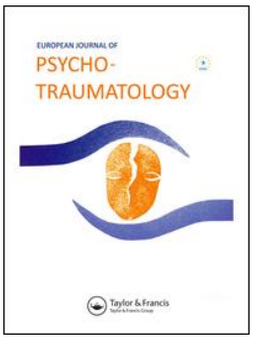

European Journal of Psychotraumatology

ISSN: 2000-8066 (Online) Journal homepage: www.tandfonline.com/journals/zept20

# Methods to induce dissociation and their effects on intrusions and memory: a randomized controlled trauma-film study

Sarah K. Danböck, Sabrina E. Hettegger, Laila K. Franke, Katharina Hillemeyer, Michael Liedlgruber, Stephan F. Miedl, Georg W. Alpers & Frank H. Wilhelm

**To cite this article:** Sarah K. Danböck, Sabrina E. Hettegger, Laila K. Franke, Katharina Hillemeyer, Michael Liedlgruber, Stephan F. Miedl, Georg W. Alpers & Frank H. Wilhelm (2025) Methods to induce dissociation and their effects on intrusions and memory: a randomized controlled trauma-film study, European Journal of Psychotraumatology, 16:1, 2563482, DOI: 10.1080/20008066.2025.2563482

**To link to this article:** https://doi.org/10.1080/20008066.2025.2563482

EUROPEAN JOURNAL OF PSYCHOTRAUMATOLOGY
2025, VOL. 16, NO. 1, 2563482
https://doi.org/10.1080/20008066.2025.2563482

BASIC RESEARCH ARTICLE

OPEN ACCESS Check for updates

# Methods to induce dissociation and their effects on intrusions and memory: a randomized controlled trauma-film study

Sarah K. Danböck [a,b], Sabrina E. Hettegger [b], Laila K. Franke [b], Katharina Hillemeyer[b], Michael Liedlgruber [b], Stephan F. Miedl [b], Georg W. Alpers [a,c] and Frank H. Wilhelm [b]

[a]Department of Psychology, University of Mannheim, Mannheim, Germany; [b]Department of Psychology, Paris-Lodron-University Salzburg, Salzburg, Austria; [c]Otto Selz Institute, University of Mannheim, Mannheim, Germany

## ABSTRACT

**Background:** Peritraumatic dissociation is thought to contribute to posttraumatic symptoms like intrusions and memory disturbances. However, trauma-analogue studies that examined effects of experimental dissociation-induction on intrusions and memory were inconclusive. To better understand this, a necessary first step is to more systematically compare various induction methods.

**Objective:** We evaluate different dissociation-induction-methods regarding their effectiveness, the intensity and quality of induced dissociation, and their effects on intrusions and memory in a pre-registered randomised-controlled online experiment.

**Method:** Healthy participants ($N = 213$) were randomised to one of six dissociation-induction-methods: audio-photic stimulation, hypnotic-suggestion, or spiral-staring, each for one-minute or three-minute duration. Participants also completed two further conditions: a non-dissociation-inducing picture task (control condition) and the comparison dissociation-induction-method dot-staring (benchmark condition). Each condition was followed by an aversive ('trauma') film. Peri-film dissociation intensity (measured using an adapted version of the Peritraumatic Dissociative Experiences Questionnaire) and quality, as well as film-specific intrusion-load and memory performance, were assessed. Dissociation-induction-methods were deemed successful if they elicited dissociation levels higher than the control condition and at least as high as the benchmark condition. Only successful dissociation-induction-methods were examined further.

**Results:** Three minutes of hypnotic-suggestion and one minute of spiral-staring successfully induced dissociation during the film, while other methods did not meet the effectiveness threshold. Hypnotic-suggestion led to a greater increase in dissociation intensity than spiral-staring, dissociation induced by spiral-staring was perceived as more uncontrollable and unpleasant. Results did not support an adverse effect of dissociation-induction or dissociation intensity on intrusion-load, but they did support an adverse effect on self-reported and objectively assessed memory performance.

**Conclusions:** Results indicate that hypnotic-suggestion and spiral-staring constitute effective, easy-to-implement, and in principle, neuroimaging-compatible dissociation-induction-methods that allow studying dissociation in the laboratory. The present data did not support the notion that dissociation fosters intrusion formation but provides causal support for effects of dissociation on trauma memory.

## ARTICLE HISTORY

Received 31 January 2025
Revised 11 September 2025
Accepted 12 September 2025

## KEYWORDS

Dissociation; experimental induction; symptom provocation; trauma-film; episodic memory; memory fragmentation; cued recall; re-experiencing; posttraumatic stress disorder

## PALABRAS CLAVE

Disociación; inducción experimental; provocación de síntomas; película de trauma; memoria episódica; fragmentación de la memoria; recuerdos con señales; intrusión; reexperimentación; trastorno de estrés postraumático

## HIGHLIGHTS

- Hypnotic-suggestion and spiral-staring are valuable tools to induce dissociation.
- Dissociation does not necessarily increase intrusive re-experiencing of distressing events.
- Experimentally induced dissociation impairs self-reported and objectively assessed memory performance.

## Métodos para inducir la disociación y sus efectos en las intrusiones y la memoria: un estudio aleatorizado controlado con películas de trauma

**Antecedentes:** Se cree que la disociación peritraumática contribuye a los síntomas postraumáticos como las intrusiones y las alteraciones de la memoria. Sin embargo, los estudios análogos al trauma que examinaron los efectos de la inducción de la disociación experimental sobre las intrusiones y las memorias no fueron concluyentes. Para comprender mejor esto, un primer paso necesario es comparar de forma más sistemática diversos métodos de inducción.

**Objetivo:** Evaluamos diferentes métodos de inducción de disociación en relación con su efectividad, intensidad y calidad de la disociación inducida, y sus efectos en las intrusiones y la memoria en un experimento en línea controlado aleatorizado pre-registrado.

**Método:** Lo participantes sanos ($N = 213$) fueron asignados aleatoriamente a uno de seis métodos de inducción de disociación: estimulación audio-fótica, sugestión hipnótica, o mirada fija en espiral, cada una con una duración de uno o tres minutos. Los participantes también completaron dos condiciones adicionales: una tarea de imágenes que no inducia disociación (condición de control) y la comparación con el método de inducción de

**CONTACT** Sarah K. Danböck Sarah.Danboeck@uni-mannheim.de School of Social Sciences, University of Mannheim, L 13, 15–17 – Room 207, Mannheim 68161, Germany

Supplemental data for this article can be accessed online at https://doi.org/10.1080/20008066.2025.2563482.

disociación de fijación de puntos (condición de referencia). Cada condición fue seguida de una película aversiva ('trauma'). Se evaluaron la intensidad de la disociación durante la película (medida a través de una versión adaptada del Cuestionario de Experiencias Disociativas Peritraumáticas) y la calidad, como también la carga de intrusión especifica de la película y el rendimiento mnésico. Los métodos de inducción de disociación se consideraron eficaces si generaban niveles de disociación superiores a los de la condición de control y al menos tan altos como los de la condición de referencia. Solo se examinaron con más detalle los métodos de inducción de disociación eficaces.
**Resultados:** Tres minutos de sugestión hipnótica y un minuto de mirada fija en espiral indujeron con éxito la disociación durante la película, mientras que otros métodos no alcanzaron el umbral de eficacia. La sugestión hipnótica produjo un mayor aumento en la intensidad de la disociación que la mirada fija en espiral, la disociación inducida por esta última se percibió como más incontrolable y desagradable. Los resultados no respaldaron un efecto adverso de la inducción de la disociación ni de su intensidad sobre la carga de intrusión, pero si apoyaron un efecto adverso sobre el rendimiento mnésico auto-reportado y evaluados objetivamente.
**Conclusiones:** Los resultados indican que la sugestión hipnótica y la mirada fija en espiral son métodos de inducción de disociación efectivos, fáciles de implementar, y en principio, compatible con la neuroimagen, que permiten estudiar la disociación en el laboratorio. Los datos actuales no apoyan la noción de que la disociación fomente la formación de intrusiones, pero proporciona apoyo causal a los efectos de la disociación en la memoria traumática.

## 1. Introduction

Dissociation, e.g. feeling detached from oneself (depersonalisation) or from the environment (derealisation), is frequently experienced during and after traumatic experiences (Marmar et al., 1997; Vonderlin et al., 2018).[1] Theoretical models conceptualise trauma-related dissociation as part of an automatically activated, biologically grounded set of defense-responses to trauma and its reminders, which is accompanied by specific behavioural, physiological, and experiential alterations (Kozlowska et al., 2015; Schauer & Elbert, 2010). They further suggest that dissociation may temporarily alleviate negative emotions and physiological arousal (Schauer & Elbert, 2010), yet, in the long run, disrupt memory encoding, leading to fragmented trauma memories (Brewin & Holmes, 2003; Marmar et al., 1998). This fragmentation, in turn, may contribute to posttraumatic stress disorder (PTSD) symptoms such as involuntary recollections of the traumatic event (intrusions) and impaired intentional recall (memory disturbances) (Brewin & Holmes, 2003; Marmar et al., 1998). Meta-analyses of studies with trauma-survivors have provided evidence for a positive association between peritraumatic dissociation and PTSD symptoms (Breh & Seidler, 2007; Ozer et al., 2003). However, other work has highlighted methodological shortcomings of these studies, including the frequent reliance on retrospective self-reports collected weeks or even years after the traumatic event (Van der Hart et al., 2008; Lensvelt-Mulders et al., 2008).

Addressing some of these limitations, researchers have used aversive stimulation, such as aversive film-clips (Danböck et al., 2021, 2023; Holmes et al., 2004, 2006), painful stimulation (Danböck et al., 2023; Giesbrecht et al., 2008), or personal trauma reminders (Danböck et al., 2024; Sack et al., 2012) to induce dissociation in the laboratory and assess its relationship with other responses to aversive stimulation (e.g. intrusions, memory disturbances) in real time. However, findings have not converged, with studies reporting not only the hypothesised positive association between dissociation and intrusion formation (Danböck et al., 2021; Holmes et al., 2004; Kindt et al., 2005; Laposa & Rector, 2012; Regambal & Alden, 2009) but also no association (Holmes et al., 2004; Hagenaars et al., 2008; Kindt & Van Den Hout, 2003). Similarly, both a positive association (Kindt et al., 2005; Hagenaars et al., 2008; Kindt & Van Den Hout, 2003) and no association (Kindt et al., 2005; Kindt & Van Den Hout, 2003; Brewin & Mersaditabari, 2013) have been found between dissociation and memory disturbances.

