The association between challenging behaviour and symptoms of post-traumatic stress disorder in people with intellectual disabilities: a Bayesian mediation analysis approach

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Abstract

Background A preponderance of behavioural symptoms is assumed to be the main difference in the manifestation of symptoms of post-traumatic stress disorder (PTSD) in people with intellectual disability (ID). However, no study so far has assessed the relationship between challenging behaviour (CB) and PTSD. The present study aims to explore this relationship by exploring whether CB is directly related to trauma exposure or whether this relationship is mediated through core symptoms of PTSD.

Methods Trauma exposure and current symptoms of PTSD were assessed in 43 adults with mild to moderate ID. Parallel versions were administered to 43 caregivers, including the Aberrant Behaviour Checklist to measure CB. Bayesian mediation analyses were conducted using self-rated and informant-rated data.

Results The self-report data showed no associations of CB with trauma exposure or PTSD symptoms. The association between informant-rated trauma exposure and irritability was mediated by severity and frequency of PTSD symptoms. The associations between informant-reported trauma exposure and the Aberrant Behaviour Checklist subscales hyperactivity and inappropriate speech were mediated by PTSD symptom severity.

Conclusions The relationship between trauma exposure and CB was mediated by PTSD symptoms. PTSD core symptoms should be considered as underlying causes of CB, highlighting the necessity to explore trauma biography and symptoms of PTSD. The improvement of self-report assessment in people with ID is an important task for future studies.

Keywords Bayesian mediation analysis, challenging behaviour, intellectual disability, PTSD, trauma

Background

Challenging behaviour and mental health in people with intellectual disabilities

Challenging behaviour (CB) is defined as culturally abnormal behaviour(s) that put the physical safety of the person or others in serious jeopardy or result(s) in the person being denied access to ordinary community facilities (Reiss 1982; Emerson and Einfeld 2011). The overall prevalence of CB in people with intellectual disability (ID) was 18.1% in a recent
study (Bowring et al. 2017). In previous studies, this number has varied considerably depending on the definition of CB and the severity of the disability, with more severely disabled people presenting with higher rates of CB (Thakker et al. 2012; Bowring et al. 2017). CB is often attributed to the basic condition of ID, without considering alternative explanations such as co-morbid psychiatric symptoms. This phenomenon is referred to as ‘diagnostic overshadowing’ and impacts clinical practice as it might lead to biased treatment recommendations (Jopp and Keyes 2001).

The relationship between CB and mental health has garnered a vast amount of research interest (Thakker et al. 2012), and it has been suggested to be ‘complex, multifaceted and potentially bidirectional’ (Painter et al. 2018). A number of hypotheses on this relationship have been brought forward in previous literature (Thakker et al. 2012). One central hypothesis has been proposed by Emerson (2001), who suggests that CB is either (1) an atypical presentation of core symptoms of psychiatric disorders, (2) a secondary feature of psychiatric disorders, or (3) itself reinforced and maintained through psychiatric disorders. Notwithstanding certain ambiguities regarding this relationship, there is agreement that CB indicates emotional distress and that a careful exploration of possible underlying factors is essential (Melville et al. 2016; Painter et al. 2018). There is a risk of overlooking symptoms of psychiatric disorders if too much attention is paid to behavioural symptoms (Melville et al. 2016; Charlot et al. 2017; Painter et al. 2018).

It has been shown that an exploration of these factors is feasible in people with mild to moderate ID and that they had clear views on factors related to CB. The people surveyed related CB to lack of structure and clarity in their daily life, others placing too much demand on them and inability to cope with emotions (Wolkerte et al. 2019). Furthermore, previous literature has emphasised considering environmental and psychological factors such as recent life events as potential triggers of CB (Thakker et al. 2012). However, the relationship between CB, trauma exposure and PTSD has not yet been addressed in research. This is further underlined considering that the vulnerability for both trauma exposure and development of PTSD are believed to be elevated in the ID population.

