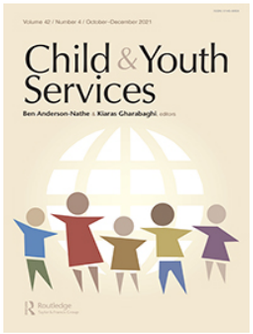
Neuro trauma training



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Neuro Trauma Training: Feasibility and Acceptability of Online Training in Executive Function for Residential Childcare Workers

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ABSTRACT

Background: In residential childcare for youth who have been removed from the birth home as a result of childhood maltreatment, staff are working with after-effects of developmental trauma. Experiencing trauma and neglect at a young age is likely to lead to adaptive alterations in brain development, in part due to over- or under-activation of the body's stress response. As a result, care-experienced children and youth with trauma backgrounds are likely to experience various neurodevelopmental difficulties, including executive function problems. There is a gap in training provision related to executive function in the context of neurodevelopmental trauma and its implications for current behavior, affect and cognition.

Objective: To conduct a feasibility and acceptability trial of an online training course for residential workers with care-experienced children, focusing on the impact of trauma on the development of executive function. The development of the training and an evaluation of its outcomes are described.

Participants and setting: Staff working in residential childcare across the UK were invited to participate in an online training and evaluation protocol.

Methods: Participants completed measures of perceived and actual knowledge before and after training. Completion rates, outcomes data and evaluation feedback was used to assess the acceptability and feasibility of the training,

Results: Of 318 initial registrants, 47.7% completed the training and post-training measures. Significant learning gains were found, along with ($p < .001$, $d = 1.08$) positive feedback from participants. Technological constraints were the most significant limitation.

Conclusions: An online neurodevelopmental trauma training is feasible and acceptable to residential childcare workers.

KEYWORDS

care-experience; children; executive function; knowledge transfer; online training; residential childcare staff; youth

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Children and youth who cannot be looked after at home, referred to here as 'care-experienced', are typically placed in foster or kinship care (Nissim, 2006). In the UK, kinship care is now the most common kind of placement (Scottish Social Services Council (SSSC), 2016; Department for Children, Schools, and Families (DCSF), 2021). In this context, placements in residential childcare units have substantially reduced in number with approximately 10% of children and youth under the care of local authorities placed in residential units (Scottish Government, 2018), reserved for those children and youth with severe and multiple behavioral and psychological difficulties (Berridge et al., 2012; Leloux-Opmeer et al., 2017). Although UK-based epidemiological research is scarce and sometimes historical, some internationally based studies indicate that children and youth being placed in residential units are older and present with more challenging and complex presentations than previously was the case (Delfabbro et al., 2005; Leloux-Opmeer et al., 2017; Steels & Simpson, 2017). Despite the increased severity of presenting difficulties and the complexity of care needs that follow this, care staff may have limited access to training and supervision (Happ et al., 2018), and understaffing is common (Galandini & Ferrer, 2020). This paper will evaluate the development and delivery of a new online training course for residential childcare workers, focusing on the impact of trauma on Executive Function (EF).

Early trauma and care experience

Whilst children and youth are taken into alternative care for different reasons, neglect or abuse, referred to hereafter as childhood maltreatment, is cited as the reason in 66% of cases (DCSF, 2021). In Scotland, 36–38% of child protection case conferences reported emotional abuse and neglect, and 27% reported concerns about physical, sexual and domestic abuse (Scottish Government, 2018). There is also extensive evidence from the USA, UK and Europe that care-experienced children and youth may experience difficulties in response to childhood maltreatment in their early lives (Fisher, 2015). Maltreatment perpetrated or facilitated by primary caregivers represents a fundamental violation of the behavioral system of proximity-seeking in infancy that ensures survival and underpins attachment development (Bowlby, 1973). Prolonged and severe violations to attachment assumptions in infancy and early childhood have widespread deleterious outcomes (Cook et al., 2005). Elevated rates of internalizing and externalizing problems have been found in foster care samples (Burns et al., 2004; Ford et al., 2007), further exacerbated by removal into care (Lawrence et al., 2006). Other negative outcomes include poorer academic

achievement (Pears et al., 2010); difficulty establishing high-quality peer relationships (DeLuca et al., 2019); and increased risk for juvenile delinquency (Malvaso et al., 2018).

Overall, studies suggest that maltreatment and alternative care experience may have different or additive effects. Maltreatment type, severity and timing are difficult to measure, leading to a lack of specificity and consistency in findings. A dearth of recent UK-based evidence forces a reliance on findings from countries with different cultures, welfare systems and policies that may impact on the nature of presenting difficulties in children and youth (e.g., through type of prenatal substance exposure), the impact of removal to care, experience in care, and long-term outcomes after leaving care.

Neurodevelopmental impact of trauma

Meta-analysis shows cognitive delays in children and youth who have been maltreated compared with age-matched controls; these delays are equivalent whether or not the child is removed to foster care (Goemans et al., 2016). The four UK studies included in this meta-analysis were all 20+ years old, with most studies conducted in the USA, Europe/Australia. Delays in cognitive, language and emotional development (Fisher, 2015) are understood to result from dysregulation of the body's stress response system – the hypothalamic–pituitary–adrenocortical (HPA) axis – or changes in the corticolimbic networks of the brain (De Bellis, 2001; De Bellis et al., 1999; Gunnar & Quevedo, 2007). The exact mechanism by which the dysregulation occurs is unclear (McLean, 2016), as research has evidenced both chronic over-activation and chronic under-responsiveness of the HPA axis over time (Frodl & O'Keane, 2013; McCrory et al., 2011; McEwen, 2012; McLaughlin et al., 2014). It is therefore likely that the regulatory mechanisms and their effect on development is dependent on a variety of complex factors.

