The effect of maltreatment type on adolescent executive functioning and inner speech

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Running head: EF, inner speech and maltreatment

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ABSTRACT

There are indications that different types of maltreatment can lead to different cognitive and behavioural outcomes. This study investigated whether maltreatment type was related to executive functioning (EF) abilities and the use of inner speech. Forty maltreated adolescents and a comparison group of 40 non-maltreated typically developing (TD) adolescents completed a battery of tasks designed to assess both their EF abilities and their vulnerability to disruptions to inner speech. They also completed an IQ test. MANCOVA and ANCOVA analyses were carried out to examine potential effects of maltreatment type (abuse alone; neglect alone; abuse/neglect combined and no maltreatment) on EF and use of inner speech.

Maltreatment type was related to EF abilities. In particular, abuse only and abuse/neglect combined had a greater negative impact on EF than neglect only. However, the neglect alone group were more vulnerable to disruptions to inner speech than the other two maltreatment groups, suggesting that they may be more reliant on the use of inner speech. These findings provide new insights into the differential impact of maltreatment type on EF and the use of inner speech in adolescence, and could be used to improve the educational outcomes of these vulnerable young people.

KEY WORDS: Adolescence, executive functioning, inner speech, maltreatment

Child maltreatment, sometimes referred to as child abuse and neglect, includes all forms of physical and emotional ill-treatment, sexual abuse, neglect, and exploitation that results in actual or potential harm to the child's health, development or dignity in the context of a relationship of responsibility, trust or power (World Health Organisation, 2010).

Maltreatment and Developmental Outcomes

Whilst there is a general consensus that child maltreatment has negative developmental outcomes (Glaser, 2000; Kirke-Smith, Henry & Messer, 2012), and that maltreated children have significantly poorer overall global cognitive functioning (Trickett, Noll & Putnam, 2011), there is an increasing body of evidence to suggest that negative associations vary according to whether the type of maltreatment is abusive or neglectful. Retrospective research on adults suggests that different areas of the brain are affected by different types of maltreatment (De Gregorio & McLean, 2013). For example, adults who had experienced child sexual abuse had a 18.1% reduction in the visual cortex (Tomoda, Navalta, Polcari, Sadato & Teicher, 2009a), adults who had experienced childhood verbal abuse had a 14.1% increase in the superior temporal gyrus (Tomoda et al., 2011), and those that had experienced harsh corporal punishment showed a 19.1% reduction in the medial prefrontal cortex (Tomada et al., 2009b). Similarly, Hahm, Lee, Ozonoff, and Van Wert (2010) concluded that not all types of maltreatment are equivalent in their potential contribution to negative developmental outcomes. As a result, there have been recommendations that studies "need to meet the challenge of becoming more systematic in delineating maltreatment type if findings across studies are to be meaningfully compared" (McCrory, De Brito & Viding, 2010, p. 1088).

There are indications that neglect may have a more severe effect on cognitive processing than other forms of maltreatment. This evidence comes from comparisons between groups

with different forms of maltreatment, and comparisons with typically developing (TD) individuals. Hildyard and Wolfe (2002) reported that neglected children had more severe cognitive and academic deficits, social withdrawal, limited peer interactions, and internalising behaviour problems than physically abused children, whilst Culp et al. (1991), who examined language ability in groups of abused, neglected and abused/neglected combined children, found that the neglect only group showed larger expressive and receptive language delays. De Bellis, Hooper, Spratt, and Wooley (2009) reported that neglected children showed significantly lower IQ, language, visual-spatial, learning/memory and academic achievements than TD comparisons.