### Trauma in people with intellectual disability

People with ID have an increased vulnerability to potentially traumatic experiences, especially interpersonal violence (Mevissen and de Jongh 2010; Wigham and Emerson 2015; Mevissen et al. 2016), with one meta-analysis reporting a 1.6-fold higher risk of exposure to violence in adults with ID compared with adults without disabilities (Hughes et al. 2012). A greater dependency on others in daily life, which leads to an elevated risk for carer-perpetrated violence, is among the risk factors that contribute to this increased vulnerability for trauma exposure (Noske et al. 2001; European Union Agency for Fundamental Rights 2015; Wigham and Emerson 2015). Furthermore, some of the most important risk factors for the development of PTSD following trauma exposure, which have been derived from the general literature, such as lower intelligence and a lower developmental level, are elevated in people with ID (Brewin et al. 2000; American Psychiatric Association 2013). Furthermore, successful disclosure of trauma and the gathering of social support have emerged as important protective factors (Brewin et al. 2000; Tran et al. 2013). As verbal limitations are common in people with ID, these can represent a barrier to disclosure and result in difficulties in receiving social support (Catani & Sossalla, 2015). The higher social isolation of people with ID further hinders them from benefitting from the protective effect of social support (Wigham et al. 2014). Overall, the conditional probability of developing pathological trauma sequelae, such as PTSD, is expected to be higher in people with ID compared with the general population (Mevissen and de Jongh 2010; Mevissen et al. 2016). Indeed, prevalence estimates for PTSD in people with ID are around 10%, which is towards the upper limit of the prevalence in the general population (Daveney et al. 2019).

### The conceptualisation of post-traumatic stress disorder in people with intellectual disability

The conceptualisation, prevention and treatment of PTSD have received a vast amount of scientific attention in the general population. However, it remains unclear, which of these research findings can be generalised to people with ID (Wigham and Emerson 2015). There is consensus that the individual developmental level influences the...
presentation of symptoms of PTSD (American Psychiatric Association 2013). The Diagnostic and Statistical Manual of Mental Disorders 5th Edition takes this into account by proposing adapted criteria for children aged 6 years and younger. These criteria highlight a behavioural symptom presentation, which is also distinctive in the symptom presentation of people with ID (Mevissen and de Jongh 2010; Wigham et al. 2011; Bakken et al. 2014). However, a specific adaption of criteria for this group has not yet been introduced by the Diagnostic and Statistical Manual of Mental Disorders. The need for a specific adaption has resulted in the publication of two manuals comprising modified criteria: the Diagnostic Manual–Intellectual Disability (DM-ID) 2 (Fletcher et al. 2017) and the Diagnostic Criteria for Psychiatric Disorders for Use with Adults with Learning Disabilities (DC-LD) (Cooper 2001) have been published. However, empirical evidence for these criteria is lacking (Wigham et al. 2011).

Recent scientific advances on PTSD in people with ID further highlight the need of adapted criteria for people with ID, suggesting that the profile of PTSD symptoms is unique in this population (Mason-Roberts et al. 2018). There is a need for looking into the phenomenology of PTSD in people with ID in order to prevent biased referrals and treatment recommendations (Truesdale et al. 2019), particularly emphasising the role of behavioural symptom presentation (Bakken et al. 2014; Mevissen and de Jongh 2010; Wigham et al. 2011). However, unravelling the relationship between CB and PTSD is especially complex by the fact that the PTSD symptoms of irritable or aggressive behaviour and self-destructive or reckless behaviour overlap with CB (Yang et al. 2017). These symptoms can be assumed to be more prevalent in people with ID. Moreover, it can be assumed that intrapsychic symptoms, such as re-experiencing and avoidance of thoughts or feelings are increasingly presented behaviourally. The ambiguity in interpreting behavioural symptoms comprises the risk of overlooking PTSD symptoms that have an unspecific appearance in people with ID (Bakken et al. 2014; Kildahl et al. 2019).

How exactly certain behaviours might relate to and be traced back to PTSD core symptoms has been discussed in previous literature. For instance, trauma-specific enactments might be an expression of experiencing flashbacks (Bakken et al. 2014).