While aversive stimulation allows studying the co-occurrence of dissociative and other responses to trauma and trauma reminders in a standardised way, this paradigm still precludes the examination of causal effects of dissociation, as aversive stimulation simultaneously elicits dissociative and other responses to trauma. Hence, to investigate causal effects of dissociation on intrusions and memory, other dissociation-induction-methods with less resemblance to trauma, like staring at a dot (Leonard et al., 1999; Lickel et al., 2008; Miller et al., 1994), staring at a rotating spiral (Lickel et al., 2008; Dorahy et al., 2016), staring in a mirror (Miller et al., 1994; Caputo, 2010; Shin et al., 2019), exposure to pulsed audio-photic stimulation, i.e. a ticking metronome sound combined with pulsing light (Leonard et al., 1999), and hypnotic-suggestion (Holmes et al., 2006; Hagenaars et al., 2008) have been developed (for an overview of available methods see also Danböck et al., 2025).

However, when some of these methods were used to study effects of dissociation on intrusions and memory, findings again were mixed: inducing dissociation using

spiral- or mirror-staring during an aversive audio-clip caused more distressing intrusions (Dorahy et al., 2016), while inducing dissociation via dot-staring (Holmes et al., 2004) or hypnotic-suggestion (Holmes et al., 2006; Hagenaars et al., 2008) during an aversive film did not affect intrusion formation. Interestingly, inducing dissociation via a divided attention task during an aversive film resulted in even fewer intrusions (Brewin & Saunders, 2001). Similarly, inducing dissociation via mirror-staring altered performance in subsequent neuropsychological memory tasks (Brewin & Mersaditabari, 2013; Brewin et al., 2013), whereas inducing dissociation via hypnotic-suggestion during an aversive film did not affect film memory (Hagenaars et al., 2008). Thus, evidence of prior studies employing various experimental dissociation-induction-methods is inconclusive. This might be due to the methodological heterogeneity of studies regarding the dissociation-induction-method, whether dissociation-induction was combined with a trauma-analog, the trauma-analog type, their timing (consecutive vs in parallel), and the employed intrusion and/or memory measures. However, the variability across studies in several of these aspects precludes definitive conclusions.

To address this, it is essential to systematically compare dissociation-induction-methods regarding their effects on dissociation, intrusions, and memory. While preliminary comparisons reported in previous studies yielded no differences in dissociation intensity between dot-staring, mirror-staring, and spiral-staring (Lickel et al., 2008; Miller et al., 1994; Dorahy et al., 2016), they suggest that audio-photic stimulation, a method that has so far not been used to study effects of dissociation on intrusions and memory, might induce higher dissociation intensity than dot-staring (Leonard et al., 1999). However, these comparisons were based on ratings of dissociation during the induction phases, which vary considerably across methods in terms of task characteristics (e.g. sensory modalities) and duration, limiting the interpretability of findings. Further, several studies on dissociation and intrusions/memory have also used hypnotic-suggestion as dissociation-induction-method (Holmes et al., 2006; Hagenaars et al., 2008), which has not yet been compared to other methods regarding evoked dissociation intensity. Finally, while at least some dissociation-induction-methods have been compared regarding dissociation intensity, no studies have yet compared dissociation-induction-methods in terms of the quality of induced dissociation or their effects on intrusions and memory.

### 1.1. The current study

This study systematically compares dissociation-induction-methods regarding their effects on dissociation intensity, quality, and subsequent intrusions and memory disturbances under standardised conditions. Dissociation was induced immediately before viewing an aversive film-clip ('trauma-film'), allowing us to assess differential effects on film-related intrusions and memory.

We selected dissociation-induction-methods based on our literature review published elsewhere (Danböck et al., 2025) that (1) are not assumed to primarily work via negative emotions or physiological arousal (unlike the methods involving aversive stimulation which elicit a broader range of trauma-related responses beyond dissociation),[2] (2) are, in principle, compatible with online and neuroimaging settings, (3) are easy to implement (i.e. only require a personal computer), and (4) take only a few minutes, enabling repeated-measures designs (e.g. in neuroimaging) and preventing loss of interest (e.g. in online settings). Based on these criteria, we selected audio-photic stimulation (Leonard et al., 1999), hypnotic-suggestion (Holmes et al., 2006; Hagenaars et al., 2008), and spiral-staring (Lickel et al., 2008; Dorahy et al., 2016). We examined one-minute and three-minute versions of all strategies to enhance comparability and determine the shortest possible method duration (essential for repeated-measurement designs). We compared the six dissociation-induction-methods to two further conditions: The first, a picture task, served as non-dissociation-inducing control condition. The second, dot-staring, was included as a benchmark condition as we expected the tested dissociation-induction-methods to be at least equally effective as this traditional and comparatively simple approach (Leonard et al., 1999; Lickel et al., 2008; Miller et al., 1994).[3]

In a randomised-controlled pre-registered online experiment, 213 participants completed three within-subject conditions: (1) dissociation-induction via one of the six dissociation-induction-methods (randomised across participants) followed by an aversive film, (2) a non-dissociation inducing picture task followed by another aversive film (control condition), and (3) dissociation-induction via dot-staring followed by another aversive film (benchmark condition). For each film, participants rated dissociation intensity and quality. Film-related intrusions, self-reported memory fragmentation, and objective memory performance were assessed at the end of the session.

As pre-registered, we examined (1) which dissociation-induction-methods successfully induced dissociation during film-viewing (i.e. elicit higher dissociation levels than the control condition and higher or equivalent levels compared to the benchmark condition), (2) differences between successful methods in the intensity and quality of induced dissociation, and (3) their effects on intrusion formation and self-reported and objectively-assessed memory performance. We also exploratively examined associations between self-reported dissociation intensity, intrusions, and memory performance. Guided by theoretical frameworks but

**Table 1.** Participant characteristics ($N = 213$).

| Variable | Descriptives |
|---|---|
| Sex | |
| Female, *n* (%) | 143 (67%) |
| Male, *n* (%) | 70 (33%) |
| Nonbinary, *n* (%) | 0 (0%) |
| Age, *M (SD)*, [range in sample] | 24.47 (7.60), [18–67] |
| Years of education, *M (SD)*, [range in sample] | 15.19 (2.47), [7–26][a] |
| Trait dissociation (FDS-20; 0–100), *M (SD)*, [range in sample] | 8.70 (8.02), [0–50] |
| Trait anxiety (STAI-T; 20–80), *M (SD)*, [range in sample] | 38.01 (9.45), [20–80] |
| Depression (ADS-L; 0–60), *M (SD)*, [range in sample] | 12.05 (8.20), [0–57] |

Note: Trait dissociation was assessed by the short version of the German Dissociative Experience Scale (FDS-20; Spitzer et al. 2004). Trait anxiety was assessed by the State-Trait-Anxiety Inventory (STAI-T; Spielberger et al., 1983). Past-week depressive symptoms were assessed with the adapted German version (ADS-L; Hautzinger & Bailer, 1993) of the Center for Epidemiological Studies Depression Scale (CES-D; Radloff, 1977). Values indicating non-clinical relevance are <13 for FDS-20 (Rodewald et al., 2006), ≤ 44 for STAI-T (Ercan et al., 2015) and ≤23 for the ADS-L (Hautzinger & Bailer, 1993).

[a]$N = 210$ due to three missing values.

acknowledging inconsistent prior findings, we tentatively hypothesised that dissociation-induction and higher dissociation intensity would be positively associated with intrusions and memory disturbances.

## 2. Methods

This study was pre-registered (https://doi.org/10.17605/OSF.IO/VWD78).

### 2.1. Participants

Data was collected until 216 individuals completed the study,[4] with a final sample of $N = 213$ after excluding three participants due to survey completion times <30 min (as per pre-registration). Inclusion criteria required participants to be at least 18 years old, fluent in German, and without current/past psychiatric or neurological disorders, current/past psychological, psychotherapeutic, or psychiatric treatment, current pregnancy, or epilepsy. Furthermore, only people who never suffered from severe physical or sexual violence and who confirmed currently feeling mentally strong could participate. Table 1 provides sample characteristics.

### 2.2. Randomisation

A 6(between-subject) × 3(within-subject) design was employed (see Figure 1).[5] Using a custom-made randomisation tool counterbalancing for sex, age, and trait dissociation, participants were successively

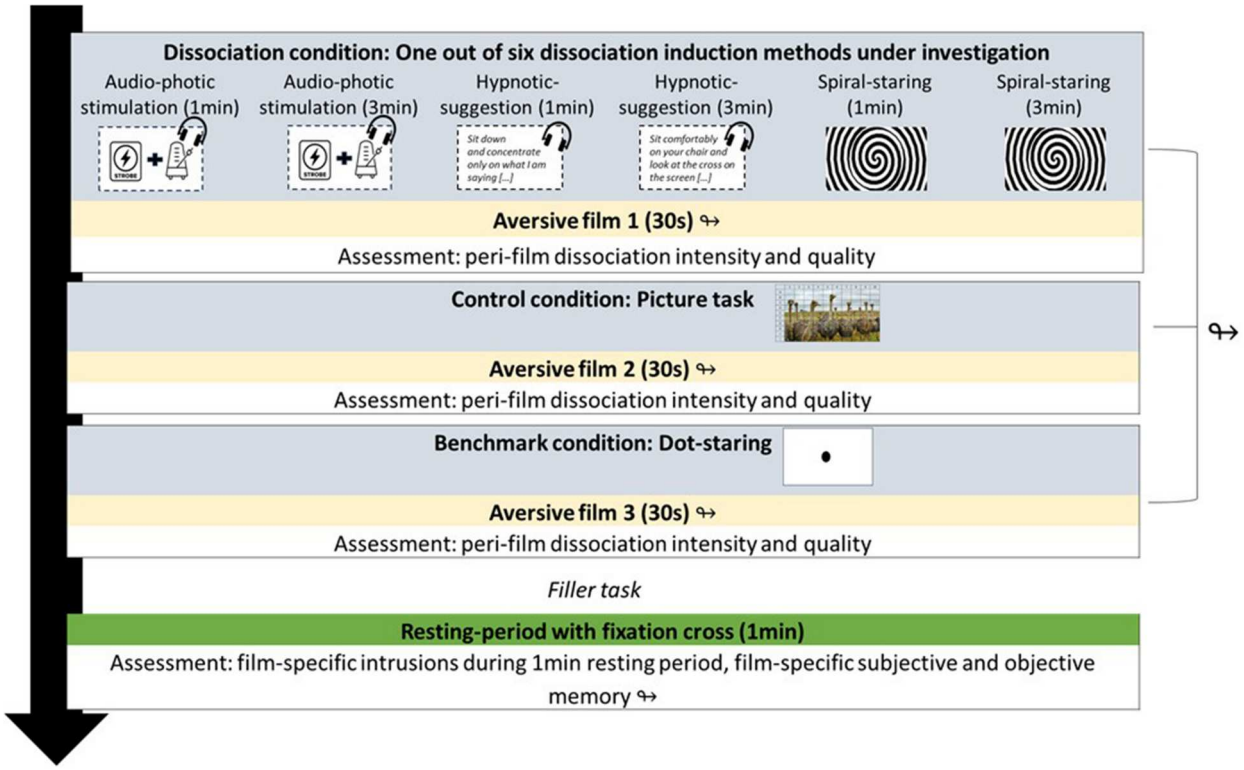


**Figure 1.** Illustration of procedures. ↬ = Randomised allocation/ order.

randomised to one of six dissociation-induction-methods: audio-photic stimulation 1 min ($n = 35$), audio-photic stimulation 3 min ($n = 36$), hypnotic-suggestion 1 min ($n = 36$), hypnotic-suggestion 3 min ($n = 34$), spiral-staring 1 min ($n = 36$), and spiral-staring 3 min ($n = 36$). Each participant completed three within-subject conditions (dissociation-induction via one of the six methods, control condition, benchmark condition) in a randomised order. Film allocation to conditions and the order of film-specific memory assessments were also randomised.