Research into the neurodevelopmental impact of trauma has progressed toward considering indirect factors including impact of timing, chronicity and abuse type. Although regarded as an act of omission and therefore less traumatic than physical abuse or maltreatment (acts of commission), neglect can also be a toxic stressor with similar pervasive and negative effects (Fisher, 2015). This is important for the care population as neglect is the most common type of maltreatment experienced by children and youth in the care system (Lind et al., 2017). Neglect is associated with neurobiological changes in the HPA axis and pre-frontal cortex. Adopted children with a history of neglect have been shown to exhibit blunted cortisol production, recording lower levels of cortisol in the morning and throughout

the day in comparison with non-maltreated controls (Kertes et al., 2008), contrasting with the typically high levels of cortisol production observed in toxic stress. Cortisol blunting is hypothesized to be a protective response to the absence in part of adequate and responsive care experienced in neglect and caregiver maltreatment (van der Vegt et al., 2009) in which brain development alters such that survival becomes the primary aim, rather than focusing on mechanisms of learning (Atkinson, 2013).

These changes are also linked with alterations in the corticolimbic networks (De Bellis, 2001; De Bellis et al., 1999; Gunnar & Quevedo, 2007). For example, the pre-frontal cortex, described as the area of the brain primarily responsible for the development of EF, appears to be particularly sensitive to the effects of trauma (De Bellis, 2005). EF is the collective term for a set of metacognitive capacities responsible for guiding, directing and managing cognitive emotional and behavioral functions (Gioia et al., 2000; Lezak et al., 2004). Notably, the brain regions most commonly affected in maltreated youth – the pre-frontal cortex, the orbitofrontal cortex, anterior cingulate cortex and amygdala (Cowell et al., 2015; De Bellis & Thomas, 2003; Teicher & Samson, 2016) – are the same regions which are activated during tasks requiring EF.

Trauma and executive function

Caregiver-related maltreatment is strongly associated with reduced EF (Hodgdon et al., 2018). Therefore, the care-experienced population is likely to be particularly vulnerable to EF deficits. Indeed, in their meta-analyses of EF in children and youth with trauma histories, Op den Kelder et al. (2018) demonstrated that children and youth in foster care or adoption demonstrated lower levels of EF, primarily inhibition and cognitive flexibility, even in comparison with other youth with trauma histories.

Most studies looking at EF in care settings take place within the foster care system. Neuropsychological tests with children and youth in foster care have demonstrated deficits in working memory, inhibitory control and cognitive flexibility (Bücker et al., 2012; Lewis et al., 2007; Pears & Fisher, 2005), three key areas of EF underpinning the development of reasoning and problem-solving skills (Op den Kelder et al., 2018). These observed differences are also evidenced by neuroimaging studies that identified altered neural pathways for children and youth in foster care when presented with tasks requiring inhibition (Bruce et al., 2009, 2013). Furthermore, behaviors that foster carers identify as being problematic for the children in their care are qualitatively similar to functional or behavioral difficulties with EF (Octoman et al., 2014). Many of these difficulties have also been demonstrated when differences in overall cognitive ability are controlled for

(Bücker et al., 2012) indicating that EF difficulty may be a distinct issue within overall cognitive function.

Executive function in residential childcare

Although not extensively studied in residential childcare populations, EF is likely problematic for children and youth in these settings. Children and youth in residential units have typically experienced similar backgrounds of maltreatment to those in foster care settings, but additionally are likely to have experienced multiple placements before being placed in a residential unit (Hart et al., 2015). In England, it is estimated that 29% of children and youth in residential units have had six or more placements. Frequent changes in residential unit placements also occur, with only 21% of placements in England (White et al., 2015) and 20% in Scotland (McPheat et al., 2007) lasting more than 12 months. Placement instability and caregiver breakdown is associated with further reductions in EF abilities, as those in the care system who experience placement instability have been shown to experience higher levels of EF difficulties than those who are placed in a single stable placement (Lewis et al., 2007; Pears & Fisher, 2005). As the number of transitions increases, so does the likelihood of negative outcomes (Newton et al., 2000), regardless of whether transitions are considered positive in and of themselves (Fisher, 2015). These include lower educational achievement and higher unemployment (Goyette et al., 2021); increased risk of needing inpatient mental health treatment (Min & Ryan, 2009); and persistent sexually inappropriate or aggressive behavior (Prentky et al., 2014). EF difficulties have been linked with externalizing problems such as aggressive or challenging behavior which may, in turn, lead to an increase in placement changes (Hodgdon et al., 2018). Although much of the research is cross-sectional and as such the direction or causal nature of this relationship has not yet been established, children and youth in residential units have likely accumulated multiple risk factors including early trauma exposure, placement instability and externalizing behavior problems, all of which interact with EF difficulties.

Staff training in residential childcare

Given the complex needs of children and youth in residential units, there has been an increasing focus on introducing minimum standards of education and training for residential childcare staff. Since 2009, several reports and guidelines for the training and education of care staff have been published, beginning with The Higher Aspirations, Brighter Futures: National Residential Child Care Initiative Overview (NRCCI; Davidson et al., 2009).

The NRCCI paper set out the aim of changing the culture in residential units and recognizing the value of its strategic role. It focused on increasing the knowledge, skills, value, and status of residential childcare staff, to bring them in line with other professionals in the social care workforce (Davidson et al., 2009). In 2015, the Scottish Social Services Council (SSSC, 2016) prepared the 'Standard for Residential Child Care', which outlined the aim of introducing a Scottish Qualification and Competency framework (SQCF) level 9 qualification for all residential childcare workers and managers. However, this has yet to be implemented. Four-fifths of the residential childcare workforce have achieved the SQCF level 7 qualification required for registration with the SSSC (McMeeking et al., 2016). Simultaneously, trauma-informed care has gained traction as a systemic approach that acknowledges the pervasive and enduring impact of trauma exposure on individuals' functioning and ability to engage with offered help.