Non-compliant behaviour and refusal to participate in activities may represent avoidance attempts in people who lack control over their daily life (Focht-New et al. 2008; Wigham and Emerson 2013). However, the nature of the relationship between CB and symptoms of PTSD remains unclear. When aiming at exploring this relationship, one particularity of PTSD has to be considered: in contrast to other psychiatric disorders, the aetiology of core PTSD symptoms is monofactorial: PTSD is tied to a specific traumatic event that triggers the core symptoms of intrusion, avoidance, negative alterations in cognitions and mood and alterations in arousal and reactivity (American Psychiatric Association 2013). Therefore, in order to understand the relationship between CB and PTSD, the interaction between CB, trauma exposure and core symptoms of PTSD has to be clarified.

The present study

A better understanding of the role of CB in PTSD is necessary to improve our understanding of the conceptualisation of PTSD in people with ID. Such an understanding would enable us to disentangle which insights from the general literature can be transferred to persons with ID and in which aspects new specific insights are necessary. These insights would have important implications for the treatment of PTSD and the prevention of negative consequences of CB, such as re-victimisation, social exclusion and systematic neglect (Emerson and Einfeld 2011). The present study aims to explore the relationship between CB and PTSD by addressing the interaction of CB with trauma exposure and symptoms of PTSD, assessing whether CB was directly related to trauma exposure or whether this relationship was mediated through core symptoms of PTSD (Fig. 1).

Method

Participants

Fifty-four adults with mild to moderate ID were interviewed by trained clinical psychologists. Five persons were excluded from the analysis due to difficulties in comprehension. Each of the participants chose either a paid caregiver or a family member as an informant. Six participants had to be excluded.
because informant data were not available. The final sample thus comprised 43 adults with mild to moderate ID and 43 informants. The sample of adults with ID consisted of 18 male participants, with a mean age of 38.6 (SD = 13.5), ranging from 20 to 56 years and 25 women with a mean age of 46.1 (SD = 13.7), ranging from 25 to 76 years. The informants consisted of 42 paid caregivers and one family member. Paid caregivers reported having known the participant for an average of 5.7 (SD = 6.2), ranging from 0.5 to 25 years and an average contact frequency of 3.9 (SD = 1.5) times per week, ranging from 1 to 7 times.

**Measures**

*Self-report measures*

Data on biographical life events were collected using the German version of the Maltreatment and Abuse Chronology of Exposure Scale (Teicher and Parigger 2015), the KERF-20 (Isele et al. 2014), which assesses sexual, physical and emotional abuse, physical and emotional neglect, and witnessing of violence during childhood in the general population. For the purpose of the current study, the instrument was adapted by simplifying the wording and extending the queried period to the lifespan. Furthermore, we refrained from distinguishing between perpetrators. In the present study, the reliabilities for the KERF subscales were Cronbach’s $\alpha = 0.63$–0.87. The physical neglect subscale showed a Cronbach’s $\alpha$ of 0.39 and was therefore excluded from the analysis. Current symptoms of PTSD were assessed using the Lancaster and Northgate Trauma Scales for Intellectual Disabilities Self-Report Version (LANTS-SR) (Wigham et al. 2011), which is specifically designed for use in people with ID. The LANTS-SR comprises 29 questions assessing possible effects of traumatic events. These effects go beyond those defined for the general population. The LANTS-SR has demonstrated good reliability, with Cronbach’s $\alpha = 0.89$ (Hall et al. 2014). In the present study, the reliability lay at Cronbach’s $\alpha = 0.84$.

The item formulation of the self-report measures was adapted for easy language in German and finalised together with a group of self-advocates. The third author, who significantly participated in the process of translation and simplifying the self-report measures, has a long-standing experience in working with people with ID.

**Informant measures**

Participants’ informant-reported biography was assessed using an adapted version of the KERF (KERF-I). The KERF was originally designed as a self-report measure, and the version adapted for self-report in participants with ID in the present study was also used with informants but omitting the physical and emotional neglect subscales. Symptoms of PTSD were assessed using the informant version of the LANTS (LANTS-I). The scale comprises 43 questions on observable effects of trauma in people with ID on three subscales: frequency, severity and behavioural changes (Wigham et al. 2011). The latter subscale measures behavioural changes observed by informants after traumatic events. It was excluded from the present analyses, as this study assessed the whole life span and thus potentially events unknown to the informant. The LANTS-I has previously shown good reliability, with Cronbach’s alphas ranging from 0.86 to 0.92 for each subscale at two different time points (Hall et al. 2014). In the current study, the psychometric properties were Cronbach’s $\alpha = 0.93$ for the frequency subscale and 0.96 for the severity subscale. Both versions of the LANTS were translated into German in a back-translation process involving the first author and a professional translator.