Data for single conditions were excluded from analyses if participants rated instruction adherence <50 on a scale from *followed instruction not at all* (0) to *followed instruction very precisely* (100), resulting in non-overlapping exclusions of five dissociation-induction conditions (2× audio-photic stimulation 3 min, 2× hypnotic-suggestion 3 min, 1× spiral-staring 3 min), one control condition, and five benchmark conditions (see Table S2 for sample sizes per analysis).

## 2.3. Procedure

The study consisted of a pre-programmed online experiment via LimeSurvey and a subsequent phone appointment. Both were pre-scheduled to increase protocol adherence. Participants gave informed consent, and inclusion criteria were verified via self-report. Study content was explained in written form, including aversive film screenshots and an example film. Participants were then guided through the preparation of the experimental setting. Next, sociodemographic and mental health information was assessed via self-report, followed by a 30 s resting-period. Participants were then exposed to the three within-subject conditions (dissociation-induction, control condition, benchmark condition) in randomised order. Each condition was followed by a different aversive film, instructions to refocus on the present, ratings of peri-film dissociation intensity and quality, and questions about the dissociation-induction-method. After completing all conditions, participants answered an absorption-questionnaire (filler task) and completed a 1 min resting-period with a fixation cross. Then, participants were asked about film-intrusions during the resting-period. Next, film-specific self-reported and objective memory performance was assessed. After the experiment, participants completed a phone appointment, were asked about their experiences during the study, and were assisted in emotion regulation if needed. The study was approved by the local ethics committee. Participants were reimbursed with course credit or 6€.

## 2.4. Material

### 2.4.1. Experimental setting

Participants were instructed to conduct the experiment on a PC or notebook with headphones or speakers on, seated at a table approximately 50 cm away from the screen, alone in a darkened room with the screen as the only light source. They were asked to set screen brightness to the highest level and adjust the volume to be well audible during a test video.

### 2.4.2. Dissociation-induction

Computerised 1 and 3 min versions of all examined dissociation-induction-methods, adapted for standard computers, were employed (see Table 2).

### 2.4.3. Control condition (picture task)

Participants completed a series of brief visual tasks, including counting or locating specific objects in pictures or spotting the difference between two pictures (for a detailed description, see the Supplement). They

**Table 2.** Dissociation-induction-methods.

| Method | Description | Availability of material |
|---|---|---|
| Audio-Photic Stimulation (1 min/ 3 min) | Participants closed their eyes and were exposed to 12 Hz stroboscopic flashing white lights synchronised with a 12 Hz ticking sound similar to a fast metronome (Leonard et al., 1999, 2000). While prior studies presented stimuli via a commercial Digital Audio-Video Integration Device, including a plastic mask resembling ski goggles and a headset (Leonard et al., 1999, 2000), we presented photic stimulation on the computer screen and audio stimulation via headphones or loudspeakers. While stimulation durations were 10 and 12 min in prior studies (Leonard et al., 1999, 2000), stimulation durations were 3 and 1 min in the present study, as our goal was to determine the shortest possible method duration. | Language-free stimulation videos provided here: https://osf.io/4jnvf/files/osfstorage |
| Hypnotic-Suggestion (1 min/ 3 min) | Participants listened to an audio-script first inducing a light hypnotic state using an adapted script from Oakley et al. (2007) and then inducing a dissociative state following adapted scripts from Holmes et al. (2006) and Röder et al. (2007). Prior studies employing hypnosis-induced dissociation did not specify script duration (Holmes et al., 2006; Röder et al., 2007), yet the written script of Holmes et al. (2006) was of comparable length to our 3 min script. In the 1 min script, instructions for inducing both the light hypnotic and the dissociative state were shortened. | German and English written scripts provided in the Supplement (Box 1 and 2); German audio files provided here: https://osf.io/4jnvf/files/osfstorage |
| Spiral-Staring (1 min/ 3 min) | Participants stared into the centre of a two-zone inwardly and outwardly rotating black-and-white spiral (100 rotations/min) (Lickel et al., 2008; Dorahy et al., 2016). The stimulus was provided by Lickel et al. (2008). While prior studies employed spiral-staring for 3 min (Lickel et al., 2008) and 7 min (Dorahy et al., 2016), the present study employed spiral-staring for 1 and 3 min. | Stimulus provided here: http://dogfeathers.com/java/spirals.html |

were informed that completing all tasks within the given time frame would not be possible and were instructed to complete as many items as possible, as accurately as possible. Task duration was matched to the duration of the experimental dissociation-induction-method.

#### 2.4.4. Benchmark condition (dot-staring)

Participants were instructed to stare intensively at a black dot in the middle of the white screen (Leonard et al., 1999; Lickel et al., 2008; Miller et al., 1994). The apparent dot diameter (0.44 cm) matched that used in prior studies (Leonard et al., 1999; Lickel et al., 2008; Miller et al., 1994). Previous studies employed 3 min (Lickel et al., 2008; Miller et al., 1994) or 10 min (Leonard et al., 1999) versions of the task. Task duration was matched to the duration of the experimental dissociation-induction-method.

#### 2.4.5. Aversive films

Three 30 s film-clips depicting severe interpersonal violence were used, drawn from the commercial movie 'Irreversible' (Noé, 2002) and the series '13 Reasons Why' (Yorkey et al., 2018). Clips depicted (1) physical and sexual violence against a woman in an underground passage, (2) physical violence against a man in a club, and (3) physical and sexual violence against a man in a restroom. Clips 1 and 2 have frequently been used in trauma analogue studies (Arnaudova & Hagenaars, 2017). Clip 3 was chosen as it depicts comparably severe violence.

### 2.5. Measures

Table 3 summarises measures of peri-film dissociation intensity and quality, intrusive memories, and film-specific self-reported and objective memory performance.

**Table 3.** Overview of outcome measures.

| Variable | Measure | Description of assessment |
|---|---|---|
| **Primary variables** | | |
| Dissociation intensity | Adapted 8-item version of the Peritraumatic Dissociative Experiences Questionnaire (PDEQ; Marmar et al., 1997; Maercker, 1994) | Assessment of dissociative experiences (e.g. derealisation, depersonalisation, and altered sense of time) during and immediately after film-viewing on a scale from '*not at all true*' (0) to '*extremely true*' (4). To better match the trauma film paradigm, two items of the original 10-item version were omitted following prior work (Danböck et al., 2021; Kindt et al., 2005; Kindt & Van Den Hout, 2003), and three items were slightly adapted (see Table S1). In the present study, Cronbach's alphas were .87 (dissociation-induction), .84 (control condition), and .81 (benchmark condition). Effects on dissociation intensity were modelled in a way that they can be understood as effects on a PDEQ mean score (for details, see statistical analysis section). |
| Dissociation quality | Four visual analogue scales (VAS) on the controllability and pleasantness of the dissociative state | Assessment of the controllability of dissociation onset on a VAS from '*The experience emerged automatically*' (−50) to '*I voluntarily elicited the experience*' (50), of the overall controllability of dissociation on a VAS from '*I felt like I could not control the experience*' (−50) to '*I felt like I could control the experience*' (50), of the overall pleasantness of dissociation on a VAS from '*I found the experience very unpleasant*' (−50) to '*I found the experience very pleasant*' (50), and of the subjective protective effect of dissociation on a VAS from '*I had the feeling that the experience intensified unpleasant feelings*' (−50) to '*I had the feeling that the experience shielded me from unpleasant feelings*' (50). |
| Intrusive memories | Intrusion-load (Franke et al., 2021) | Assessment of film-specific intrusions during the 1 min resting-period at the end of the experiment. Intrusions were defined as memories of the film-clip (e.g. images, sounds, thoughts, feelings) that unintentionally entered consciousness. For each film-clip (named after their settings: tunnel, club, restroom), participants rated (1) the percentage of time with intrusions about the film-clip on a VAS from 0% to 100% and (2) the accompanying distress on a VAS from '*not distressing at all*' (0) to '*very distressing*' (100). Akin to prior work (Franke et al., 2021), we operationalised intrusions as intrusion-load (percentage of time × accompanying distress). |
| Self-reported memory performance | Subjective memory fragmentation subscale of the Trauma Memory Questionnaire (Halligan et al., 2003) | Unannounced assessment of subjective deficits in intentional recall of each film-clip (named after their settings: tunnel, club, restroom). Participants were asked to evaluate the extent to which the film memory is disorganised or incomplete on five items on a Likert Scale from '*not at all*' (0) to '*very strongly*' (4). In the present study, Cronbach's alpha was .87 (tunnel), .91 (club), and .89 (restroom). For analyses, a mean score of the five items was used. |
| Objective memory performance | Correct responses in cued recall (Holmes et al., 2004; Hagenaars et al., 2008; Ganslmeier et al., 2022) | Unannounced assessment of objective deficits in intentional recall of each film-clip (named after their settings: tunnel, club, restroom) using a cued recall task entailing eleven open questions regarding the location, offender(s), victim(s), and actions. Participants typed answers were rated following an a-priori fixed rating scheme. Correct answers scored 1 point each, yielding a total sum score of 0–11 per clip which was used for analyses. |
| **Further variables** | | |
| Characteristics of dissociation-induction-methods | Two VAS on distress and compliance during dissociation-induction-methods | Assessment of distress on a VAS from '*not distressing at all*' (0) to '*very much distressing*' (100) and of compliance on a VAS from '*did not follow the instruction at all*' (0) to '*very precisely followed the instruction*' (100). |

Note: All measures were assessed three times per participant (once per condition; see Procedure).