However, while many of the above qualifications and trainings explore the symptoms and behaviors experienced by youth who have experienced trauma, very few detail the potential neurodevelopmental limitations which may underly these behaviors. Systematic review of residential childcare trainings has found limited evidence that cognitive factors are being considered as a contributing factor to the behaviors children and youth demonstrate in care (Morison, 2018). This is despite evidence that explaining the difficulties encountered by care-experienced children and youth, such as considering deficits in learning, organization and memory can be empowering for both children and carers. A recent systematic review of training focused on trauma-informed care found improvements in knowledge and awareness of trauma-informed practice and attitudes, including talking about trauma histories and responding to problematic behavior in more compassionate ways (e.g. fewer restraints) (Purtle, 2020). Linking pre-care experiences with poorly developed cognitive skills has been found to support foster carers to persevere in the face of challenging behavior (McLean, 2016). Training programs in foster care settings have also been linked with carer retention, improved placement stability and more positive outcomes for children and youth (Dumaret et al., 1997; McGuinness, 2007). However, the overall effectiveness of training in care settings is somewhat mixed (Everson-Hock et al., 2012) and there is little to no evidence regarding the impact of training for residential childcare staff. Only one of the 23 studies cited in Purtle's (2020) review was conducted in a residential facility – a juvenile justice center (Elwyn et al., 2015). Where knowledge is limited, there is scope for misunderstanding and with care-experienced children and youth, the greatest risk might be that an inadequately nuanced understanding of neurodevelopmental principles or the

specific impact of trauma leads to a perception by childcare workers of trauma-exposed children as 'damaged' and unfixable. Whilst childcare workers may have more sympathy for the behaviors they encounter, there may be less chance of effective intervention to improve outcomes for children and youth, despite evidence showing successful intervention for attentional control and self-regulation in foster children (Bruce et al., 2009; Pears et al., 2013).

In a review by the Department of Education in England (White et al., 2015) residential childcare staff self-identified gaps in their knowledge that included psychological, behavioral and developmental issues. Residential childcare staff outlined that improved knowledge in these areas was required to help them understand what lay behind the children's psychological state and/or behavior (White et al., 2015). However, training alone has not always been evidenced as leading to better outcomes. Other organizational factors such as an ongoing culture of learning, organizational support, and adequate resources (Nolan & Keady, 1996) are also required for individual training packages to be most effective. Despite these challenges, it is recognized that the specialist nature of residential childcare requires a rolling programme of comprehensive training to support staff to meet the needs of the children and youth in their care (White et al., 2015). Training for residential childcare staff is therefore generally viewed favorably, with staff and managers expressing that they felt more able to take a broader view of children and youth and their presentations (White et al., 2015). Inclusion of practical information and specific modules aimed at the care population are also recognized as being beneficial as opposed to generic training packages (White et al., 2015). It is further recommended that to be effective, training needs to be informed by relevant theories, appropriate to the day-to-day tasks of residential childcare and transferable into practice (Clough et al., 2006). Therefore, tailored trainings relevant to the daily practice of residential childcare staff are indicated as being most acceptable and desirable to staff.

Online training

Prior to the Covid-19 pandemic, when this research took place, there had already been an expansion in the use of online learning tools (Ellis & Kuznia, 2014) and online training had become a favored option in industries, educational institutions, and organizations (Paranal et al., 2012). When used for continuing professional development, the use of online tools may be a more efficient use of training resources and eliminate the need for employee travel (Donavant, 2009), although other access issues have emerged during the pandemic, described as a 'digital divide'

(Bennett et al., 2020). WHO guidelines (Cometto et al., 2018) for training recommend a balance between the preference for face-to-face training against accessibility and resources. This is relevant for a 24-h industry like residential childcare, where opportunities for whole staff training are limited. There is evidence that technology-based learning can have equivalent or better outcomes for training health professionals (Tudor Car et al., 2019). Online approaches to training for residential staff have been successfully trialed for carers of older adults experiencing dementia (Hobday et al., 2010). In this pilot, more than 85% of care staff who completed the training agreed or strongly agreed that the training protocol improved their competency and sense of mastery regarding the care they provided (Hobday et al., 2010). Online packages have also been delivered and positively evaluated for areas such as detection and reporting of child maltreatment (Kenny, 2007) and palliative care (Pelayo-Alvarez et al., 2013), demonstrating that online learning can be effective with sensitive subject matter. Currently, there is also a push toward trauma-informed approaches locally, nationally, and internationally, in part through initiatives based on the Adverse Childhood Experiences project (e.g., ACES; Edwards et al., 2003). However, evidence of the implementation of online training for trauma is limited (2021, both in schools; Espelage et al., 2020).

Training course development and study aims

There is an evidenced need for ongoing, relevant, and tailored training amongst residential childcare staff working with children and youth in their care. Alongside this there is a potential under-acknowledgement of how neurocognitive factors might influence the behavior of care-experienced children and youth. Given the importance of EF and the high likelihood of difficulties for children and youth in residential units, education in EF has been identified as a key area of focus and the need to develop training for residential childcare staff. The increased use of technology to provide flexible and convenient learning for staff groups who may find it difficult to attend more traditional training programmes suggests an online delivery may be more feasible. The current study aims to 1. Establish the feasibility of delivering effective online training on neurodevelopmental trauma to residential childcare staff and 2. To assess the acceptability of this training to residential childcare staff.

Method

Design

The study followed a feasibility and acceptability framework. Feasibility studies are employed to establish whether a novel training warrants further

testing (Bowen et al., 2009). As such they are a pre-cursor to a trial of effectiveness, although effectiveness is a necessary outcome measure to further evidence whether scaling up to an effectiveness trial is justified. Acceptability is a key part of a feasibility trial (Craig et al., 2008), recognizing that the feasibility of a study is meaningless if the target population do not find the intended training acceptable. Feasibility studies are rarely used in training development, reflecting an overall weakness in training development rigor. Therefore, there was no direct precedent for testing feasibility and acceptability. Therefore, we adapted a process set out by Tickle-Degnen (2013). To explore the study aims, an online training course for residential childcare staff was developed and evaluated using a pre-and post-test within-group design.