Challenging behaviour was assessed using the Aberrant Behaviour Checklist (ABC) (Aman 2013). The ABC comprises 58 items covering five subscales of CB: irritability, lethargy, stereotypy, hyperactivity and inappropriate speech. The subscales of the German translation of the ABC have shown Cronbach’s alphas ranging from 0.78 to 0.92.
(Zeilinger et al. 2011). In the present study, the reliability lay at Cronbach’s $\alpha = 0.95$.

**Procedure**

Ethical approval was obtained from the Ethics Committee of the University of Vienna (reference number: 00283; date of approval: 02.11.2017). Participants were contacted in a top-down process and through snowball sampling. Public institutions for housing, work and advocacy of people with ID in Austria were approached via email. Contact with these institutions was also established through a presentation at an umbrella organisation for the psycho-social care of people with ID. After this initial contact, the authors offered to provide caregivers and potential participants with a personal presentation of further study details. Furthermore, participants were approached at a congress for self-advocates. Additionally, data were collected at an institution for people with ID in Switzerland by the on-site clinical psychologist. Data collection took place from January to October 2018. The self-report questionnaire was administered in a face-to-face interview situation. Adequate understanding was checked using an empirical assessment of capacity to consent (Wigham et al. 2014). Since the interviews comprised sensitive topics, short psychological interventions were offered following the interview if necessary. Additionally, participants were provided with a list of specialised institutions (e.g. counselling centres) and a helpline run by the authors. Assessment of informant data either took place in an interview situation (67.4%) or the informants completed the questionnaire in their own time (32.6%).

**Data analysis**

Statistical mediation analysis (MacKinnon and Tofghi 2013) was conducted in MPLUS 8.2 (Muthén and Muthén 1998) to test whether CB is directly related to trauma exposure or mediated by core PTSD symptoms. A Bayesian Markov chain Monte Carlo (MCMC) estimation method based on non-informative prior distributions according to the programme’s default settings was applied (Depaoli et al. 2017). Bayesian estimation was chosen because the default maximum likelihood estimation method assumes large samples, while Bayesian estimation allows smaller data sets to be analysed (Van de Schoot et al. 2015). Unlike maximum likelihood estimation, Bayesian estimation does not require the sampling distribution of the product term for testing the indirect effect to be normally distributed. Hence, the statistical significance of the product term can be tested without using a bootstrap approach (Yuan and MacKinnon 2009).

Following recommendations by Hox et al. (2012), convergence was assessed using the Gelman–Rubin criterion with a stricter cut-off value of 0.01 rather than the default setting of 0.05. Eight chains were requested for the Gibbs sampler, and a minimum number of 10,000 iterations was specified. Starting values were based on the maximum likelihood estimates of the model parameters. All trace plots were manually inspected to check for convergence.

**Results**

The means and standard deviations of the ABC subscales rated by informants are presented in Table 1. Percentile ranges are based on an Austrian/German norm sample of people with mild to moderate ID (Zeilinger 2009). Participants reported a mean of 4.45 (SD = 9.66) traumatic events in the KERF, with emotional violence being the most prevalent form, followed by physical abuse, sexual abuse, witnessing of violence and emotional neglect. The mean LANTS score reported was 49.08 (SD = 19.32). Informants reported a mean of 1.97 (SD = 2.22) traumatic events, with emotional violence being the most prevalent form, followed by physical and sexual violence, with witnessing of violence being the least prevalent form. The mean I-LANTS score severity reported was 23.42 (SD = 22.02), and the mean

| Subscale         | M (SD) | Range | Percentile range | Minimum | Maximum |
|------------------|--------|-------|------------------|---------|---------|
| Irritability     | 7.4 (8.9) | 0–34 | 87 | 0–45 |
| Lethargy         | 2.8 (3.4)  | 0–13 | 79 | 0–48 |
| Stereotypy       | 1.5 (2.1) | 0–9  | 93 | 0–21 |
| Hyperactivity    | 5.4 (7.4)  | 0–35 | 86 | 0–48 |
| Inappropriate speech | 2.6 (2.9) | 0–12 | 90 | 0–12 |

Percentile ranks mark the percentage of scores in the normative population that are equal or lower than the mean in the current sample.
frequency score was 67.06 (SD = 26.68). The correlation between the self-reported PTSD symptoms and informant-rated symptom frequency was \( r = -0.275 \) (\( P > 0.05 \)) and with severity \( r = -0.389 \) (\( P < 0.05 \)).

