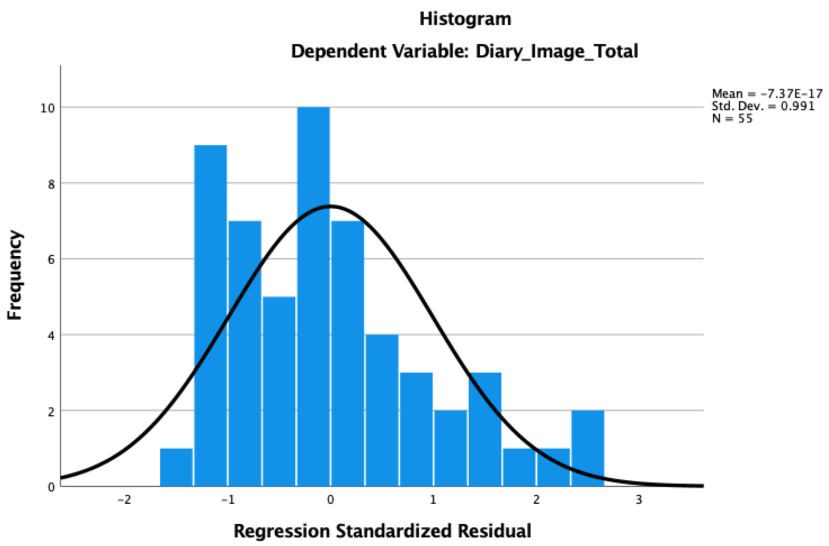
Histogram of image-based intrusions study 2



Note: Check for normal distribution for image-based intrusions in study 2 sample with outliers included.

Figure A4.

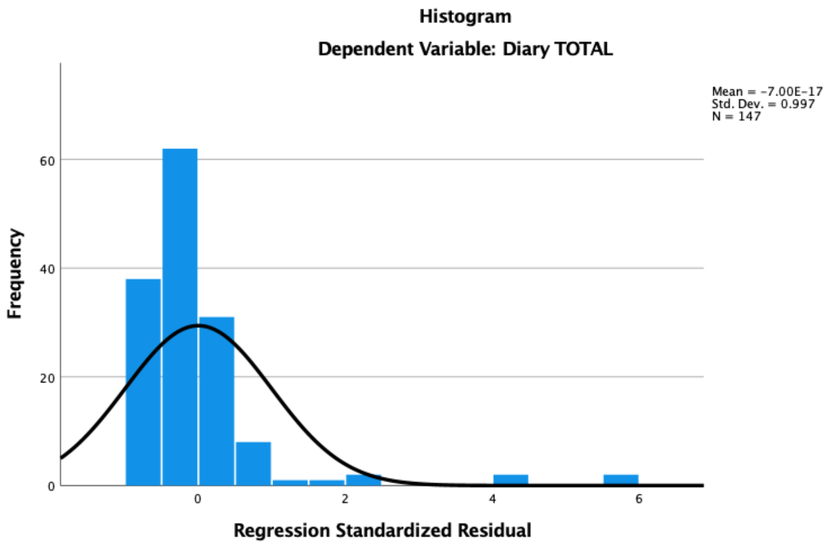
Histogram image-based intrusions study 2



Note. Check for normal distribution image-based intrusions in study 2 sample with outliers excluded

Figure A5.

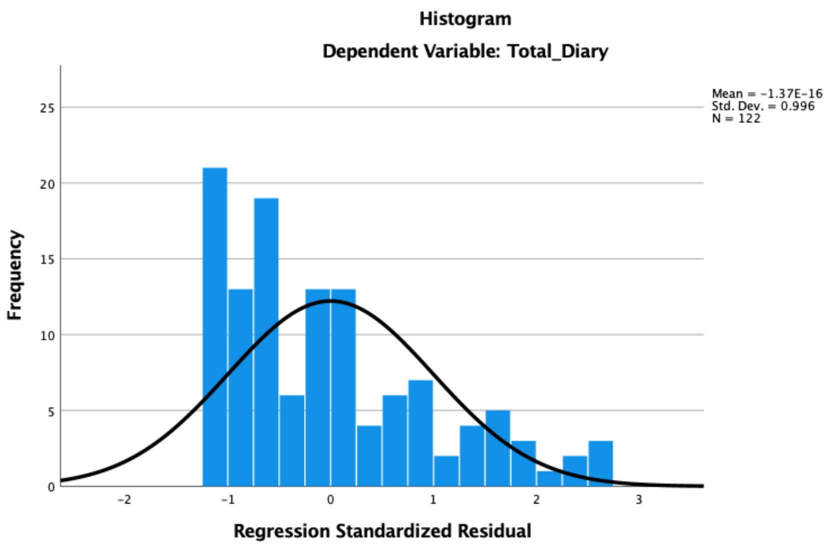
Histogram total intrusions study 1



Note. Check for normal distribution total intrusions in study 1 sample with outliers excluded.