Participants and recruitment

Participants were recruited from residential childcare units across the UK in private and council-run facilities. Nine providers in central Scotland were approached, leading to recruitment agreements with six local councils and private care providers, a success rate of 67% for councils and companies combined. Once initial contact had been made, the principal researcher met with the care provider to discuss the recruitment strategy. All care providers chose to distribute the training materials through their internal e-mail distribution, and regular feedback was provided on the number of staff from the organization who had completed pre-course measures, so managers could gauge the success of their approach. No identifying information was shared.

A secondary pathway utilized social media and online platforms. As the training was delivered remotely, participants were not limited by geographical areas. Facebook and Twitter accounts were set up under the moniker of "Neuro Trauma Training". The Twitter account sent direct messages and public tweets to care providers and tweeted information about the training at regular intervals.

Any individual currently working within a registered provider of residential units for children and youth was eligible to take part in the study. Details of the person's role, length of service in residential childcare and level of training were collected during participant registration. Individuals from alternative professions or designations were not discouraged from taking part, but it was explained that they were not the target audience, and were not included in the analysis. No stipulation was made about whether training should be completed during working hours, but the platform was designed in such a way that materials could be accessed on older devices and could be done at the learner's pace.

Materials

The training materials were delivered across four modules, each requiring approximately one hour to be completed. Each module covered a different area of interest including the brain and behavior, EF, difficulties with EF and supporting youth with tasks requiring EF. Participants were encouraged to complete the modules in sequence as information was sequential and case examples were developed over the four modules. Within each module were scenario and knowledge-based multiple-choice questions to encourage the participants' learning, based on evidence that interactive learning strategies are more effective than passive methods (Creelman & Reneland-Forsman, 2013) and that problem-based learning can enhance knowledge acquisition and problem-solving skills (Dolmans, 2019). The knowledge questionnaire was designed to assess the identified learning objectives, which were: 1. To understand the basic physiology and systems of the frontal and pre-frontal cortex. 2. To understand the basic principles of EF. 3. To understand why EF is important in relation to care-experienced children's prenatal and early experiences. 4. To consider a variety of reasons for the described presenting behaviors typically encountered during their work.

The authors of the training were clinical psychologists with academic expertise in and applied experience of care-experienced children and youth, neurodevelopmental trauma and executive function. Once developed, the materials were reviewed by a specialist clinician and an independent academic with relevant expertise. A small pilot using three lay individuals was conducted to identify and resolve any issues before the wider roll-out of the training. During the pilot, the individuals were able to access the materials in the same manner as when live recruitment was taking place. They completed all the measures and the evaluation measures as described. The principal researcher also met with pilot participants to discuss any feedback received directly. This allowed for consideration of the acceptability of the training, the ease of use, and any barriers to participation. Feedback was used to refine the functionality of the training rather than the content, which was adapted based on the expert reviews described above. Developing interventions, training in this case, using a carefully phased systematic approach is part of best practice as recommended by the Medical Research Council (Craig et al., 2013). The training was released live online on 16th October 2018 and remained active and recruiting participants until 31st March 2019.

Platform & access

The training materials were hosted on a website designed using WordPress.org and hosted by servers at the University of Edinburgh,

chosen on the grounds of cost, availability and functionality. It was remotely accessed by participants at a time of their choosing. Questionnaire responses were collected anonymously to reduce social desirability factors and to comply with current data protection legislation. As a result, two separate systems were used, and data pre- and post-training were collected by Qualtrics Online Survey Software. During the initial registration survey, each participant created a unique identifying code to identify and link their data throughout the collection process. Once the registration measures were collected, an automated email was sent after a seven-day delay, detailing the website address for the training materials. When accessed through the website address, no additional registration information was collected. This enabled access to the training but also presented a limitation in that no identifiable data regarding time spent on training or number of page visits was available for comparison with learning outcome.

Pedagogy

The training content was developed in line with various theories of learning. The identified learning objectives predominantly related to knowledge gains. Therefore, cognitive theories were considered to support the participant to engage with the information and adopt it into their preexisting knowledge (Yilmaz, 2011). We also hoped to influence practice change within the participant's caregiving role, through a process of knowledge transfer. However, knowledge transfer is understood to be a multifaceted process that requires the interaction of active strategies including regular feedback, reflective discussion, and ongoing support, which were not available within the training design. Kolb's Experiential Learning Theory (Kolb & Fry, 1974) has been demonstrated to underpin interprofessional learning (Fewster-Thuente & Batteson, 2018) and was chosen to support the training design. The theory centers primarily on the cognitive process within the learner (McLeod, 2013) and can therefore support learning in the absence of the multiple ongoing supports required for knowledge transfer methods. Kolb's model has been successfully translated into the online learning environment. It may be particularly well-matched to asynchronous online learning that allows the learner time to reflect and implement learning in practice as they progress through a course (Avery et al., 2020; Baassenjav, 2013).

Experiential Learning Theory informs a model where knowledge can be transformed from concrete experiences into understanding an abstract concept that can be experimented with and applied across multiple settings, thereby supporting the process of turning knowledge gain into behavioral change. In this training, case examples were used to illustrate abstract theoretical concepts, which was considered essential for participant who might

not have formal psychology education prior to the training. The cyclical nature supports the acquisition of new learning built upon prior knowledge, which is aligned with the modular nature of this training. Reference to context and cases anchored new learning in familiar territory for participants, and modules regularly referenced material in previous modules.

Effective educational tools should include the full cycle of learning experiences to support the learner to fully adopt the new information (McCarthy, 2010). Therefore, various design elements were included to encourage movement around this cycle. As knowledge transfer occurs most effectively within an active process (Menon et al., 2009) interactive and educational activities were included throughout the training, including drag-and-drop exercises, interactive diagrams and case examples. These were designed to increase self-reported evidence-based knowledge and produce a change in practice (Davis et al., 2018; Menon et al., 2009) as the user must engage with the information beyond watching and reading alone (Kolb, 1984). The interactive elements also incorporated feedback to simulate the benefits of group learning experiences.