Self-reported trauma exposure and trauma sequelae

Results of the mediation analysis testing the indirect effect of self-reported trauma exposure, via trauma sequelae, on CB, statistically controlling for age and gender, are shown in Table 2 and depicted in Fig. 2.

The results showed no indirect effect of trauma exposure, via trauma sequelae, on irritability (\( \hat{\beta} = 0.01, \ P = 0.724 \)), lethargy (\( \hat{\beta} = 0.03, \ P = 0.184 \)), stereotypy (\( \hat{\beta} = 0.02, \ P = 0.384 \)), hyperactivity (\( \hat{\beta} = -0.01, \ P = 0.702 \)) and inappropriate speech (\( \hat{\beta} = 0.01, \ P = 0.866 \)). The direct effects while statistically controlling for the indirect effect were also not significant for irritability (\( \hat{\beta} = 0.24, \ P = 0.138 \)), lethargy (\( \hat{\beta} = 0.07, \ P = 0.266 \)), stereotypy (\( \hat{\beta} = 0.02, \ P = 0.850 \)), hyperactivity (\( \hat{\beta} = 0.24, \ P = 0.138 \)).

Table 2  Results of the mediation analysis: self-reported trauma exposure abuse and trauma sequelae

| Independent variable | Mediating variable | Dependent variable | Est. (SD) | 95% CI | Std. Est. |
|----------------------|-------------------|-------------------|----------|-------|----------|
| Trauma exposure      | PTSD              | Irritability      | 0.014 (0.060) | [−0.098, 0.154] | 0.013 |
| Trauma exposure      | PTSD              | Lethargy          | 0.025 (0.027) | [−0.011, 0.094] | 0.063 |
| Trauma exposure      | PTSD              | Stereotypy        | 0.020 (0.034) | [−0.031, 0.103] | 0.039 |
| Trauma exposure      | PTSD              | Hyperactivity     | −0.012 (0.050) | [−0.127, 0.080] | −0.014 |
| Trauma exposure      | PTSD              | Inappropriate speech | 0.006 (0.067) | [−0.154, 0.128] | −0.005 |
| Trauma exposure      | PTSD              | Irritability      | 0.244 (0.166) | [−0.083, 0.571] | 0.239 |
| Trauma exposure      | PTSD              | Lethargy          | 0.069 (0.063) | [−0.055, 0.194] | 0.175 |
| Trauma exposure      | PTSD              | Stereotypy        | 0.016 (0.085) | [−0.151, 0.185] | 0.031 |
| Trauma exposure      | PTSD              | Hyperactivity     | 0.240 (0.136) | [−0.030, 0.506] | 0.286 |
| Trauma exposure      | PTSD              | Inappropriate speech | 0.330 (0.185) | [−0.029, 0.699] | 0.281 |

95% CI = 95% Bayesian credibility interval. Est. = unstandardised Bayesian posterior median estimate; SD = standard deviation of the posterior distribution; Std. Est. = standardised estimate.

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0.078) and inappropriate speech ($\hat{\beta} = 0.33, P = 0.072$).

Informant-reported trauma exposure and trauma sequelae frequency

The results of the mediation analysis testing the indirect effect of informant-reported trauma exposure via trauma sequelae frequency, on CB, statistically controlling for age and gender, are shown in Table 3 and depicted in Fig. 3. The results revealed an indirect effect of trauma exposure, via trauma sequelae, frequency on irritability ($\hat{\beta} = 0.39, P = 0.002$). However, the indirect effects on lethargy ($\hat{\beta} = 0.07, P = 0.116$), stereotypy ($\hat{\beta} = 0.04, P = 0.452$), hyperactivity ($\hat{\beta} = 0.14, P = 0.120$) and inappropriate speech ($\hat{\beta} = 0.16, P = 0.192$) were not statistically significant. The direct effects while statistically controlling for the indirect effect were not significant for irritability ($\hat{\beta} = 0.03, P = 0.852$), lethargy ($\hat{\beta} = 0.06, P = 0.502$), stereotypy ($\hat{\beta} = 0.04, P = 0.452$), hyperactivity ($\hat{\beta} = 0.14, P = 0.120$) and inappropriate speech ($\hat{\beta} = 0.16, P = 0.192$).