Figure A6.

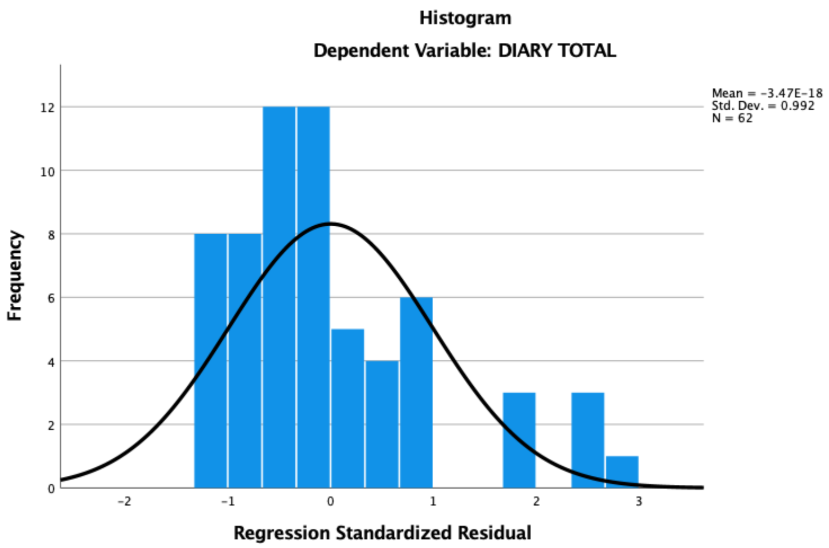
Histogram total intrusions study 1



Note. Check for normal distribution total intrusions in study 1 sample with outliers excluded.

Figure A7.

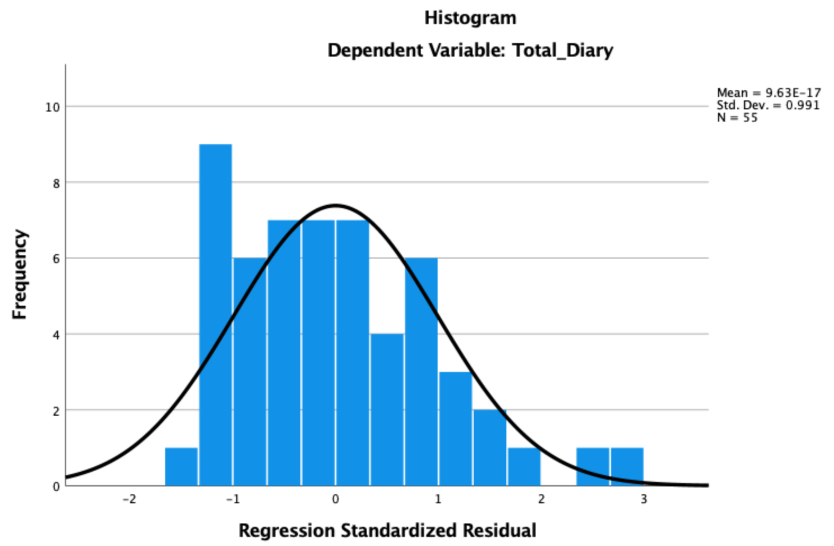
Histogram total intrusions study 2



Note: Check for normal distribution total diary intrusions in study 2 sample with outliers included.

Figure A8.