### 2.6. Statistical analyses

We computed Bayesian regression models (BRMs) in R 4.0.3 and R 4.3.1 (R Core Team, 2019) via the Stan-based package *brms* (Bürkner, 2017; Carpenter et al., 2017). We report regression coefficients (*b*s), 89% credible intervals (CIs), i.e. Bayesian uncertainty intervals, and posterior probabilities ($PP_{b>0}$ and $PP_{b<0}$) of effects. 89%CIs constitute intervals where the respective parameter falls with an 89% probability given the observed data, prior, and model assumptions. $PP_{b>0}$ / $PP_{b<0}$ values denote the posterior probability of the respective parameter being greater/ smaller than zero given the observed data, prior, and model assumptions. 89%CIs and PP values allow for a continuous evaluation of support for our hypotheses. Nevertheless, in line with prior work (e.g. Danböck et al., 2024; Franke et al., 2022), we considered effects significantly different from zero if the estimate's 89%CI did not include zero. We used weakly- or non-informative default priors of brms (Bürkner, 2017, 2018). An overview of fitted models is provided in Table S2. Statistical comparisons of interest were pre-registered.

To examine the effectiveness of the six tested dissociation-induction-methods (compared to the control and benchmark conditions) in inducing dissociation during aversive film-clips, we computed six multilevel BRMs (one per dissociation-induction-method). Dissociation intensity measured by the eight PDEQ items and fitted with a cumulative model (Bürkner & Vuorre, 2019) served as the outcome, the within-subject condition (dissociation-induction, control condition, benchmark condition) served as the main predictor of interest. We were primarily interested in the dissociation-induction vs. control and dissociation-induction vs. benchmark comparisons, which were crucial to evaluate the effectiveness of dissociation induction methods according to our pre-defined criteria. However, to allow for a more comprehensive understanding of results, we also secondarily report the benchmark vs. control comparison. To consider that responses might differ between PDEQ items, as these capture different facets of dissociation, item-type was entered into the model as an additional predictor. Item-type was effect-coded (i.e. zero reflecting the grand mean); hence, estimates for effects of condition are effects on average PDEQ levels. In other words, these coefficients can be similarly interpreted as effects on a PDEQ mean-score. To also allow for the possibility that conditions might have different effects on different dissociation facets captured by distinct items, interactions between condition and item-type were included as well. Coefficients for these interactions indicate whether the effect of the predictor of interest on the respective dissociation item deviates from the effect of the predictor on the mean of all eight items. For exploratory purposes, item-specific deviations are summarised in Table S9. We accounted for the repeated measurement design with 8(items) × 3(conditions), i.e. 24 observations per subject, by including a random intercept and random slopes for condition and item-type into each model.

To compare successful dissociation-induction-methods regarding the quantity and quality of induced dissociation, we computed five BRMs. One for the dependent variable induced mean dissociation intensity (i.e. mean dissociation intensity after dissociation-induction minus mean dissociation intensity after control condition) and four for the dependent variables assessing dissociation quality, all fitted with student distributions. As a predictor, the factor group, including only those dissociation-induction-methods deemed successful in the first step, was entered.

To examine effects of successful dissociation-induction on intrusion-load and memory and to investigate potential interaction effects with dissociation-induction-method, we computed three multilevel BRMs. Intrusion-load, fitted with a hurdle lognormal distribution to account for zero-inflation in the data, subjective memory fragmentation fitted with a student distribution, and correct cued recall responses fitted with a Gaussian distribution served as outcomes. Condition (dissociation-induction, control condition), effect-coded group, and the condition X group interaction were entered as predictors. As group was effect-coded (i.e. zero reflecting the grand mean), estimates for effects of condition can be interpreted as main effects of condition. We accounted for the repeated measurement design by including random intercepts.

All BRMs converged as indicated by common algorithms-agnostic (Vehtari et al., 2021) and algorithm-specific diagnostics (Betancourt, 2017). There were no divergent transitions, $Rhat < 1.01$ and $ESS > 400$ for all relevant parameters.

## 3. Results

### 3.1. Which dissociation-induction-methods successfully induce dissociation?

We first evaluated which dissociation-induction-methods successfully induced dissociation according to our pre-defined criteria (dissociation intensity > control condition and ≥ benchmark condition). Two of the six methods demonstrated above-threshold effectiveness (see Table 4 and Figure 2): Hypnotic-suggestion 3 min elicited higher average dissociation intensity during aversive film-viewing than the control and the benchmark condition. Furthermore, spiral-staring 1 min elicited higher average dissociation levels than the control condition and demonstrated no above-threshold differences with the benchmark condition. Other dissociation-induction-methods did not meet the effectiveness threshold. The benchmark condition

**Table 4.** Regression coefficients and 89% CIs of condition differences in dissociation intensity per examined dissociation-induction-method.

| Dissociation-induction-method | Dissociation-Induction – Control<br>*b* [89% CI], $PP_{b>0}$ | Dissociation-Induction – Benchmark<br>*b* [89% CI], $PP_{b>0}$ | Benchmark – Control[a]<br>*b* [89% CI], $PP_{b>0}$ |
|---|---|---|---|
| Audio-Photic Stimulation 1 min | 0.39 [−0.04, 0.83], 0.92 | 0.17 [−0.22, 0.56], 0.76 | 0.22 [−0.23, 0.67], 0.79 |
| Audio-Photic Stimulation 3 min | 0.43 [−0.01, 0.87], 0.94 | 0.16 [−0.22, 0.55], 0.75 | 0.27 [−0.22, 0.75], 0.82 |
| Hypnotic-Suggestion 1 min | 0.30 [−0.14, 0.75], 0.86 | 0.33 [−0.01, 0.69], 0.94 | −0.04 [−0.47, 0.40], 0.44 |
| **Hypnotic-Suggestion 3 min** | ***0.92 [0.63, 1.25], 1.00*** | ***0.80 [0.52, 1.10], 1.00*** | 0.12 [−0.21, 0.46], 0.73 |
| **Spiral-Staring 1 min** | ***0.89 [0.41, 1.42], 1.00*** | 0.23 [−0.16, 0.61], 0.83 | ***0.66 [0.20, 1.19], 0.99*** |
| Spiral-Staring 3 min | 0.36 [−0.24, 0.98], 0.83 | 0.31 [−0.11, 0.72], 0.88 | 0.05 [−0.50, 0.62], 0.54 |

Note: Values are *b*s and 89% CIs of differences between conditions separately for each dissociation-induction-method under investigation. Positive *b*s denote higher average dissociation intensity. Bold values indicate 89% CIs not including zero. Formula of fitted models and detailed descriptive statistics are reported in the supplements.
[a]No primary comparisons, denoted for information only. PP = posterior probability.

induced more dissociation than the control condition for participants in the spiral-staring 1 min group, but not in other groups. Based on these results, hypnotic-suggestion 3 min and spiral-staring 1 min were considered successful methods and further analyzed.

### 3.2. Do successful dissociation-induction-methods differ in intensity and quality of dissociation?

Next, we compared the two effective dissociation-induction-methods (hypnotic-suggestion 3 min, spiral-staring 1 min) regarding the intensity and quality of evoked dissociation (see Table 5): Hypnotic-suggestion 3 min caused a greater increase in dissociation intensity than spiral-staring 1 min. On the other hand, dissociation induced by spiral-staring 1 min was rated as more uncontrollable in onset, more unpleasant, and more intensifying unpleasant feelings than dissociation induced by hypnotic-suggestion 3 min. No above-threshold difference was found regarding the perceived general controllability of the dissociative experience.

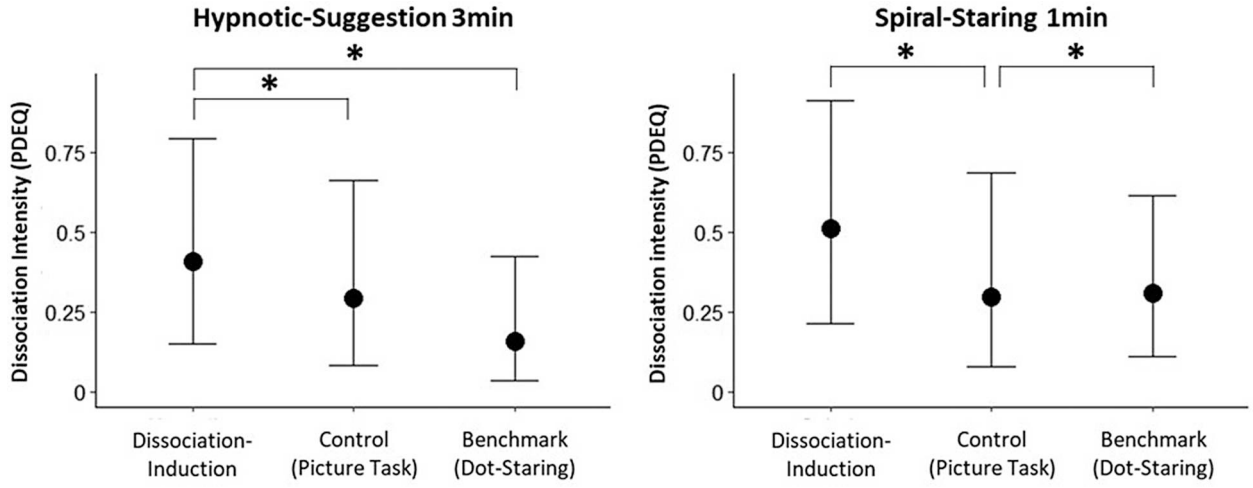


**Figure 2.** Hypnotic-suggestion 3 min (left) and spiral-staring 1 min (right) successfully induced dissociation during aversive film viewing (dissociation-induction > control and ≥ benchmark). Fitted values of regression models are displayed. Vertical lines represent 89% CIs. Asterisks denote 89%CIs of differences not including zero. Abbreviations: PDEQ = Peritraumatic Dissociative Experiences Questionnaire (scale range: 0–4).