The process of rolling recruitment and the option to learn asynchronously limited the potential for simultaneous progression of participants through the training and, therefore, opportunities for spontaneous group-based reflective discussion. To encourage reflection thought-provoking questions and problem-based scenarios were included at regular intervals throughout the presentation of text information. These questions were posed both as prompts for reflection and activities requiring a response. Where a response was required, formative feedback was provided through pop-up boxes with the correct answer, and where a response was not required, these questions aimed to encourage the participant to relate the information to their situation and provide the opportunity for experiential learning within what is, at times, a necessarily directive framework.

Abstract conceptualization is the stage where the learner draws upon new theories, ideas, and discussions to assimilate the new learning with previous knowledge (Kolb, 1984). Links to further information, relevant reading, and alternative materials were signposted to support the process of abstract conceptualization (Svinicki & Dixon, 1987), recognizing that this training was introductory and as such participants were not expected to achieve a highly nuanced or abstracted knowledge. Finally, to support active experimentation, case-based scenarios were provided throughout the training, and the final knowledge questionnaire included opportunities for the participants to consider how they might respond to a given scenario, based on the knowledge and skills they had acquired. Problem-based

learning of this type can enhance knowledge acquisition and problem-solving skills (Gijbels et al., 2005).

Ausburn's (2004) desirable design elements for adult learning were also incorporated where possible to encourage completion and acceptability to participants. This included opportunities to customize learning with further readings and resources, facilitation of self-directed learning, variety in learning activities, and ensuring clear instructions and expectations. Ausburn also highlighted the importance of interactive peer-peer and peer-instructor elements which were not possible in this iteration. Given the heterogeneous nature of the staff group completing the training, universal design for online learning (Dell et al., 2015) were also applied to support access to the training. This included using a simple linear design to facilitate navigation; default settings for text and displays that would allow for individual users to apply their own adjustments, such as screen readers; ensuring language and images were nondiscriminatory (paying attention to unconscious biases and reinforcement of stereotypes); and using non-specialist language with definitions for all technical terms. It was expected that in combination these elements would foster knowledge, encourage skills-gain and support feasibility.

Measures

Participants were invited to complete the initial measures and register for the training using an online survey powered by Qualtrics. On registration, the participant was presented with the participant information and asked to provide informed consent to take part in the study. Prior to completing the training, participants completed a demographics questionnaire, perception of knowledge and a bespoke questionnaire assessing knowledge of executive function. The training was released seven days later. On completion of the training, participants completed the same questionnaire assessing knowledge and perceived knowledge and an evaluation questionnaire. In developing the evaluation protocol, attention was given to gathering useful information without overloading participants and inadvertently undermining feasibility and acceptability.

To assess the comprehension and retention of the knowledge presented in the training course a short, bespoke, knowledge and skills-based questionnaire was developed. There were 12 questions, 10 of which were multiple-choice, one a ranking question and one free-text, all relevant to the information contained within the training modules. The total possible score was 14. The questions were relevant to the training content, with scenarios in which potential hypotheses for behavior were presented, and short free-

text questions. The responses to questions were measured using a points-based system, which included both positive and negative scales.

Feasibility

The study measured the feasibility of a short online training using the following criteria: retention and follow-up rates, feasibility and suitability of the training and survey platforms, feasibility and suitability of the amount and scope of content, feasibility and suitability of the outcome measures, and whether they could effectively detect change. The training was assessed against these criteria through capturing participant numbers and missingness in data at each stage, logging number of help requests for each platform, analysis of change scores for knowledge gain, and analysis of free text responses to open questions such as '*would you recommend any changes to the course in the future?*'.

Acceptability

Acceptability was established using criteria around enjoyment and relevance of the training, potential application to practice, recommendation to others and perceived knowledge gain. Participants were asked to rate their overall experience, and their experience of each module, on a scale of one to five, where five stars were entirely positive, and one was entirely negative. Participants also rated each module for its relevance to their current role, ranging from "not at all relevant" to "totally relevant". Participants were also asked whether they would apply knowledge gain to their practice and if they would recommend the training to colleagues. Participants were asked to self-rate their knowledge on each of the four topic areas so that perceived knowledge on a five-point scale could be calculated before and after the training (see Supplementary document 1 for question set).

Data analysis

A repeated measures *t*-test was used to examine the difference between the participants' responses pre- and post-training, while Friedman's Repeated Measures ANOVA was intended to examine the results in comparison to three-month follow-up. The a priori calculation for a repeated measures *t*-test, using an alpha level of 0.05 (Cohen, 1992), an effect size of 0.6, and statistical power of 0.8 (Cohen, 1992; Tabachnick & Fidell, 2001) was computed via G*Power (Faul et al., 2009). This calculation stipulated a minimum of 24 participants was required for pre- and post-test comparisons. Content analysis was conducted at a categorical level (Erlingsson & Brysiewicz, 2017) to summarize free-text responses into non-predetermined

categories (Neuendorf, 2016). The first author conducted the primary analysis with a second researcher coding a random sample of text to establish the reliability of coding (Cohen's Kappa interrater reliability of .93). As a small number of categories frequently recurred these were counted across the sample to establish representability of the categories.

Ethical considerations

The study was approved by the university ethics committee and was also screened by three participating local authority ethics panels. Given the level of participant commitment required, an effort was made to highlight to participants that this was a novel training and as such the training had not yet demonstrated beneficial effect. For this reason, participants were awarded a certificate of completion, as opposed to a certificate of achievement.

Results

In total 237 registered participants completed the full set of pre-training measures. Registered participants ranged in age from 20 to 65 years old

Table 1. Demographics of sample.