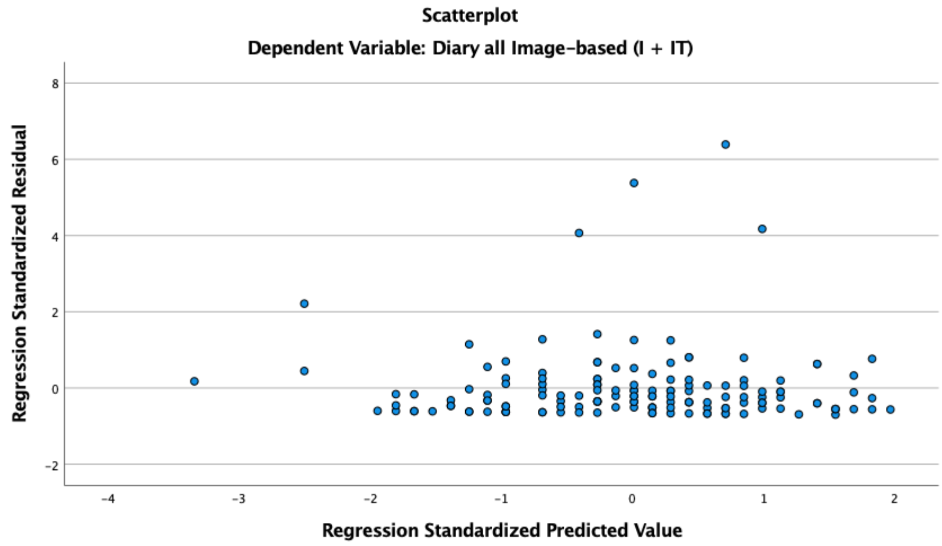
Histogram total intrusions study 2



Note: Check for normal distribution total diary intrusions in study 2 sample with outliers excluded

Figure A9.

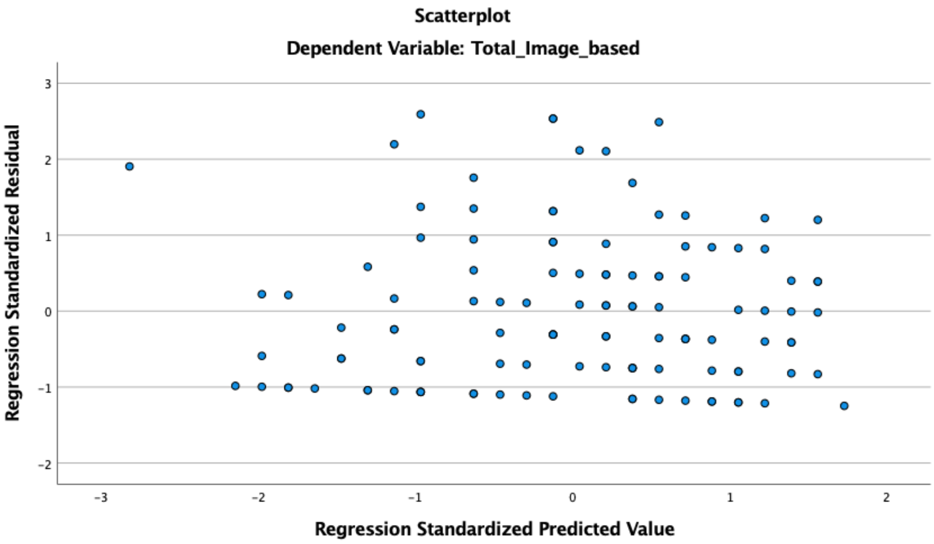
Scatterplot image-based intrusions study 1



Note. Check for homoscedasticity image-based intrusions in study 1 sample with outliers included.

Figure A10.

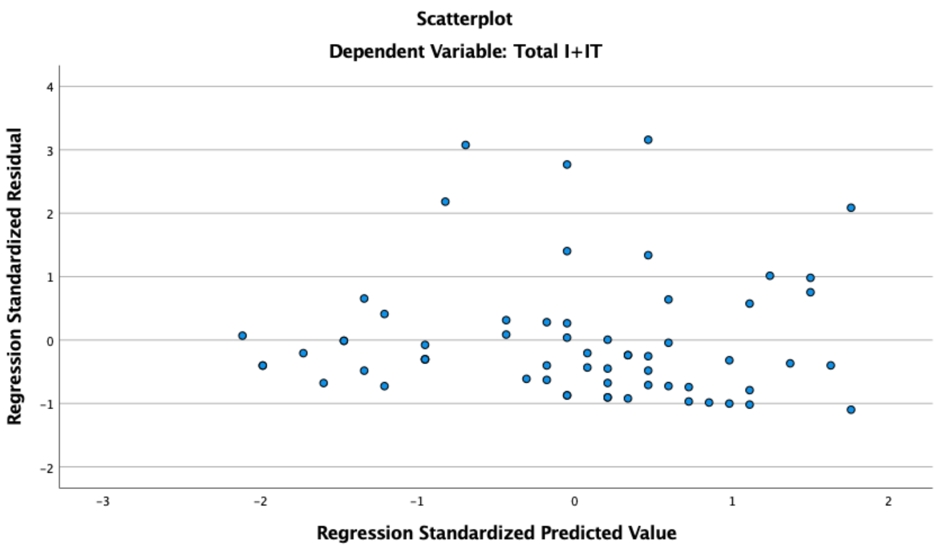
Scatterplot image-based intrusions study 1



Note. Check for homoscedasticity image-based intrusions in study 1 sample with outliers excluded.