**Table 5.** Differences in the intensity and quality of dissociation induced by hypnotic-suggestion 3 min vs. spiral-staring 1 min.

| | Hypnotic-Suggestion 3 min | | Spiral-Staring 1 min | | Hypnotic-Suggestion 3 min – Spiral-Staring 1 min |
|---|---|---|---|---|---|
| | *n* | *M (SD)* | *n* | *M (SD)* | *b* [89% CI], $PP_{b>0}$ |
| **Δ Dissociation intensity (PDEQ, Dissociation-Induction – Control, −4–4)** | 32 | 0.32 (0.46) | 36 | 0.17 (0.56) | ***0.18 [0.04, 0.31], 0.98*** |
| Dissociation quality | | | | | |
| **Uncontrollable vs. controllable onset (VAS, −50–50)** | 28[a] | −10.71 (26.10) | 26[a] | −28.08 (21.91) | ***17.69 [6.62, 28.58], 1.00*** |
| Uncontrollable vs. controllable in general (VAS, −50–50) | 28[a] | 1.07 (25.44) | 26[a] | 1.15 (30.64) | 0.03 [−12.66, 12.82], 0.50 |
| **Unpleasant vs. pleasant (VAS, −50–50)** | 28[a] | −8.93 (25.14) | 26[a] | −20.77 (24.15) | ***11.56 [0.25, 22.81], 0.95*** |
| **Intensifying vs. protecting from unpleasant feelings (VAS, −50–50)** | 28[a] | 1.79 (21.95) | 26[a] | −15.00 (26.42) | ***16.85 [6.15, 27.47], 0.99*** |

Note: *M (SD)* per successful dissociation-induction-method and *b*s and 89% CIs of differences between successful methods are reported. Positive *b*s denote higher values in the Hypnotic-Suggestion 3 min group than in the Spiral-Staring 1 min group. Bold values indicate 89% CIs not including zero. Formula of fitted models is reported in the Supplements.
[a]Dissociation quality was assessed in individuals with dissociation intensity > 0 for the aversive film following the dissociation-induction.

**Table 6.** Effects of successful dissociation-induction on intrusion formation and memory performance.

| | Dissociation-Induction – Control<br>*b* [89% CI], $PP_{b>0}$ | Interaction with Dissociation-Induction-Method<br>*b* [89% CI], $PP_{b>0}$ |
|---|---|---|
| Intrusion-load | | |
| **Hurdle part** | ***1.06 [0.08, 2.13], 0.96*** | −0.04 [−1.00, 0.92], 0.47 |
| Continuous part | −0.13 [−0.59, 0.33], 0.31 | −0.07 [−0.52, 0.38], 0.40 |
| **Subjective memory fragmentation** | ***0.23 [0.02, 0.44], 0.96*** | 0.11 [−0.09, 0.32], 0.82 |
| Correct cued recall responses | −0.30 [−0.87, 0.26], 0.20 | −0.53 [−1.10, 0.04], 0.07 |

Note: Values are *b*s and 89% CIs of effects of dissociation-induction on intrusion-load, subjective memory fragmentation, and objective memory performance in participants who received either spiral-staring 1 min or hypnotic-suggestion 3 min as well as interaction effects with the employed dissociation-induction-method. Bold values indicate 89% CIs not including zero. Formula of fitted models and detailed descriptive statistics are reported in the supplements.

### 3.3. Does dissociation-induction affect intrusion-load and memory?

Regression coefficients and 89%CIs of effects of dissociation-induction (via successful methods only) on intrusion-load and memory are shown in Table 6.

The two successful dissociation-induction-methods caused a higher probability of experiencing zero film-related intrusion-load during the resting-period than the control condition; in other words, dissociation induction decreased the likelihood of having distressing intrusions (hurdle part; see Figure 3, left). Our data did not yield above-threshold effects of dissociation-induction on intrusion-load severity (log-normal part; see Figure 3, right).

The two successful dissociation-induction-methods caused higher subjective memory fragmentation than the control condition (see Figure 4, left). No overall above-threshold effect of dissociation-induction on correct responses in the cued recall emerged. However, we exploratively followed up on below-threshold evidence for a group x condition interaction on correct responses in the cued recall ($b = -0.53$, 89% CI[−1.10, 0.04], $PP_{b>0} = 0.07$, $PP_{b<0} = 0.93$) and examined effects of dissociation-induction on correct cued recall responses separately for both induction methods (see Figure 4, right): While dissociation-induction via spiral-staring 1 min caused less correct responses in the cued recall than the control condition ($b = -0.83$, 89%CI[−1.60, −0.06], $PP_{b>0} = 0.04$, $PP_{b<0} = 0.96$), dissociation-induction via hypnotic-suggestion 3 min did not ($b = 0.23$, 89%CI[−0.60, 1.06], $PP_{b>0} = 0.67$, $PP_{b<0} = 0.33$).

Finally, we explored associations between changes in self-reported dissociation intensity and changes in intrusions and memory (dissociation-induction minus control condition). Our data did not yield an above-threshold effect of the increase in self-reported dissociation intensity on an increase in intrusion-load ($b = 0.16$, 89%CI[−2.25, 2.61], $PP_{b>0} = 0.56$). However, in line with expectations, a greater increase in dissociation intensity from control condition to dissociation-induction was linked to higher subjective memory fragmentation ($b = 0.45$, 89%CI[0.09, 0.79], $PP_{b>0} = 0.97$) and fewer correct cued recall responses ($b = -1.27$, 89%CI[−2.47, −0.06], $PP_{b<0} = 0.95$), see Figure 5.

## 4. Discussion

We experimentally evaluated methods for inducing dissociation during trauma-films and examined their effects on film-related intrusions and memory

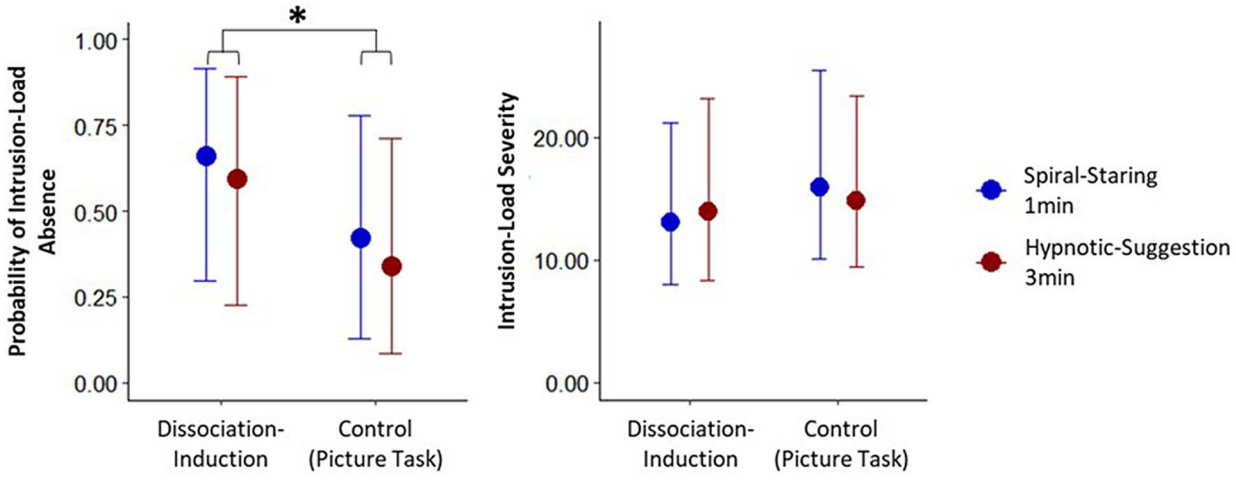


**Figure 3.** Effects of successful dissociation-induction on the probability of intrusion-load absence (hurdle part; left) and intrusion-load severity (lognormal part; right). A hurdle lognormal model was used to account for zero inflation in the data. Fitted values of regression models are displayed. Vertical lines represent 89% CIs. Asterisks denote 89%CIs of differences not including zero.

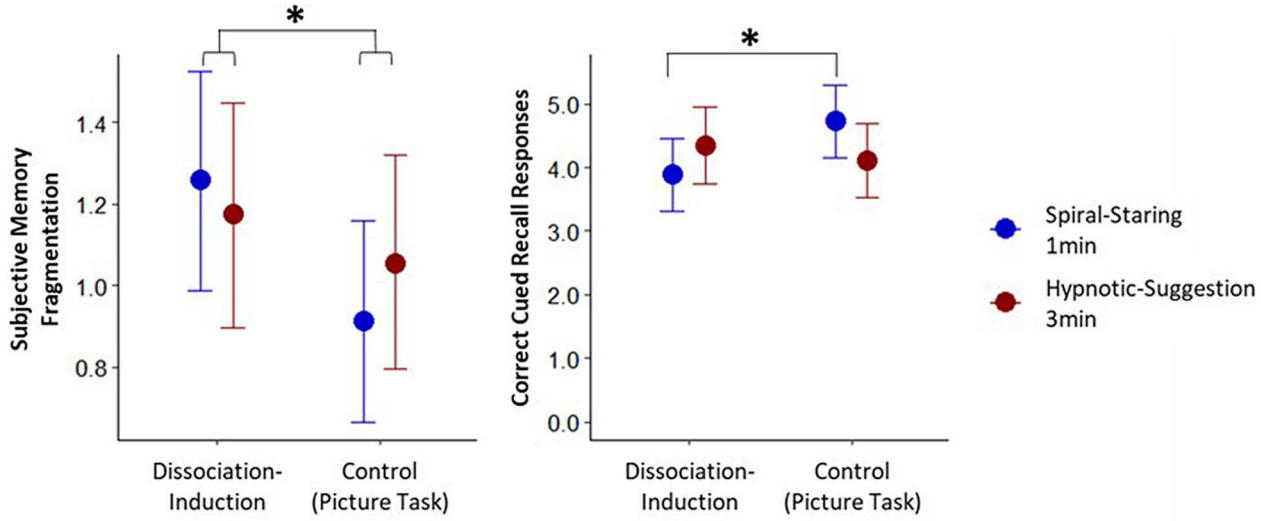


**Figure 4.** Effects of successful dissociation-induction on subjective memory fragmentation (left) and correct cued recall responses (right). Fitted values of regression models are displayed. Vertical lines represent 89% CIs. Asterisks denote 89%CIs of differences not including zero.

performance. Of the six dissociation-induction-methods tested (audio-photic stimulation, hypnotic-suggestion, and spiral-staring, either with 1 and 3 min duration), two met our pre-defined effectiveness criteria: hypnotic-suggestion 3 min and spiral-staring 1 min. They differed regarding the intensity and quality of evoked dissociation, providing valuable insights for future research: Hypnotic-suggestion caused higher dissociation intensity, while spiral-staring induced dissociative states which were perceived as more uncontrollable and unpleasant (properties that also characterise naturally occurring dissociation, see Table S8). Against our expectations, neither dissociation-induction nor the increase in self-reported dissociation intensity was linked to more distressing intrusions – our data even partly supported a contrary effect. This challenges theoretical assumptions that dissociation contributes to the development of intrusions and might call for a refined understanding of the complex dissociation-intrusion relationship. Finally, the present data showcased causal effects of dissociation on subjective memory fragmentation and objectively assessed memory disturbances, thereby providing experimental support for a much-debated theoretical notion.