Table 3 Results of the mediation analysis: informant-reported trauma exposure and trauma sequelae frequency

| Independent variable | Mediating variable | Dependent variable | Est. (SD) | 95% CI         | Std. Est. |
|----------------------|-------------------|--------------------|----------|----------------|-----------|
| Indirect effect      |                   |                    |          |                |           |
| Trauma exposure      | LANTS frequency   | Irritability       | 0.389 (0.146) | [0.141, 0.715] | 0.306     |
| Lethargy             |                   |                    | 0.067 (0.052) | [-0.019, 0.187] | 0.129     |
| Stereotypy           |                   |                    | 0.042 (0.067) | [-0.084, 0.190] | 0.062     |
| Hyperactivity        |                   |                    | 0.135 (0.104) | [-0.039, 0.374] | 0.124     |
| Inappropriate speech |                   |                    | 0.160 (0.146) | [-0.092, 0.490] | 0.100     |
| Direct effect controlling for indirect effect | | | | | |
| Trauma exposure      |                   | Irritability       | 0.030 (0.167) | [-0.298, 0.357] | 0.023     |
| Lethargy             |                   |                    | 0.057 (0.087) | [-0.114, 0.229] | 0.110     |
| Stereotypy           |                   |                    | 0.001 (0.119) | [-0.234, 0.234] | 0.002     |
| Hyperactivity        |                   |                    | 0.227 (0.175) | [-0.122, 0.570] | 0.208     |
| Inappropriate speech |                   |                    | 0.223 (0.254) | [-0.274, 0.729] | 0.141     |

Statistically significant results at $\alpha = 0.05$ are in boldface. 95% CI = 95% Bayesian credibility interval. Est. = unstandardised Bayesian posterior median estimate; SD = standard deviation of the posterior distribution; Std. Est. = standardised estimate.

Figure 3. Path diagram of the mediation model with informant-reported trauma exposure and trauma frequency: unstandardised estimates. Statistically significant results at $\alpha = 0.05$ are in boldface. LANTS, Lancaster and Northgate Trauma Scales for Intellectual Disabilities.

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Informant-reported trauma exposure and trauma sequelae severity

The results of the mediation analysis testing the indirect effect of informant-reported trauma exposure, via trauma sequelae severity, on CB statistically controlling for age and gender, are shown in Table 4 and depicted in Fig. 4. The results revealed an indirect effect of trauma exposure, via trauma sequelae severity, on irritability ($\hat{\beta} = 0.42$, $P < 0.001$), hyperactivity ($\hat{\beta} = 0.22$, $P = 0.016$) and inappropriate speech ($\hat{\beta} = 0.28$, $P = 0.032$). However, the indirect effects for lethargy ($\hat{\beta} = 0.08$, $P = 0.056$) and stereotypy ($\hat{\beta} = 0.07$, $P = 0.222$) were not statistically significant. The direct effects while statistically controlling for the indirect effect were not significant for irritability ($\hat{\beta} = 0.00$, $P = 0.978$), lethargy ($\hat{\beta} = 0.04$, $P = 0.634$), stereotypy ($\hat{\beta} = -0.03$, $P = 0.798$), hyperactivity