Figure A11.

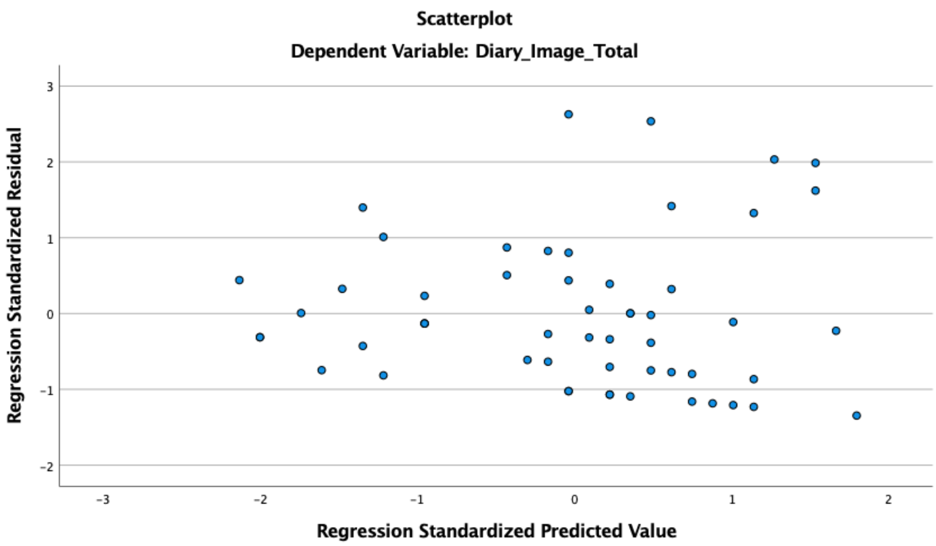
Scatterplot image-based intrusions study 2



Note: check for homoscedasticity image-based intrusions in study 2 sample with outliers included.

Figure A12.

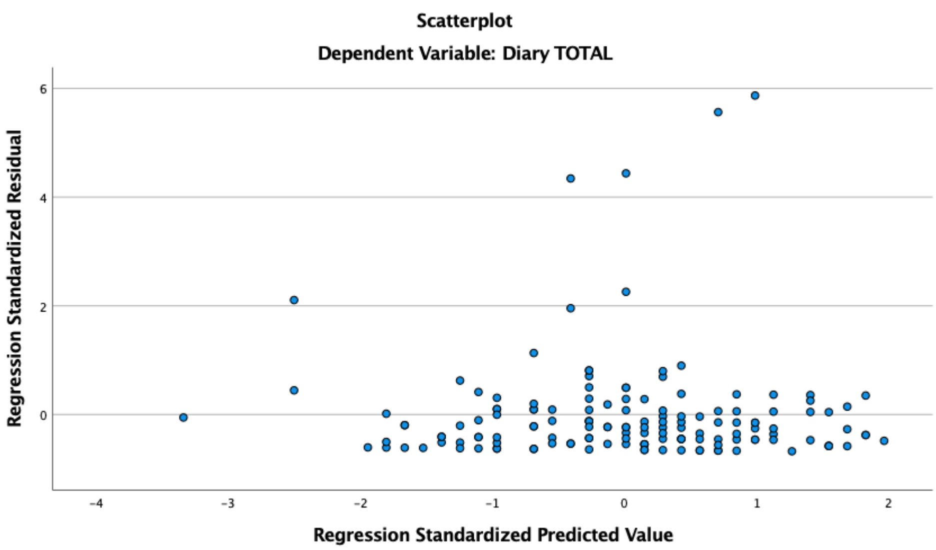
Scatterplot image-based intrusions study 2



Note. Check for homoscedasticity image-based intrusions in study 2 sample with outliers excluded.

Figure A13.