### 4.1. Evaluating dissociation-induction-methods

Extending upon initial studies suggesting dissociative effects of spiral-staring and hypnotic-suggestion

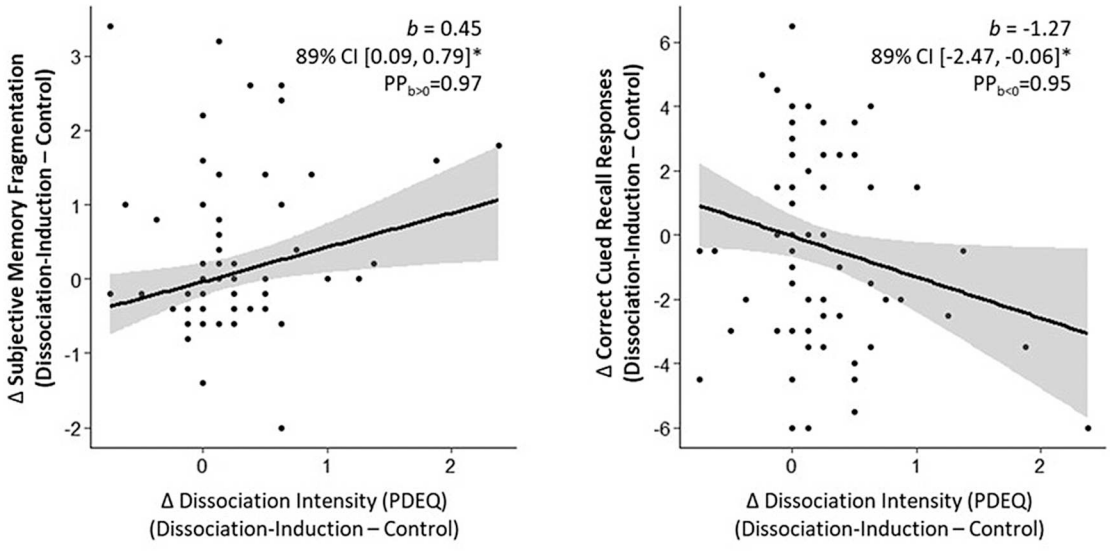


**Figure 5.** Effects of increases in dissociation intensity from control condition to dissociation-induction on subjective memory fragmentation (left) and correct cued recall responses (right). Fitted values of regression models are displayed. Vertical lines represent 89% CIs. Asterisks denote 89%CIs not including zero.

(Holmes et al., 2006; Hagenaars et al., 2008; Lickel et al., 2008; Dorahy et al., 2016), the present study demonstrated that spiral-staring 1 min and hypnotic-suggestion 3 min can elicit dissociation during a subsequent standardised task (i.e. a 30 s trauma film). Both methods, hence, constitute valid tools for studying the effects of acute dissociation. They are brief, repeatable, easy-to-implement (requiring only a PC), in principle compatible with online and neuroimaging designs, and work well with non-dissociation-inducing control conditions, such as the picture task used here.

Which dissociation-induction-method should be preferred in future studies? The shorter duration of spiral-staring (1 min) may make it preferable for repeated-measurement designs. Comparing the quantity and quality of dissociation, hypnotic-suggestion produced a greater increase in dissociation intensity than spiral-staring. However, as hypnotic-suggestion explicitly describes the target state (e.g. 'You feel as if everything around you is unreal … '), this may at least partly reflect heightened expectancy or social desirability effects rather than true dissociation. In contrast, spiral-staring lacks explicit descriptions, reducing the likelihood of such biases. Regarding dissociation quality, spiral-staring-induced states were perceived as more uncontrollable and unpleasant, while hypnotic-suggestion resulted in more neutral experiences. To facilitate the evaluation of the ecological validity of induced dissociation, we exploratively assessed the quality of peritraumatic and posttraumatic (trauma-narrative-induced) state dissociation in a clinical study in 71 individuals with PTSD using the same measures as in the present study (for a detailed description of the study's procedure and main findings on biological correlates of acute dissociation, see Danböck et al. (2024). Notably, individuals with PTSD described dissociative states as predominantly uncontrollable and unpleasant (see Table S8), suggesting that dissociation induced by spiral-staring may more closely resemble naturally-occurring dissociative states in clinical populations than dissociation induced by hypnotic-suggestion.

Beyond duration of the induction task, dissociation intensity, and quality, it is crucial to consider the research question when selecting a dissociation-induction-method. For example, methods that induce dissociation through aversive stimulation may be less appropriate for studying the causal effects of dissociation on emotion, since the induction itself also directly elicits emotional responses. In contrast, methods such as spiral-staring or hypnotic suggestion, which are thought to induce dissociation through other mechanisms, may be better suited for isolating dissociation-related causal effects on emotional processing. Relatedly, understanding the working mechanisms of dissociation-induction-methods might itself constitute an important venue for future research and bear insights into mechanisms underlying dissociative states. For instance, aversive films and painful stimulation have been shown to induce dissociation via subjective and physiological emotional and pain responses, suggesting that negative emotions and pain contribute to acute dissociation (Danböck et al., 2023). Similarly, future research could examine how spiral-staring and hypnotic suggestion foster dissociation, shedding light on other contributing mechanisms. For instance, spiral-staring may induce dissociation by overwhelming the visual processing system, leading to a subsequent suppression of sensory input (sensory deafferentation), a process that has been hypothesised to be important for dissociative psychopathology (Schauer & Elbert, 2010). However, this has yet to be tested empirically.

According to our strict criteria, the other examined dissociation-induction-methods (hypnotic-suggestion 1 min, spiral-staring 3 min, audio-photic stimulation) were unsuccessful. However, for all methods, rather high posterior probabilities for positive effects on dissociation ($\geq$.83) suggest that these are possibly working as well but lead to a smaller increase in dissociation intensity as indicated by smaller regression coefficients. The smaller effects might be due to several factors: Hypnotic-suggestion 1 min might only lead to a slight increase in dissociation as it might take longer and require more detailed instructions (as in the 3 min condition) to get into a more intense dissociative state; spiral-staring 3 min might have resulted in lower compliance (potentially due to a higher aversiveness) than the 1 min condition, decreasing its effectiveness (see also Table S7); for audio-photic stimulation, neither 1 min nor 3 min stimulation might have been sufficient – previous studies using this method employed much longer stimulation times (Leonard et al., 1999, 2000). Alternatively, the use of audio-photic stimulation via a standard screen – unlike the commercial goggles used by Leonard et al. (1999, 2000), which also restrict the participants' visual field – may have reduced its effectiveness. Due to these shortcomings potentially underlying the limited effectiveness of these specific dissociation-induction-methods, we would not recommend their usage, yet see potential for further improvement and evaluation.

While not the primary objective of our work, our findings also offer guidance for selecting appropriate control conditions in future dissociation-induction studies. The successful methods clearly outperformed the picture task, supporting its use as a control condition. In contrast, we recommend against using resting-state or baseline periods commonly included in neuroimaging protocols, as they resemble our benchmark condition (dot-staring), which – both in our study and previous work – has inconsistently induced dissociation.

### 4.2. Dissociation and intrusion formation

Our findings challenge the assumption that dissociation fosters intrusion formation (Brewin & Holmes, 2003; Marmar et al., 1998). Instead, dissociation-induction was linked to a lower likelihood of experiencing intrusions immediately after the trauma-film. This finding adds to a heterogenous body of evidence including positive effects (Dorahy et al., 2016), no effects (Holmes et al., 2004, 2006; Hagenaars et al., 2008), and negative effects (Brewin & Saunders, 2001) of dissociation-induction on intrusion formation.

Notably, we found no moderating effect of induction-method, suggesting that these inconsistencies are unlikely due to how dissociation was induced. This is further supported by the mixed evidence across studies using the same methods – for example both positive (Dorahy et al., 2016) and negative (this study) effects for spiral-staring, positive effects for mirror-staring (Dorahy et al., 2016), no (Holmes et al., 2006; Hagenaars et al., 2008) and negative (this study) effects for hypnotic-suggestion, and negative effects for a dual-attention task (Brewin & Saunders, 2001). An alternative explanation for the inconsistent evidence might be that the effects of dissociation on intrusions vary over time, with dissociation initially causing a transient period of grace followed by a time-lagged maladaptive effect, similar to the complex effects of sleep on intrusions (Werner et al., 2020). We assessed intrusion-load immediately after encoding of the trauma (analog) memory and before consolidation could take place, while at least some (but not all) studies indicating no or maladaptive effects examined intrusions over a longer period, ranging from three days (Dorahy et al., 2016) to a week (Holmes et al., 2006; Hagenaars et al., 2008). Alternatively, the unconvincing evidence from experimental dissociation-induction studies might also imply that dissociation is not a central causal factor for intrusion formation but rather an epiphenomenon. Previously reported correlations of spontaneous dissociation with intrusions in trauma analog and (prospective) clinical studies might also be largely driven by effects of the accompanying physiological alterations provoked by trauma analogs and traumatic events (Danböck et al., 2021).

### 4.3. Dissociation and memory

Building upon two studies showing effects of dissociation-induction on neuropsychological memory tests (Brewin & Mersaditabari, 2013; Brewin et al., 2013), the present study demonstrated effects of dissociation-induction on trauma-film memory, supporting theoretical notions that dissociation contributes to memory disturbances (Brewin & Holmes, 2003; Marmar et al., 1998). Yet, it also suggests that memory effects may depend upon the way dissociation is induced, with spiral-staring (this study) and mirror-staring (Brewin & Mersaditabari, 2013; Brewin et al., 2013) demonstrating more robust links than hypnotic-suggestion (Hagenaars et al., 2008; this study). The present findings indicate that spiral-staring-induced dissociation is qualitatively more comparable to real-life dissociation, which might support the generalizability of the observed memory effects of spiral-staring to dissociative states in clinical populations. The same might apply to mirror-staring, which shares some properties with spiral-staring, such as the fixed eye gaze, the narrow visual field, and visual alterations as perceived working mechanisms. Essential venues for future research are now to empirically examine and directly compare the effects of dissociation induced by spiral- or mirror-staring to the effects of spontaneous dissociation on memory performance within a clinical population. Advancing our understanding of the effects of dissociation on memory has important practical implications. For example, high levels of peritraumatic dissociation during assaults may lead to memory fragmentation, potentially contributing to both incoherence as well as lower memory performance in police interviews and courtroom proceedings.