A potential cause for these developmental differences between abuse and neglect was suggested by Teicher et al. (2004). They found that neglected children had the largest reduction in corpus callosum size relative to children who had been physically or sexually abused. It has also been suggested that the absence of a reliable and consistent caregiver for a young child is associated with a negative impact on the developing brain, which results in persistent deficits in social, behavioural, and cognitive development (De Bellis, 2005). This lends credence to the idea that the underutilisation of neural connections in neglected children can result in permanent altered growth or even neuronal death. This may be because neglected children can experience a chronic lack of relational experiences on which to construct their mental representations of the world, whereas parents who are being abusive towards their children are, at a minimum, attempting to engage with them in some way (Nolin &Ethier, 2007). Relational experiences are critical because they form the basis of linguistic competence, social cognition, problem solving, emotional self-regulation and the development of coping strategies (Snow, 2009). However, it is possible that neglected children become more resourceful and vigilant in their everyday lives in order to survive and, in the absence of trusted caregivers, need to depend on themselves to a much greater extent

and thus develop internal thought processing to monitor their situation (Nolin & Ethier, 2007). Other research has indicated that multiple forms of victimization (poly-victimization) may have a cumulative negative impact on child developmental outcomes (Turner, Finkelhor, & Ormrod, 2006). In addition, there is evidence that neglect with physical abuse is more damaging to cognitive functioning than neglect alone (Nolin & Ethier, 2007).

To extend this line of research the current study compared the cognitive functioning of individuals who had experienced different forms of maltreatment. Three subtypes of maltreatment were identified: a) Neglect; b) Abuse (which included physical abuse, sexual abuse and witnessing domestic violence); and c) Neglect and Abuse combined (see Culp et al., 1991).

Executive Functioning

Over the past two decades, evidence has accumulated about the association between childhood maltreatment with impaired performance on assessments of ability involving cognitive abilities and behaviour regulation (see Kirke-Smith, Henry & Messer, 2012, for a review). It seems likely that the differences in developmental outcomes between maltreatment types are mediated by higher order cognitive processes such as executive functioning (EF) and inner speech. EF involves the skills that underlie flexible goal-directed responses to novel or difficult situations (Hughes & Graham, 2002; Miyake & Friedman, 2012). These skills include strategic planning, flexibility of thought and action (switching), inhibition of inappropriate responses, generation of new responses (fluency) and concurrent remembering and processing (executive-loaded working memory) (Henry, Messer, & Nash, 2012). Inhibition, for example, (which refers to both attentional and motor inhibition, as will be described in the section on methodology) is considered to be important as the ability to inhibit a preponderant response is the primary EF upon which other functions evolve and may

be related to behavioural regulation (Brocki & Bohlin, 2004). Recent conceptualisations also characterise inhibition as the 'common' EF component across different EF skills (Miyake & Friedman, 2012).

It is now generally agreed that EF in children appears to develop in a sequential fashion with different developmental trajectories (Diamond, 2013). Whilst some EF skills, such as inhibition, develop rapidly in the preschool years, there is evidence that other skills, such as switching and working memory, continue to develop into adolescence/adulthood (Huizinga, Dolan & van der Molen, 2006). There is increasing evidence that distinct profiles of EF impairment occur in individuals with a wide variety of developmental, psychiatric and neurological disorders (Ozonoff& Jensen, 1999). For children subjected to maltreatment, EF impairments have been reported in a range of investigations (e.g., Carrion, Garrett, Menon, Weems & Reiss, 2008; De Prince, Weinzierl & Combs, 2009; Kirke-Smith, Henry & Messer, 2014; Webster, Hackett & Joubert, 2009). However, to our knowledge no studies have focussed on differences according to maltreatment type during adolescence. Furthermore, MRI studies have shown changes in the frontal cortex during adolescence and EF skills rely heavily on this area. Hence, it is conceivable that EF abilities might be expected to be vulnerable during this period.

Inner Speech

Another higher order cognitive skill involves inner speech, which is usually defined as internalised, self-directed speech that serves as a self-regulatory tool for thinking, planning and self-organisation (Wallace, Silvers, Martin, & Kenworthy, 2009). According to Joseph and Tager-Flusberg (2004), language, EF, and theory of mind are all inter-related, and inner speech is at their intersection. Inner speech relates to EF in that it is a tool of thought that provides a means of planning, organising and directing one's actions. Research suggests that

when impairments or delays occur in the internalisation of speech, there may be implications for behavioural self-regulation and EF (Winsler & Naglieri, 2003). Accordingly, we were interested in differences between adolescents in the maltreated subgroups in terms of inner speech functioning.