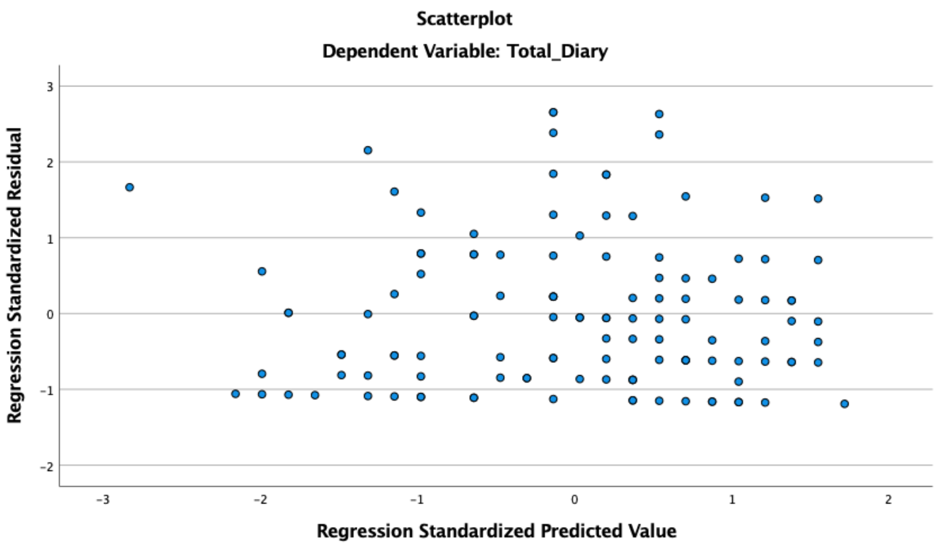
Scatterplot total intrusions study 1



Note: check for homoscedasticity total intrusions in study 1 sample with outliers included.

Figure A14.

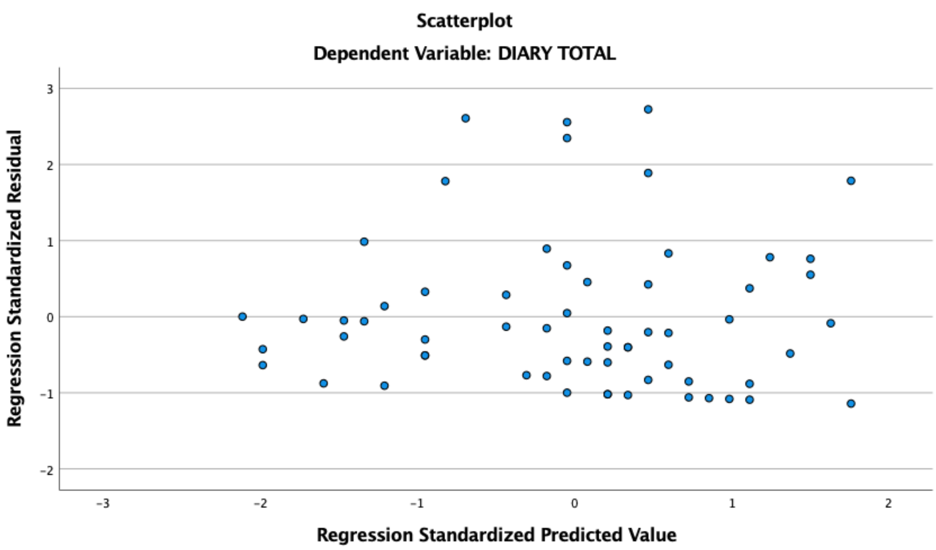
Scatterplot total intrusions study 1



Note: check for homoscedasticity total intrusions in study 1 sample with outliers excluded.

Figure A15.