	Registrants ($N = 237$)		Completers ($N = 88$)	
Variable	*n*	%	*n*	%
Female	161	67.9	60	68.2
Male	76	32.1	28	31.8
Ethnicity: White*	232	97.9	85	96.6
Working full-time	205	86.5	78	88.6
Working Part-time	32	13.5	10	11.4
Scotland	217	91.6	78	88.6
UK/elsewhere	20	8.5	10	11.2
Length of service				
Less than 6 months	23	9.7	7	8.0
Less than 1 year	14	5.9	6	6.8
1–2 years	39	16.5	15	17.0
2–3 years	33	13.9	13	14.8
4–5 years	19	8.0	8	9.1
More than 5 years	34	14.3	14	15.9
More than 10 years	75	31.6	25	28.4
Highest Educational Attainment				
No formal qualification	2	.8	2	2.3
High School Qualifications	115	48.5	33	37.5
Undergraduate degree	65	27.4	29	33.0
Postgraduate degree	27	11.4	11	12.5
Professional qualification	28	11.8	13	14.8
Job title				
Residential support worker	150	63.3	53	60.2
Senior support worker	33	13.9	15	17.0
Registered managers	17	7.2	8	9.1
Other**	37	15.6	12	13.6

*Participants belonging to other ethnic groupings were too small in number to be reported on separately.
**Participants did not ascribe to one of the prescribed job titles but provided a job title that clearly identified them as residential childcare workers.

($M = 41.54$, SD = 11.16) and the 88 participants who completed the training ranged in age from 22 to 65 years old ($M = 43.07$, SD = 10.98). Age was normally distributed with no significant difference between the samples. Complete demographics are in Table 1. Amongst those registered, educational attainment ranged from no formal qualifications ($n = 2$) to postgraduate or professional qualifications. The most common level of educational attainment was A-Levels (final awards at secondary school, completed between the ages of 16 and 18 years), SVQ level 3 or NVQ level 3 equivalent (vocational courses equivalent to A-Levels), with 115 (48.5%) of participants reporting this. The majority worked as residential support workers but 10 identified roles with other titles within residential childcare, e.g., House Manager or Assistant Team Leader.

A one-way ANOVA identified no significant differences between the pre- or post-training scores based on the participant's role, length of service, or level of education. No significant differences were found between registered-only and completer participants for pre-training actual or perceived knowledge or any of the occupational/educational variables.

Feasibility

Retention and follow-up rates

Over five months, there were 318 responses to the registration questionnaire. Whilst 98.4% provided consent for participation, 41.8% of these were ineligible for inclusion in the study due to incomplete pre-training data. Consequently 185 were eligible for inclusion (58.2%). Of the 104 returned post-training questionnaires, 88 were complete and could be matched to pre-training data, a conservative completion rate of 47.6%. The final sample, therefore, included 88 sets of complete pre-post data and 91 with acceptability data. See Figure 1 for full details of participant attrition.

Follow-up invitations were issued after three-months, 23 participants completed the training in a timescale allowing for the completion of the follow-up measures, of which 16 provided their email details and were issued the follow-up questionnaires. Of these 16, five completed the follow-up questionnaires providing an attrition rate of 68.8% from completion to follow-up. The follow-up data has therefore not been analyzed further at this stage.

Feasibility and suitability of the learning platform

We received no help requests for platform usage. There were 312 free-text comments elicited from four feedback questions. Of these, one participant reported difficulties navigating between pages. Two participants wanted printed resources and one participant objected to the principle of online

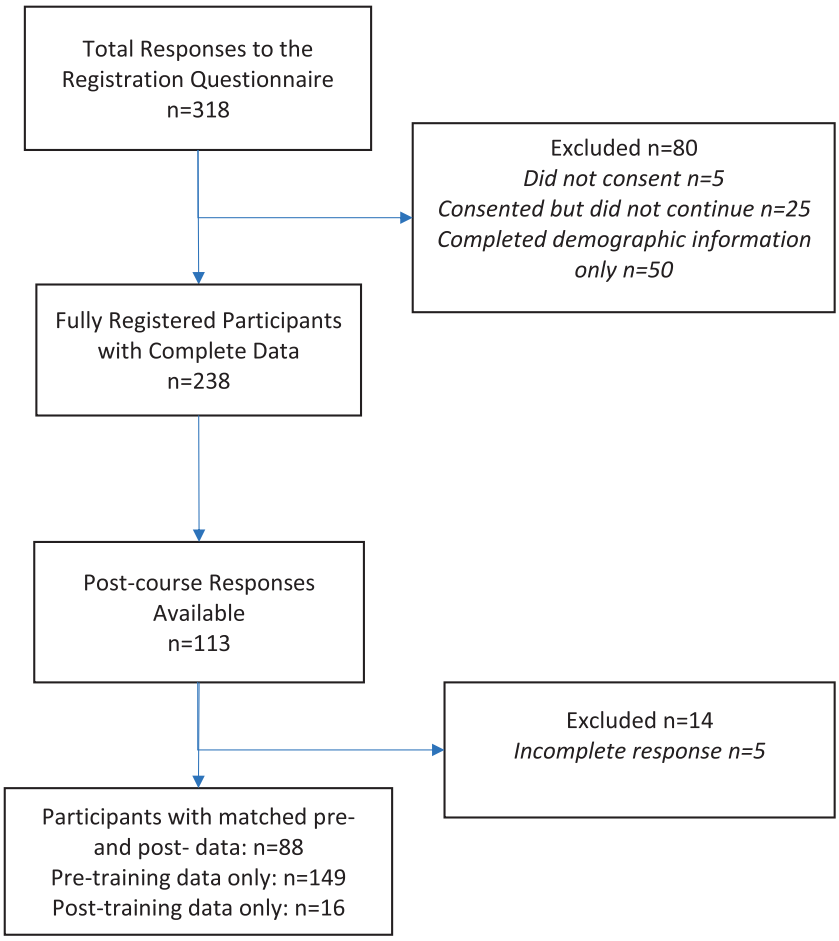

Figure 1. Participant flowchart.

delivery. However, the majority of responses either identified no changes to be made ($n = 42/78$) or refinements to the existing platform such as more interactivity.