Inner speech can be regarded as a developmental progression from 'private speech', which is overt, audible speech about an individuals' thinking that is not addressed to another person. Following an overall curvilinear developmental trend, TD children initially use overt private speech in the form of monologues, which appear to help plan and organize their behaviour. These monologues subsequently become internalised at around seven years to become inner, or sub-vocal, speech, which provides a basis for thinking. However, it should be pointed out that while inner and private speech are dichotomous in the sense that they cannot occur at the same instance, the same individual may make use of both forms of speech depending on circumstances (Winsler & Naglieri, 2003). On the other hand, the presence or absence of internalised speech can be seen as evidence for differences in ability between groups.

The Present Study

The present investigation was designed to address whether EF performance and use of inner speech differ according to the type of maltreatment, or whether the boundaries between maltreatment types are too blurred to show any differences in outcomes. In the investigation into EF a comprehensive battery of tasks were used to assess both verbal and non-verbal EF abilities within the domains of executive-loaded working memory (ELWM), fluency, switching, inhibition and directed attention. These are widely regarded as key executive functions (e.g. Henry et al., 2012; Huizinga et al., 2006). The tests were selected to be simple in order to ensure that each assessment focused as much as possible on the relevant executive skill and minimise the task impurity problem (e.g. Miyake & Friedman, 2012). The method

we selected to investigate the use of inner speech involved articulatory suppression (AS), a technique designed to suppress the use of inner speech, previously used in a similar context by Lidstone, Meins and Fernyhough (2012) and Wallace et al. (2009). Young people in the maltreated and TD groups were given a number of EF 'tower' problem-solving tasks, whereby individuals had to change an arrangement of discs on three rods into another arrangement while following a set of rules. In the AS condition, participants carried out these tasks while repeating the word "Monday" out loud; this was designed to provide an assessment of their performance *without* inner speech. In the other condition, young people carried out the tasks while tapping their feet. This was assumed to control for the effects of motor performance, and provide an indication of problem-solving performance when inner speech was possible. Our own work has suggested that the performance of maltreated adolescents in the foot tapping condition is not significantly different to that of TD individuals, but their performance in an AS condition is significantly poorer. This suggests that maltreated adolescents are more vulnerable to disruptions of inner speech, implying that they may rely on inner speech to a greater extent than TD individuals. In the present analyses we were interested in whether these effects were present across all types of maltreatment, or only present in some types of maltreatment, in comparison to the performance of a TD group.

In the first set of analyses we used a MANCOVA with planned contrasts firstly to compare the EF performance of all the maltreated groups (neglect only, abuse only, neglect/abuse combined) with the performance of a reference group consisting of TD individuals. This follows other studies examining maltreatment and EF (e.g. Beers & De Bellis, 2002; De Prince et al., 2009; Kirke-Smith et al., 2014): in this way it was possible to determine whether there was significantly lower performance for the combined maltreated groups compared to a typical sample. It was predicted that all of the maltreated groups would perform more poorly than the TD group. However, based on Hildyard and Wolfe (2002), it

was hypothesised that neglected participants would show greater EF impairments than abused participants, and, therefore planned contrasts were also conducted to make direct comparisons between the three groups of maltreated individuals without reference to the TD group. In this way it was possible to determine whether some maltreated groups had significantly lower performance than others. An ANCOVA with planned contrasts was subsequently carried out following the same format to examine vulnerability to disruption of inner speech. It was predicted that the neglected group might be less affected by the prevention of inner speech because their advanced cognitive processes would be less developed (i.e. they would use less inner speech).