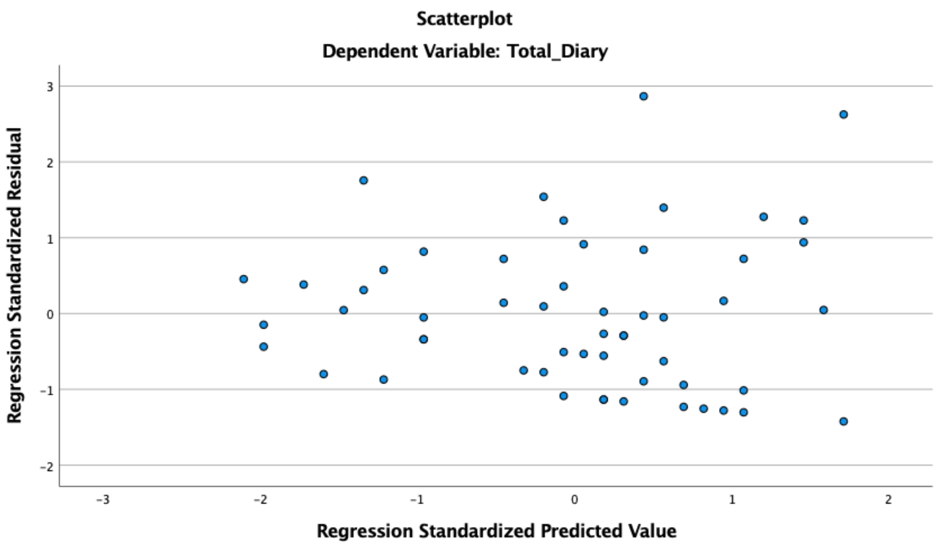
Scatterplot total intrusions study 2



Note: check for homoscedasticity total intrusions in study 2 sample with outliers included.

Figure A16.

Scatterplot total intrusions study 2



Note. Check for homoscedasticity total diary in study 2 sample with outliers excluded.

Appendix B

Regression tables

Table B1.

Linear regression tables image-based intrusions corrected for film-rating

Model	β	*t*	*p*
Intercept		0.22	.824
Visual Imagery	0.09	0.94	.352
Distress	0.19	2.13	.035

Model	β	*t*	*p*
Intercept		0.328	.743
Visual Imagery	0.07	0.74	.461
Attention	0.03	2.29	.766

Model	β	*t*	*p*
Intercept		1.04	.301
Visual Imagery	0.07	0.77	.445
Eyes closed	0.04	0.43	.667

Note. Regression tables for study 1 excluding outliers for the different film rating scores

Table B2.

Linear regression tables image-based intrusions corrected for diary compliance

Model	β	*t*	*p*
Intercept		0.81	.421
Visual Imagery	0.08	0.88	.384
Unable/Forgot	0.24	2.64	.009

Model	β	*t*	*p*
Intercept		2.16	.033
Visual Imagery	0.08	0.08	.392
Accuracy	-0.19	-2.063	.041

Model	β	*t*	*p*
Intercept		0.73	.469
Visual Imagery	0.06	0.71	.481
Reminders	0.42	4.93	<.001

Note. Regression tables for study 1 sample excluding the outliers for the different diary compliance scores.

Table B3.

Linear regression models image-based intrusions, corrected for film rating

Model	β	*t*	*p*
Intercept		-1.53	.132
Visual Imagery	0.26	1.97	.053
Distress	0.37	2.86	.006

Model	β	*t*	*p*
Intercept		0.44	.661
Visual Imagery	0.17	1.27	.208
Attention	-0.06	-0.41	.686

Model	β	*t*	*p*
Intercept		0.27	.786
Visual Imagery	0.14	1.02	.311
Eyes closed	0.13	0.95	.345

Note. Regression tables for study 2 sample excluding outliers for the different film rating scores.

Table B4.

Linear regression models for image-based intrusions, corrected for diary compliance

Model	β	*t*	*p*
Intercept		0.23	.817
Visual Imagery	0.18	1.34	.187
Unable/Forgot	-0.23	-0.89	.378

Model	β	*t*	*p*
Intercept		2.561	.013

Visual Imagery	0.22	0.22	.085
Accuracy	-0.38	-0.38	.004

Model	β	*t*	*p*
Intercept	0	0.02	.986
Visual Imagery	0.10	0.89	.374
Reminder	0.54	4.69	<.001

Note. Regression tables for image-based intrusions on study 2 sample excluding outliers for the different diary compliance scores

Table B5.

Linear regression models for total intrusions, corrected for film rating

Model	β	*t*	*p*
Intercept		0.59	.553
Visual Imagery	0.05	0.05	.589
Distress	0.20	.201	.027

Model	β	*t*	*p*
Intercept		1.17	.244
Visual Imagery	0.03	0.35	.724
Attention	-0.04	-0.45	.651

Model	β	*t*	*p*
Intercept		1.33	.186
Visual Imagery	0.04	0.45	.652
Eyes closed	0.12	1.28	.202

Note. Linear regression for total intrusions on study 1 sample excluding outliers for different film rating scores

Table B6.