Suitability of the content

The completion rate to the end of post-training measurement was 56.2% but this does not capture those who completed the training but did not complete the post-training measures. Feedback from completers suggested that the content was pitched at the right level. Whilst some thought the content too basic ($n = 2$) or asked for further reading/resources or expanded content ($n = 5$), three thought the information wordy or complex. This was borne out by change in knowledge scores for completers. A paired samples *t*-test was conducted between participants' overall score on the knowledge-based questionnaire before and after the training was

completed. There was a significant difference in the scores between the pre- and post-training scores with a large effect size: $t(87) = -9.52$, $p < .001$, $d = 1.08$. As well as indicating that participants' overall knowledge was higher at the end of the training, there was less variation in post-training scores, suggesting that those who performed least well before the training improved and those who performed well before the training maintained their knowledge during the training. See Table 2 for means and standard deviations.

Feasibility and suitability of the outcome measures

As noted above, the knowledge questionnaire was able to effectively detect change. Raw scores showed no evidence of a floor effect but 51/108 respondents in the post-training phase scored 14/14, suggesting that there may be a ceiling effect. Although the sample was somewhat more experienced than the target audience for the training, there was no statistical association between years worked or seniority and knowledge score.

Missingness was calculated as a percentage using number of missing data points across each measure (see Table 3). At the pre-training stage, 33 (12.2%) people did not complete measures past the initial demographic information. Amongst the remaining 238 respondents, there was very low missingness at <1%. This increased slightly for the perceived knowledge questions in the post-training phase but was equivalent for knowledge questionnaire. There was a small but noticeable drop-off in engagement with the evaluation questions, but all participants provided a response to the four free-text questions in the post-training evaluation. Whilst significant numbers were lost to each stage, it does not appear that the length or nature of the outcome measures contributed to this. Free-text responses did refer to the outcome measures, with three people criticizing the use of Likert scales to respond to complex issues. One participant was concerned

Table 2. Pre- and post-training scores.

	Pre-training		Post-training	
	N	Mean (SD)	*N*	Mean (SD)
Knowledge	88	11.10 (2.16)	88	12.99 (1.22)
Acceptability	–	–	90	22.02 (2.49)
Relevance	–	–	91	19.22 (1.79)
Perceived knowledge	85	11.34 (2.84)	85	16.71 (2.35)

Table 3. Missingness data for outcome measures.

	Percentage missingness	
	Pre ($n = 238$)	Post ($n = 108$)
Perceived knowledge	0.28	3.24
Knowledge	0.66	0.62
Evaluation	–	4.86

however that free-text responses allowed people to opt out of giving an adequate response. No help requests were received for the survey platform, which is a widely used platform for online data collection. No comments were noted in the free text in relation to this either. The low levels of missingness suggest that technical problems were not an issue.

Acceptability

Participants responded positively to the training materials. Overall, mean satisfaction was 19.22 out of a possible 20, and individual modules were rated a mean 4.52 out of 5. Participants rated all modules as highly relevant to their role, with mean scores for each module ranging from 4.80 to 4.86 out of 5. Participants were, on average, 93% likely to recommend the training to their colleagues, reflected in free text comments in which 18 participants explicitly cited a plan to disseminate information onwards.

Perceived increases in knowledge

Registered participants reported a low to moderate level of prior awareness of EF, but most reported some or more knowledge of the impact of trauma on development. Perceived knowledge scores increased significantly: $t(84) = -15.12$, $p < .001$, $d = 2.06$, demonstrating a very large effect size, suggesting that participants believed they had gained a lot in knowledge. Participants identified intended changes to practice including being more understanding and empathic with children and youth in their care ($n = 12$) and analyzing the meaning behind outward behaviors ($n = 18$) and reinforcing current good practice ($n = 3$).

Discussion

The results demonstrate support for the acceptability and feasibility of online training for residential childcare workers. Given the open approach to recruitment and lack of surveillance or supervision over completion, there was a high level of subscription to the training, a good rate of training completion, and generally positive feedback from participants. Furthermore, there was a statistically significant increase in knowledge following the training and qualitative feedback that the information had supported reflection on current practice. However, there is limited information about those who prematurely exited the training, which makes it difficult to speculate on the reasons for non-completion. It may be that the self-selecting sample of training completers are those who most identify with and support the training aims, which provides a bias toward positive outcomes.

Acceptability

A key aim of this study was to explore the acceptability of online training for residential childcare workers. We received positive responses to direct approaches to services and online advertising, indicating that there is a willingness amongst providers to engage in this type of training. While some providers did not wish to participate, this was largely attributed to the time costs spent on an untested and unproven training. There was also a high level of completion for those who registered to join the training. Comparable data is difficult to source, with evaluations of training for social care workers largely unpublished. The closest comparators in terms of an online training with a specialist audience in mind might be specialist health online courses, which have achieved completion rates of 42.1% (Ravindran et al., 2021); 37% (Lavette et al., 2021) and 85.5% (Brands et al., 2021). This training reported a 47.7% completion rate, which appears equivalent. Although managers encouraged individuals to complete the training all marketing material and participant information made clear that the training was in development so knowledge gains could not be guaranteed, that there was no 'pass' mark, and that participation must be voluntary. This indicates that the training materials and the online format were likely acceptable to individual participants, as well as at an organizational level. A notable number of those registered did not complete the training, and there is limited data regarding those who exited or failed to complete it. Evidence from MOOCs has identified that completion rates may be a flawed measure of success, as many participants may complete a substantial element of the training (Hadi & Gagen, 2016). Due to technological limitations, there is no available data regarding the points that individual users exited the training. The use of a secondary system to collect data, which required the participant to exit the training webpage and begin data entry in another system might have also contributed to attrition between training completion and evaluation. Future permutations of the training would likely involve a higher level of online functionality and metadata tracking so that these issues could be explored.