### 4.4. Limitations

The study was employed online, limiting standardisation. However, participants were thoroughly instructed to set up their environment at the beginning of the experiment, and adherence to instructions was checked via self-report multiple times during study participation and a subsequent phone appointment. Data below a pre-determined adherence threshold were excluded from analyses. Further, differences in findings between the 1 and 3 min induction groups may also reflect variations in the time between encoding and recall. Additionally, carryover effects from previous conditions could have influenced memory performance in subsequent conditions, although the randomised condition order likely minimised this impact. Finally, it was beyond the scope of the present study to directly compare dissociative states induced by the experimental dissociation-induction-methods to dissociative symptoms spontaneously experienced by clinical populations. However, we do show that experimental dissociation-induction causes an experience similar to that experienced by clinical populations in terms of symptoms, appraisals of the dissociative state (particularly for spiral-staring), and (assumed) effects on posttraumatic psychopathology (particularly memory disturbances). Hence, we are confident that experimental dissociation-induction constitutes a promising and exciting pathway for a better understanding of dissociative symptoms in trauma-related disorders.

## 5. Conclusions

Hypnotic-suggestion 3 min and spiral-staring 1 min are effective, easy-to-implement, in principle neuroimaging-compatible dissociation-induction-methods suitable for studying the interplay between dissociation, the body, brain, and mind. They differ in duration, dissociation intensity, and quality, with hypnotic-suggestion causing higher dissociation intensity, but spiral-staring being linked to dissociation quality better resembling dissociative symptoms in clinical populations. Future studies should consider these differences when selecting dissociation-induction-methods and further explore the mechanisms underlying their effects. The present data challenges the notion that dissociation fosters the formation of intrusive trauma memories but provides valuable experimental support for the long-held theoretical assumption that dissociation impairs voluntary episodic memory retrieval.

## Notes

1. Please note that 'dissociation' is an umbrella term for a broad range of psychological symptoms characterised by disruptions of the normal integration of consciousness, memory, identity, emotion, perception, body representation, motor control, and behavior (American Psychiatric Association, 2013) – for an overview of dissociative phenomena, see also Danböck et al. (2025). In the present paper, the term 'dissociation' refers to depersonalisation and derealisation only, both of which are highly prevalent during and after traumatic experiences.
2. Please note that mirror-staring was also excluded due to this criterion, as Schäflein et al. (2018) observed that in some populations mirror-gazing might work via negative emotions.
3. Secondly, we were also interested in whether successful dissociation-induction-methods would outperform this benchmark condition. Such findings could inform whether standard baseline or resting-state periods – commonly included in experimental designs and sharing some characteristics with dot-staring – might be used as provisional control conditions in future studies. This would offer a fallback option when time and resource constraints render other procedures unfeasible.
4. Sample size determination was assisted by an a-priori frequentist power analyses (power = 0.80, $\alpha = 0.05$) suggesting at least $N = 168$ to examine research question 1, $N = 216$ to examine research question 2, and $N = 60$ to examine research question 3. Based upon the highest estimate, we decided to recruit 216 study completers. However, please note that the power analysis served only as a benchmark and that the conducted Bayesian analyses continuously evaluate the level of evidence.
5. Please note that we a-priori conceptualised the six between-subject conditions as six different conditions, as we were interested in specific effects of each combination of task and duration and not into main effects of duration or task (see pre-registration).

## Open Scholarship

This article has earned the Center for Open Science badge for Preregistered. The materials are openly accessible at https://doi.org/10.17605/OSF.IO/VWD78

## Acknowledgements

We thank Lara Schröder for her help in preparing the study material.

## Disclosure statement

No potential conflict of interest was reported by the author(s).

## Funding

The first author was supported by the Doctoral College 'Imaging the Mind' funded by the Austrian Science Fund [FWF; W1233-B; Subproject Principal Investigator: FHW].

## Data availability statement

Data are, in conjunction with an appropriate data sharing agreement, available on request.

## ORCID

*Sarah K. Danböck* http://orcid.org/0000-0001-9989-1146
*Sabrina E. Hettegger* http://orcid.org/0000-0002-9697-2490
*Laila K. Franke* http://orcid.org/0000-0002-8207-6628
*Michael Liedlgruber* http://orcid.org/0000-0001-8035-6426
*Stephan F. Miedl* http://orcid.org/0000-0002-1977-5637
*Georg W. Alpers* http://orcid.org/0000-0001-9896-5158
*Frank H. Wilhelm* http://orcid.org/0000-0002-4414-7085

## References

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.).

Arnaudova, I., & Hagenaars, M. A. (2017). Lights … action: Comparison of trauma films for use in the trauma film paradigm. *Behaviour Research and Therapy*, *93*, 67–77. https://doi.org/10.1016/j.brat.2017.02.007

Betancourt, M. (2017). A conceptual introduction to Hamiltonian Monte Carlo. *ArXiv*. https://doi.org/10.48550/arXiv.1701.02434

Breh, D. C., & Seidler, G. H. (2007). Is peritraumatic dissociation a risk factor for PTSD? *Journal of Trauma & Dissociation*, *8*(1), 53–69. https://doi.org/10.1300/J229v08n01_04

Brewin, C. R., & Holmes, E. A. (2003). Psychological theories of posttraumatic stress disorder. *Clinical Psychology Review*, *23*(3), 339–376. https://doi.org/10.1016/S0272-7358(03)00033-3

Brewin, C. R., Ma, B. Y. T., & Colson, J. (2013). Effects of experimentally induced dissociation on attention and memory. *Consciousness and Cognition*, *22*(1), 315–323. https://doi.org/10.1016/j.concog.2012.08.005

Brewin, C. R., & Mersaditabari, N. (2013). Experimentally-induced dissociation impairs visual memory. *Consciousness and Cognition*, *22*(4), 1189–1194. https://doi.org/10.1016/j.concog.2013.07.007

Brewin, C. R., & Saunders, J. (2001). The effect of dissociation at encoding on intrusive memories for a stressful film. *British Journal of Medical Psychology*, *74*(4), 467–472. https://doi.org/10.1348/000711201161118

Bürkner, P.-C. (2017). Brms: An R package for Bayesian multilevel models using stan. *Journal of Statistical Software*, *80*(1), 1–28. https://doi.org/10.18637/jss.v080.i01

Bürkner, P.-C. (2018). Advanced Bayesian multilevel modeling with the R package brms. *The R Journal*, *10*(1), 395. https://doi.org/10.32614/RJ-2018-017

Bürkner, P.-C., & Vuorre, M. (2019). Ordinal regression models in psychology: A tutorial. *Advances in Methods and Practices in Psychological Science*, *2*(1), 77–101. https://doi.org/10.1177/2515245918823199

Caputo, G. B. (2010). Apparitional experiences of new faces and dissociation of self-identity during mirror gazing. *Perceptual and Motor Skills*, *110*(3_suppl), 1125–1138. https://doi.org/10.2466/pms.110.C.1125-1138

Carpenter, B., Gelman, A., Hoffman, M. D., Lee, D., Goodrich, B., Betancourt, M., Brubaker, M., Guo, J., Li, P., & Riddell, A. (2017). Stan: A probabilistic programming language. *Journal of Statistical Software*, *76*(1), 1–32. https://doi.org/10.18637/jss.v076.i01

Danböck, S. K., Franke, L. K., Miedl, S. F., Liedlgruber, M., Bürkner, P.-C., & Wilhelm, F. H. (2023). Experimental induction of peritraumatic dissociation: The role of negative affect and pain and their psychophysiological and neural correlates. *Behaviour Research and Therapy*, *164*, 104289. https://doi.org/10.1016/j.brat.2023.104289

Danböck, S. K., Liedlgruber, M., Franke, L. K., Miedl, S. F., Hettegger, S. E., Weber, R.-C., & Wilhelm, F. H. (2024). Acute dissociation as part of the defense cascade: Associations with behavioral, autonomic, and experiential threat responses in posttraumatic stress disorder. *Journal of Psychopathology and Clinical Science*, *133*(1), 76–89. https://doi.org/10.1037/abn0000873

Danböck, S. K., Mertens, Y. L., Kulla, P., Seitz, K. I., & Schalinski, I. (2025). How-to study dissociative symptoms in a broad range of mental disorders: A methodological primer. *Journal of Trauma & Dissociation*, *26*(3), 1–37. https://doi.org/10.1080/15299732.2025.2481474

Danböck, S. K., Rattel, J. A., Franke, L. K., Liedlgruber, M., Miedl, S. F., & Wilhelm, F. H. (2021). Peritraumatic dissociation revisited: Associations with autonomic activation, facial movements, staring, and intrusion formation. *European Journal of Psychotraumatology*, *12*(1), 1991609. https://doi.org/10.1080/20008198.2021.1991609

Dorahy, M. J., Peck, R. K., & Huntjens, R. J. C. (2016). The impact of dissociation on perceptual priming and intrusions after listening to auditory narratives. *Journal of Trauma & Dissociation*, *17*(4), 410–425. https://doi.org/10.1080/15299732.2015.1134746

Ercan, I., Hafizoglu, S., Ozkaya, G., Kirli, S., Yalcintas, E., & Akaya, C. (2015). Examining cut-off values for the state-trait anxiety inventory. *Revista Argentina de Clinica Psicologica*, *24*(2), 143–148.