Linear regression models for total intrusions, corrected for diary compliance

Model	β	*t*	*p*
Intercept		1.20	.232
Visual Imagery	0.04	0.49	.623
Unable/Forgot	0.27	0.27	.003

Model	β	*t*	*p*
Intercept		3.31	.001
Visual Imagery	0.04	0.51	.614
Accuracy	-0.29	-3.38	<.001

Model	β	*t*	*p*
Intercept		1.28	.205
Visual Imagery	0.01	0.11	.911
Reminder	0.48	0.48	<.001

Note. Linear regression for total intrusions on study 1 sample excluding outliers for different diary compliance scores

Table B7.

Linear regression models for total intrusions, corrected for film rating

Model	β	*t*	*p*
Intercept		-1.72	.091
Visual Imagery	0.26	2.09	.041
Distress	0.424	0.42	.001

Model	β	*t*	*p*
Intercept		1.37	.178
Visual Imagery	0.16	1.18	.242
Attention	-0.19	-0.19	.173

Model	β	*t*	*p*
Intercept		0.52	.608
Visual Imagery	0.11	0.80	.425
Eyes closed	0.24	1.72	0.091

Note. Linear regression on total intrusions on study 2 sample excluding outliers for different film rating scores

Table B8.

Linear regression models for total intrusions, corrected for diary compliance

Model	β	*t*	*p*
Intercept		0.32	.751
Visual Imagery	0.19	1.43	.159
Unable/Forgot	-0.16	-1.18	0.243

Model	β	*t*	*p*
Intercept		2.196	.033
Visual Imagery	0.23	1.74	.088
Accuracy	-0.32	-2.48	0.016

Model	β	*t*	*p*
Intercept		0.02	.984
Visual Imagery	0.14	1.15	.257
Reminder	0.42	3.42	0.001

Note. Linear regression on total intrusions on study 2 sample excluding outliers for different diary compliance scores.

Appendix C

Results including outliers

Table C1.

Linear regression tables image-based intrusions corrected for film-rating

Model[a]	β	*t*	*p*
Intercept		0.37	.714
Visual Imagery	0.04	0.50	.618
Distress	0.11	1.33	.185

Model[b]	β	*t*	*p*
Intercept		1.733	.085
Visual Imagery	0.03	0.396	.693
Attention	-0.12	-1.403	.163

Model[c]	β	*t*	*p*
Intercept		0.83	.411
Visual Imagery	0.04	0.43	.671
Eyes closed	0.14	0.14	.097

Note. Regression tables for study 1 including outliers for the different film rating scores.

[a] Model with $F(2, 144) = 0.95$, $p = .390$

[b]Model with $F(2, 144) = 1.04$, $p = .355$

[c]Model with $F(2, 144) = 1.45$, $p = .237$

Table C2.

Linear regression tables image-based intrusions corrected for diary compliance

Model[a]	β	*t*	*p*
Intercept		0.61	.543
Visual Imagery	0.04	0.51	.613
Unable/Forgot	0.26	3.23	.002

Model[b]	β	*t*	*p*
Intercept		2.48	.014
Visual Imagery	0.04	0.47	.641

Accuracy	-0.20	-2.48	.014

Model[c]	β	*t*	*p*
Intercept		0.61	.545
Visual Imagery	0.02	0.26	.795
Reminders	0.31	3.96	<.001

Note. Regression tables for study 1 sample including the outliers for the different diary compliance scores.

[a] Model with $F(2, 144) = 5.27$, $p = .006$

[b] Model with $F(2, 144) = 3.13$, $p = .047$

[c] Model with $F(2, 144) = 7.90$, $p < .001$

Table C3.

Linear regression models image-based intrusions, corrected for film rating

Model[a]	β	*t*	*p*
Intercept		-1.21	.1230
Visual Imagery	0.19	1.54	.130
Distress	0.32	2.63	.011

Model[b]	β	*t*	*p*
Intercept		0.58	.564
Visual Imagery	0.12	0.92	.360
Attention	-0.06	-0.48	.633

Model[c]	β	*t*	*p*
Intercept		0.49	.627
Visual Imagery	0.08	0.64	.522
Eyes closed	0.17	1.32	.191

Note. Regression tables for study 2 sample including outliers for the different film rating scores.

[a] Model with $F(2, 59) = 3.97$, $p = .024$

[b] Model with $F(2, 59) = 0.59$, $p = .559$

[c] Model with $F(2, 59) = 7.90$, $p = .265$

Table C4.