Table 4 Results of the mediation analysis: informant-reported trauma exposure and PTSD severity

| Independent variable | Mediating variable | Dependent variable | Est. (SD) | 95% CI     | Std. Est. |
|----------------------|-------------------|--------------------|----------|-----------|-----------|
| Indirect effect      |                   |                    |          |           |           |
| Trauma exposure      | LANTS severity    | Irritability       | 0.424    | [0.164, 0.757] | 0.424     |
|                      |                   | Lethargy           | 0.084    | [-0.002, 0.208] | 0.084     |
|                      |                   | Stereotypy         | 0.072    | [-0.051, 0.228] | 0.072     |
|                      |                   | Hyperactivity      | 0.215    | [0.039, 0.473] | 0.215     |
|                      |                   | Inappropriate speech | 0.275  | [0.026, 0.632] | 0.275     |
| Direct effect controlling for indirect effect | | Irritability | -0.004 | [-0.323, 0.311] | -0.003   |
| Trauma exposure      |                   | Lethargy           | 0.040    | [-0.131, 0.208] | 0.076     |
|                      |                   | Stereotypy         | -0.030   | [-0.265, 0.200] | -0.044    |
|                      |                   | Hyperactivity      | 0.145    | [-0.184, 0.470] | 0.135     |
|                      |                   | Inappropriate speech | 0.106  | [-0.368, 0.586] | 0.067     |

Statistically significant results at $\alpha = 0.05$ are in boldface. 95% CI = 95% Bayesian credibility interval. Est. = unstandardised Bayesian posterior median estimate; SD = standard deviation of the posterior distribution; Std. Est. = standardised estimate.

Figure 4. Path diagram of the mediation model with informant-reported trauma exposure and trauma severity: unstandardised estimates. Statistically significant results at $\alpha = 0.05$ are in boldface. LANTS, Lancaster and Northgate Trauma Scales for Intellectual Disabilities.
The association between symptoms of post-traumatic stress disorder and challenging behaviour

The current results contribute to the understanding of the complex relationship of CB and symptoms of PTSD by suggesting that CB is not directly related to trauma exposure but mediated by PTSD symptoms. It can be assumed that PTSD symptoms and CB interact in different ways. PTSD comprises externalising behaviours that overlap with CB, such as irritable and aggressive behaviours. In the current study, the forms of CB that were associated with PTSD symptoms corresponded with these externalising behaviours. However, these symptoms are not distinctive to PTSD (Kildahl et al. 2019). Intrapsychic symptoms, such as re-experiencing a traumatic event and avoidance of thoughts and feelings are more characteristic for the disorder. The lack of associations on intrapsychic symptoms are in line with the findings of previous studies on PTSD in people with ID (Kildahl et al. 2019): These symptoms are underreported in studies involving people with ID, even though it can be assumed that these individuals experience them similarly to the general population. Underreporting of these symptoms is very likely due to people with ID having problems understanding them or verbal limitations in the ability to express these (Kildahl et al. 2019; Rittmannsberger et al. 2019). It is therefore important to further improve adapted assessment for PTSD symptoms in people with ID (Mevissen et al. 2016).

A behavioural overshadowing of these symptoms can be assumed (Daveney et al. 2019). Considering the definition of PTSD symptoms, this might mean for example that during intrusive memories, such as flashbacks, where the memory cannot be distinguished from an actual real-life experience, CB might occur as a reaction to this perceived threat. Knowledge about trauma history can facilitate a correct classification of behaviours as symptoms of PTSD (Kildahl et al. 2019).

Distinctiveness of self-report and informant-report

The present findings indicate that self-rated and informant-rated data are distinct from one another. One possible explanation for this lies in the correlation between the self-reported PTSD symptoms and informant-rated symptom frequency, which has to be considered as small according to the conventions of Cohen (1992). The finding is in line with Hall et al. (2014), who found a significant but small correlation between the self-report and the informant version of the LANTS (Cohen 1992). Another factor that possibly underlies the distinctiveness of the current data sources is that CB was rated only by informants. The question therefore arises of why informants report associations between symptoms of PTSD and CB that do not become apparent when analysing self-report data. This might be explained by barriers in self-report: Behaviours that informants consider as related to PTSD symptoms might be an expression of precisely those symptoms that people with ID themselves are having difficulties in verbalising.

Evidently, this does not minimise the importance of self-report, especially when assessing subjective states (Finlay and Lyons 2001; Mileviciute and Hartley 2015) and a potential biography of trauma exposure (Mevissen and de Jongh 2010). Studies relying on information gathered from informants may be hampered by a lack of knowledge about the internal states of people in their care or about their behavioural manifestations (Hall et al. 2014; Mileviciute and Hartley 2015). Nevertheless, the current informants were confidants selected by the participants themselves, suggesting a certain level of awareness. An important issue for future research will
be to improve the assessment of internal states in people with mild to moderate ID.