Franke, L. K., Miedl, S. F., Danböck, S. K., Grill, M., Liedlgruber, M., Kronbichler, M., Flor, H., & Wilhelm, F. H. (2022). Neuroscientific evidence for pain being a classically conditioned response to trauma- and pain-related cues in humans. *Pain*, *163*(11), 2118–2137. https://doi.org/10.1097/j.pain.0000000000002621

Franke, L. K., Rattel, J. A., Miedl, S. F., Danböck, S. K., Bürkner, P.-C., & Wilhelm, F. H. (2021). Intrusive memories as conditioned responses to trauma cues: An empirically supported concept? *Behaviour Research and Therapy*, *143*, 103848. https://doi.org/10.1016/j.brat.2021.103848

Ganslmeier, M., Kunze, A. E., Ehring, T., & Wolkenstein, L. (2022). The dilemma of trauma-focused therapy: Effects of imagery rescripting on voluntary memory. *Psychological Research*, *1*, 3. https://doi.org/10.1007/s00426-022-01746-z

Giesbrecht, T., Smeets, T., & Merckelbach, H. (2008). Dissociative experiences on ice – peritraumatic and trait dissociation during the cold pressor test. *Psychiatry Research*, *157*(1–3), 115–121. https://doi.org/10.1016/j.psychres.2006.12.012

Hagenaars, M. A., van Minnen, A., Holmes, E. A., Brewin, C. R., & Hoogduin, K. A. L. (2008). The effect of hypnotically induced somatoform dissociation on the development of intrusions after an aversive film. *Cognition and Emotion*, *22*(5), 944–963. https://doi.org/10.1080/02699930701575151

Halligan, S. L., Michael, T., Clark, D. M., & Ehlers, A. (2003). Posttraumatic stress disorder following assault: The role of cognitive processing, trauma memory, and appraisals. *Journal of Consulting and Clinical Psychology*, *71*(3), 419–431. https://doi.org/10.1037/0022-006X.71.3.419

Hautzinger, M., & Bailer, M. (1993). *Allgemeine Depressionsskala* [General depression scale]. Beltz.

Holmes, E. A., Brewin, C. R., & Hennessy, R. G. (2004). Trauma films, information processing, and intrusive memory development. *Journal of Experimental Psychology: General*, *133*(1), 3–22. https://doi.org/10.1037/0096-3445.133.1.3

Holmes, E. A., Oakley, D. A., Stuart, A. D. P., & Brewin, C. R. (2006). Investigating peri-traumatic dissociation using hypnosis during a traumatic film. *Journal of Trauma & Dissociation*, *7*(4), 91–113. https://doi.org/10.1300/J229v07n04_06

Kindt, M., & Van Den Hout, M. (2003). Dissociation and memory fragmentation: Experimental effects on metamemory but not on actual memory performance. *Behaviour Research and Therapy*, *41*(2), 167–178. https://doi.org/10.1016/S0005-7967(01)00135-8

Kindt, M., Van den Hout, M., & Buck, N. (2005). Dissociation related to subjective memory fragmentation and intrusions but not to objective memory disturbances. *Journal of Behavior Therapy and Experimental Psychiatry*, *36*(1), 43–59. https://doi.org/10.1016/J.JBTEP.2004.11.005

Kozlowska, K., Walker, P., McLean, L., & Carrive, P. (2015). Fear and the defense cascade. *Harvard Review of Psychiatry*, *23*(4), 263–287. https://doi.org/10.1097/HRP.0000000000000065

Laposa, J. M., & Rector, N. A. (2012). The prediction of intrusions following an analogue traumatic event: Peritraumatic cognitive processes and anxiety-focused rumination versus rumination in response to intrusions. *Journal of Behavior Therapy and Experimental Psychiatry*, *43*(3), 877–883. https://doi.org/10.1016/j.jbtep.2011.12.007

Lensvelt-Mulders, G., van der Hart, O., van Ochten, J. M., van Son, M. J. M., Steele, K., & Breeman, L. (2008). Relations among peritraumatic dissociation and posttraumatic stress: A meta-analysis. *Clinical Psychology Review*, *28*(7), 1138–1151. https://doi.org/10.1016/j.cpr.2008.03.006

Leonard, K. N., Telch, M. J., & Harrington, P. J. (1999). Dissociation in the laboratory: A comparison of strategies. *Behaviour Research and Therapy*, *37*(1), 49–61. https://doi.org/10.1016/S0005-7967(98)00072-2

Leonard, K. N., Telch, M. J., & Owen, K. K. (2000). Fear response to dissociation challenge. *Anxiety, Stress & Coping*, *13*(4), 355–369. https://doi.org/10.1080/10615800008248341

Lickel, J., Nelson, E., Lickel, A. H., & Deacon, B. (2008). Interoceptive exposure exercises for evoking depersonalization and derealization: A pilot study. *Journal of Cognitive Psychotherapy*, *22*(4), 321–330. https://doi.org/10.1891/0889-8391.22.4.321

Maercker, A. (1994). *Deutsche Übersetzung des Peritraumatic Dissociative Experiences Questionnaire* [German version of the peritraumatic dissociative experiences questionnaire]. Unpublished manuscript. https://www.psychologie.uzh.ch/dam/jcr:9a580e93-85b4-4b12-aa97-fb2778d9d855/PDEQ_Fragebogen.pdf

Marmar, C. R., Weiss, D. S., & Metzler, T. (1998). Peritraumatic dissociation and posttraumatic stress disorder. In J. D. Bremner & C. R. Marmar (Eds.), *Trauma, memory, and dissociation* (pp. 229–252). American Psychiatric Press.

Marmar, C. R., Weiss, D. S., & Metzler, T. J. (1997). The peritraumatic dissociative experiences questionnaire. In J. P. Wilson & T. M. Keane (Eds.), *Assessing psychological trauma and PTSD* (pp. 412–428). Guilford Press.

Miller, P. P., Brown, T. A., DiNardo, P. A., & Barlow, D. H. (1994). The experimental induction of depersonalization and derealization in panic disorder and nonanxious subjects. *Behaviour Research and Therapy*, *32*(5), 511–519. https://doi.org/10.1016/0005-7967(94)90138-4

Noé, G. (2002). *Irreversibel [Film]*. StudioCanal.

Oakley, D. A., Deeley, Q., & Halligan, P. W. (2007). Hypnotic depth and response to suggestion under standardized conditions and during fMRI scanning. *International Journal of Clinical and Experimental Hypnosis*, *55*(1), 32–58. https://doi.org/10.1080/00207140600995844

Ozer, E. J., Best, S. R., Lipsey, T. L., & Weiss, D. S. (2003). Predictors of posttraumatic stress disorder and symptoms in adults: A meta-analysis. *Psychological Bulletin*, *129*(1), 52–73. https://doi.org/10.1037/0033-2909.129.1.52

R Core Team. (2019). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing.

Radloff, L. S. (1977). The CES-D scale: A self-report depression scale for research in the general population. *Applied Psychological Measurement*, *1*(3), 385–401. https://doi.org/10.1177/014662167700100306

Regambal, M. J., & Alden, L. E. (2009). Pathways to intrusive memories in a trauma analogue paradigm: A structural equation model. *Depression and Anxiety*, *26*(2), 155–166. https://doi.org/10.1002/da.20483

Röder, C. H., Michal, M., Overbeck, G., van de Ven, V. G., & Linden, D. E. J. J. (2007). Pain response in depersonalization: A functional imaging study using hypnosis in healthy subjects. *Psychotherapy and Psychosomatics*, *76*(2), 115–121. https://doi.org/10.1159/000097970

Rodewald, F., Gast, U., & Emrich, H. (2006). Screening auf Komplexe Dissoziative Störungen mit dem Fragebogen für dissoziative Symptome (FDS) [Screening for major dissociative disorders with the FDS, the German version of the dissociative experience scale]. *PPmP – Psychotherapie · Psychosomatik · Medizinische Psychologie*, *56*(6), 249–258. https://doi.org/10.1055/s-2006-932590

Sack, M., Cillien, M., & Hopper, J. W. (2012). Acute dissociation and cardiac reactivity to script-driven imagery in trauma-related disorders. *European Journal of Psychotraumatology*, *3*(1), 17419. https://doi.org/10.3402/ejpt.v3i0.17419

Schäflein, E., Sattel, H., Schmidt, U., & Sack, M. (2018). The enemy in the mirror: self-perception-induced stress results in dissociation of psychological and physiological responses in patients with dissociative disorder. *European Journal of Psychotraumatology*, *9*, 1472991. https://doi.org/10.1080/20008198.2018.1472991

Schauer, M., & Elbert, T. (2010). Dissociation following traumatic stress. *Zeitschrift Für Psychologie/Journal of Psychology*, *218*(2), 109–127. https://doi.org/10.1027/0044-3409/a000018

Shin, G. I., Goldstein, L. H., & Pick, S. (2019). Evidence for subjective emotional numbing following induced acute dissociation. *Behaviour Research and Therapy*, *119*, 103407. https://doi.org/10.1016/j.brat.2019.05.004

Spielberger, C. D., Gorsuch, R. L., Lushene, R., Vagg, P. R., & Jacobs, G. A. (1983). *Manual for the state-trait anxiety scale*. Consulting Psychologists Press.

Spitzer, C., Mestel, R., Klingelhöfer, J., Gänsicke, M., & Freyberger, H. J. (2004). Screening und Veränderungsmessung dissoziativer Psychopathologie: Psychometrische Charakteristika der Kurzform des Fragebogens zu dissoziativen Symptomen (FDS-20) [Screening and Measurement of Change of Dissociative Psychopathology: Psychometric Properties of the Short Version of the Fragebogen zu Dissoziativen Symptomen (FDS-20)]. *PPmP – Psychotherapie · Psychosomatik · Medizinische Psychologie*, *54*(3/4), 165–172. https://doi.org/10.1055/s-2003-814783

Van der Hart, O., van Ochten, J. M., van Son, M. J. M., Steele, K., & Lensvelt-Mulders, G. (2008). Relations among peritraumatic dissociation and posttraumatic stress: A critical review. *Journal of Trauma and Dissociation*, *9*(4), 481–505. https://doi.org/10.1080/15299730802223362

Vehtari, A., Gelman, A., Simpson, D., Carpenter, B., & Bürkner, P.-C. (2021). Rank-normalization, folding, and localization: An improved R^ for assessing convergence of MCMC (with discussion). *Bayesian Analysis*, *16*(2), 667–718. https://doi.org/10.1214/20-BA1221

Vonderlin, R., Kleindienst, N., Alpers, G. W., Bohus, M., Lyssenko, L., & Schmahl, C. (2018). Dissociation in victims of childhood abuse or neglect: A meta-analytic review. *Psychological Medicine*, *48*(15), 2467–2476. https://doi.org/10.1017/S0033291718000740

Werner, G. G., Schabus, M., Blechert, J., & Wilhelm, F. H. (2020). Differential effects of REM sleep on emotional processing: Initial evidence for increased short-term emotional responses and reduced long-term intrusive memories. *Behavioral Sleep Medicine*, *19*, 1–16. https://doi.org/10.1080/15402002.2020.1713134

Yorkey, B., Alvarez, K. P., & Allesandro, B. D. (2018). *13 reasons Why. Bye (season 2, episode 13)* [film]. July Moon Productions, Kicked to the Curb Productions, That Kid Ed., Anonymous Content, Paramount Television.