The qualitative and quantitative feedback for the training demonstrates evidence of acceptability. Where changes were suggested, these often related to technological limitations of the training such as requesting the ability to listen to information rather than read it, or the addition of being able to save their work within the webpage for when they return later. These elements were also considered desirable by the researchers during the design process. There was also a request for further information, and expansion of the current modules to include links with attachment and relationship development. This was considered by the researchers as part of the training development, as neurodevelopment is one set of theories and evidence in a

wider context of child development and is best understood alongside attachment theory, theories of resilience, trauma and loss, and theories of normative psychosocial development. It is likely that residential care workers have some broad awareness of attachment and trauma as it applies to the residential childcare population, and that this would contrast with awareness and understanding of executive functioning in the context of neurodevelopmental trauma. Therefore, this training would produce an equivalent baseline knowledge. There were also practical considerations, such as time availability and willingness to commit, which might diminish as the size of the training package grew. Evidence suggest "bite-size" learning (English, 2005) has optimal acceptability and efficacy in the workplace especially when delivered as self-directed e-learning (Poulin, 2013). It is positive that individuals are requesting additional information and expansion of the current materials, as this implies a level of acceptability for the method of delivery, and a direction for future module developments. Participants also requested more feedback and interactivity which will be considered in future developments.

Feasibility

The significant knowledge gain results support the feasibility of online training for residential childcare workers. There was a significant increase in the average score following the training compared with the scores before the training, and an associated increase in perceived knowledge for the topics covered. However, as might be expected for a short training course, the overall increase was quite small, just under two points on the scoring scale (despite a statistical large effect). The participants were largely self-selecting and therefore may be more motivated to seek information and training and have a higher level of baseline knowledge. This could be addressed in future by using a cohort design and working with service level management to identify those most suitable for the training or including the training as part of initial training for inexperienced workers. However, length of service and level of seniority did not play a significant role in the participant's pre-training scores, challenging assumptions about expertise and seniority.

Implications for practice

Although knowledge gain was the primary aim of the training, a secondary aim was knowledge transformation to influence practice change. Participants reported an intention to use the strategies and skills gained in the training to support their professional roles and to share the knowledge

gained with colleagues and other multidisciplinary groups. Positively, many reported an increased level of understanding and insight for children and youth concerning challenging behavior. This has positive implications for clinical practice as staff attributions can influence responses to challenging behavior. It was beyond the scope of the study to measure actual change in practice, and this would be a useful step in establishing the value of trainings such as this.

Limitations

In addition to those reported above, there are other limitations to the findings. Given the bespoke nature of the questionnaire, there may be issues regarding knowledge measurement. There was evidence of a ceiling effect. It is possible that the items used were not robust enough to identify gaps in knowledge or could be solved by other means. We weren't able to gather enough data to establish whether information was retained over time, or if high scores were reflective of immediate recall only. Adjusting the knowledge questionnaire to avoid a ceiling effect would be recommended but collecting follow-up data via survey may be a fundamental feasibility issue. Evidence of sustained learning and application to practice may need to be collected in a more organic way through, for example, observational study.

The technological difficulties of using two systems for training delivery and data collection led to complications regarding the evaluation of the training and the direction of future changes. The training was hosted on a publicly available website with no login, limiting the interpretability of visits to the training and its pages. As participants tended to come from a small selection of organizations, the website could be shared and accessed amongst colleagues without completing the pre-training registration. There was evidence of this happening, as post-training data was submitted that was not linked to a pre-training registration and provided no demographic information or comparative value. This difficulty was compounded by the reliance on a participant-provided code to identify pre- and post-training data that was omitted or altered by several participants leading to unmatched data that could not be analyzed as part of the final sample.

Our sample was representative of the Scottish population, which is not very ethnically diverse, and of the residential childcare workforce which is majority female. However, there is a risk that the material contains unconscious bias that will not have been uncovered in this study. Such biases reflect those in research and theory that are only being properly investigated now (Roberts et al., 2020). A necessary step prior to generalizing beyond the Scottish context will be to test the training for sensitivity to

diverse populations, both in terms of its subject matter and its intended audience.

High attrition rates were evident following training completion it was not possible to assess knowledge retention over time and subsequently the impact on possible practice change. This may reflect engagement with and efficacy of training and alternative methods of assessment such as self-reported measures of practice-change or observational measures of change would enhance understanding of effectiveness. However, it also reflects the reality of working conditions for residential childcare workers, in which little time for professional development, supervision, managerial support and training in the context of managing severe behavioral problems including violence and high staff turnover (Smith, 2020; Smith et al., 2021) contribute to burnout (Lakin et al., 2008). Therefore, the implications for practice cannot be explored fully and this is a focus for future research.

Conclusions

The evidence for a pervasive deleterious impact of early neglect and trauma on neurodevelopment, and on executive functioning especially is strong. The day-to-day effects include affect dysregulation and behavioral problems that can present significant challenges in the residential childcare setting. Increasing knowledge of the neurodevelopmental impact of trauma can help staff conceptualize and contextualize problem behaviors in a way that fosters compassionate and constructive interventions. This training was designed to introduce key concepts to residential childcare staff via a short online training. Overall, the results and evaluation of the training provide positive support that online learning is feasible and acceptable with residential childcare workers working with children and youth in care. There was a demonstrable increase in learning for those who completed the training, and a high level of completion, compared to typical online courses, which shows a high degree of acceptability. Many participants also left feedback regarding their appetite for information and consideration for how they might use the information in their practice, indicative of intention to implement in practice. Future changes may include additional modules in attachment and relationships as well as further reading materials for those who wish to know more. A sophisticated learning platform is required to support the level of functionality needed for a high-quality presentation and more detailed evaluation of engagement.

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