**Subscales of challenging behaviour**

The current study found no significant associations of trauma exposure or trauma sequelae with the subscale stereotypy. This finding is most likely related to the milder impairment of the current sample, as stereotypical behaviour more frequently occurs in people with more severe impairments and autism spectrum disorder (Carcani-Rathwell et al. 2006). Similar results emerged for the subscale lethargy. According to Aman and Singh (1994), a percentile rank under 85 is be considered problematic. Thus, the relatively low occurrence of lethargy in the current sample might best explain this result.

**Strengths of the study**

This is the first study to explore the relationship between CB and PTSD in people with ID. It was central to the current authors to support the self-determination and autonomy of people with ID by including self-advocates in the process of simplifying the language of assessment instruments as well as leaving the choice of who should be interviewed as an informant to the participants with ID. Furthermore, the current study applied a Bayesian mediation analysis to investigate the interaction between CB, trauma exposure and core symptoms of PTSD. Considering the usually small sample sizes in studies in persons with ID, the current data were analysed using Bayesian statistics, an approach better suited for the analysis of small samples (Van de Schoot et al. 2015).

**Limitations of the study**

The current study is based on the cross-sectional assessment of retrospective accounts, which makes biographical data prone to a recall bias. Another limitation is that translations of the applied measures have not yet been tested for their psychometrics. This also applies to the simplification of the KERF, for example, lack of differentiating between perpetrators. This certainly led to a loss of information on the severity of trauma exposure. Moreover, it was not considered whether the current participants were presenting a full-blown PTSD. The LANTS does not allow for this assessment. The participants were contacted in a top-down process and therefore pre-selected by the institutions, who considered them sufficiently stable to take part in this potentially stressful interview. CB is especially relevant in more severely impaired persons. This should be considered when drawing conclusions based on the present findings and in designing further research.

**Research implications**

The current results underline the importance of exploring underlying internal states of CB in order to further unravel the complex and multifaceted relationship between CB and PTSD (Painter et al. 2018). Emotional dysregulation is likely to play a major role in this relationship (Sappok et al. 2014; Melville et al. 2016). Inability to handle emotions has been mentioned as a subjective cause of CB by people with ID (Wolkorte et al. 2019). Moreover, emotional dysregulation is a symptom of complex PTSD (World Health Organisation 2018). The interaction of trauma exposure, emotional dysregulation, core symptoms of PTSD and CB is an important issue for future work. Moreover, further research might take a closer look at differentiating between core PTSD symptoms. In order to optimise self-report assessment in persons with ID, it is important to distinguish between core PTSD symptoms. So far, the LANTS does not provide a manualised instruction for the clustering of separately queried problems into the core symptoms, and there are no publications on the dimensionality of the LANTS. This is an important issue for future research. Research efforts should furthermore be directed towards the assessment of trauma biography in people with ID. The research question proposed by the current study should also be addressed in people with more severe forms of ID. Finally, the current results highlight the importance of considering several sources when assessing PTSD in persons with ID.

**Clinical implications**

The risk of overlooking internal states while focusing too much on behaviour is mentioned repeatedly in the literature on mental health and on the care of people with ID (Charlot et al. 2017; Painter et al. 2018). Given the increased vulnerability to trauma exposure in these individuals, symptoms of PTSD have to be considered as an underlying cause of CB (Wigham
and Emerson 2015). The current results highlight the importance of exploring the underlying causes of CB. Therefore, an exploration of the individual’s biography is essential. In a previous study, we demonstrated the feasibility of assessing a biography of trauma exposure in people with mild to moderate ID (Rittmannsberger et al. 2020). Awareness of a trauma biography facilitates the exploration of underlying causes of CB for caregivers. Interventions should focus on helping people with ID to understand underlying causes of CB for caregivers. Interventions should focus on helping people with ID to understand underlying internal symptoms, especially intrusive memories, and on enabling them to handle these symptoms.

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Conflict of Interest

The authors of this manuscript report no conflict of interest.

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