Linear regression models for image-based intrusions, corrected for diary compliance

Model[a]	β	*t*	*p*
Intercept		0.39	.692
Visual Imagery	0.13	1.02	.313
Unable/Forgot	-0.09	-0.66	.514

Model[b]	β	*t*	*p*
Intercept		2.47	.017
Visual Imagery	0.16	1.33	.189
Accuracy	-0.36	-2.73	.008

Model[c]	β	*t*	*p*
Intercept		0.23	.822
Visual Imagery	0.09	0.73	.470
Reminder	0.31	2.51	.015

Note. Regression tables for image-based intrusions on study 2 sample including outliers for the different diary compliance scores

[a] Model with $F(2, 59) = 0.69$, $p = .506$

[b]Model with $F(2, 59) = 4.26$, $p = .019$

[c]Model with $F(2, 59) = 3.68$, $p = .031$

Table C5.

Linear regression models for total intrusions, corrected for film rating

Model[a]	β	*t*	*p*
Intercept		0.52	.603
Visual Imagery	0.03	0.39	.692
Distress	0.09	1.10	.273

Model[b]	β	*t*	*p*
Intercept		1.32	.190
Visual Imagery	0.03	0.30	.764
Attention	-0.08	-0.91	.367

Model[c]	β	*t*	*p*
Intercept		0.94	.349

Visual Imagery	0.03	0.33	.744
Eyes closed	0.10	1.22	.224

Note. Linear regression for total intrusions on study 1 sample including outliers for different film rating scores.

[a] Model with $F(2, 144) = 0.64$, $p = .529$

[b]Model with $F(2, 144) = 0.45$, $p = .642$

[c]Model with $F(2, 144) = 0.78$, $p = .460$

Table C6.

Linear regression models for total intrusions, corrected for diary compliance

Model[a]	β	*t*	*p*
Intercept		0.69	.488
Visual Imagery	0.03	0.42	.677
Unable/Forgot	0.24	3.02	.003

Model[b]	β	*t*	*p*
Intercept		2.46	.015
Visual Imagery	0.03	0.39	.700
Accuracy	-0.19	-2.38	.019

Model[c]	β	*t*	*p*
Intercept		0.65	.518
Visual Imagery	0.01	0.18	.859
Reminder	0.33	4.18	<.001

Note. Linear regression for total intrusions on study 1 sample including outliers for different diary compliance scores

[a] Model with $F(2, 144) = 4.59$, $p = .012$

[b]Model with $F(2, 144) = 2.88$, $p = .060$

[c]Model with $F(2, 144) = 8.76$, $p < .001$

Table C7.

Linear regression models for total intrusions, corrected for film rating

Model[a]	β	*t*	*p*
Intercept		-0.82	.414

Visual Imagery	0.15	1.19	.237
Distress	0.34	2.76	.008

Model[b]	β	*t*	*p*
Intercept		0.57	.596
Visual Imagery	0.08	0.586	.560
Attention	-0.03	-0.26	.799

Model[c]	β	*t*	*p*
Intercept		0.99	.328
Visual Imagery	0.05	0.38	.704
Eyes closed	0.12	0.92	0.361

Note. Linear regression on total intrusions on study 2 sample including outliers for different film rating scores

[a] Model with $F(2, 59) = 4.02$, $p = .023$

[b]Model with $F(2, 59) = 0.22$, $p = .803$

[c]Model with $F(2, 59) = 0.61$, $p = .545$

Table C8.

Linear regression models for total intrusions, corrected for diary compliance

Model[a]	β	*t*	*p*
Intercept		0.94	.450
Visual Imagery	0.09	0.67	.507
Unable/Forgot	-0.09	-0.74	.462

Model[b]	β	*t*	*p*
Intercept		3.03	.004
Visual Imagery	0.12	0.99	.326
Accuracy	-0.38	-3.67	.004

Model[c]	β	*t*	*p*
Intercept		0.78	.437
Visual Imagery	0.04	0.32	.749
Reminder	0.35	2.86	.006

Note. Linear regression on total intrusions on study 2 sample including outliers for different diary compliance scores.

[a] Model with $F(2, 59) = 0.46$, $p = .632$

[b] Model with $F(2, 59) = 4.76$, $p = .012$

[c] Model with $F(2, 59) = 4.29$, $p = .018$