Method

Participants

Forty adolescents of both genders who had suffered from maltreatment (either physical, emotional, sexual, neglect, or witnessing domestic violence as defined by the Working Together to Safeguard Children paper (H.M. Government, 2010, 1.33-1.36), aged 11-18, were recruited from specialist schools for youngsters with emotional and behavioural difficulties (EBD). An age-matched comparison group of 40 non-maltreated TD adolescents was recruited from mainstream secondary schools, with the stipulation that they had not suffered from childhood maltreatment and that they did not have any EBD. In the maltreated group there were 26 males and 14 females, whilst in the TD group there were 23 males and 17 females. Individual matching on IQ was deliberately not attempted as it is known that maltreatment is associated with lower IQ (e.g. Saltzman et al., 2006) so it is likely matched samples would be skewed towards higher functioning individuals. It was therefore preferable to control for IQ statistically rather than matching (abuse group IQ mean: 88.95; neglect group: 89.75; abuse/neglect combined mean: 79.33; compared to TD mean: 100.97).

All maltreated participants had been subjected to Significant Harm as defined in the Children Act (Department of Health, England and Wales, 1989), although it was not possible to ascertain the severity of the maltreatment. Whilst an attempt to use the Maltreatment Classification System (Barnett, Manly & Cicchetti, 1993) was made, it was not possible to gain sufficient detail to utilise this system accurately. However, background information was compiled by means of existing data taken from student records and/or teacher/tutor interviews. As can be seen in Table 1, this demonstrated that 40% of participants had been physically abused, 32.5% had been sexually abused, 55% had been neglected, and 22.5% had witnessed domestic violence (emotional abuse was not listed separately, as it may be argued that every act of maltreatment constitutes emotional abuse, Barnett et al., 1993). It should be noted that these percentages add up to more than 100% because some children experienced more than one type of abuse, however, 65% experienced a single sub-type, 22.5% experienced 2 subtypes; 10% experienced 3 subtypes; and 2.5% experienced all 4 subtypes.

- *Table 1 about here* -

Although some participants had been subjected to more than one type of maltreatment, it was possible to categorise the maltreated group into three distinct sub-groups: a) 'neglect only'; b) 'abuse only' (which included physical abuse, sexual abuse and witnessing domestic violence); and c) neglect/abuse combined. The reference group was the non-maltreated TD group.

Ethics

The research was carried out in accordance with the Code of Ethics and Conduct of the British Psychological Society (BPS, 2006). Ethical clearance was obtained from the relevant University Research Ethics prior to commencing the study. Schools were approached via letter asking for their co-operation in this study, and help in identifying suitable students for the study. Once participants had been selected, a letter was sent to their families/caregivers explaining the purpose of the study and asking for their written consent. In the case of some maltreated participants, Local Authority consent was also an essential pre-requisite.

Before commencing with the testing, the participants were given a short presentation detailing the general aims of the study, and informed of their right not to participate, to omit questions and withdraw their consent. They were given assurances of anonymity, and assured that no risks or deception would take place at any time. The researcher had enhanced CRB clearance, and extensive experience of working with youngsters with emotional and behavioural difficulties in educational settings.

Procedure

All participants were tested individually in a quiet room at school within the school day. Before commencing the testing, every effort was made to ensure that the students were comfortable, relaxed and assured that their answers were anonymous and confidential. The tasks were in a game-like format to ensure they were not too onerous, and assurances were made that there were no right/wrong answers.

Measures

All participants completed the following tasks:

IQ test.

Participants completed the Stanford Binet test: Version 5 (Roid, 2006) abbreviated version (ABIQ) which contains two subtests that assess both verbal and non-verbal intelligence. Standardised scores were used to give an overall measure of IQ. Corrected test-retest reliability coefficients are given as .84 for 6-20 year-olds. With regard to criterion validity the overall correlation between ABIQ and full-battery IQ scores (FSIQ) is given as .87 for ages 6 and above.

Executive functioning tests.

Executive-loaded working memory (ELWM).

Verbal ELWM was assessed using an adapted version of the Listening Recall task (Leather & Henry, 1994) which requires concurrent processing and storage. The experimenter read a series of short sentences (e.g. 'snails have arms'; 'water is wet') and the participant firstly judged whether each was true or false (processing), before being asked to recall the final word from each sentence in correct serial order (storage). Trials commenced with list lengths of one item and proceeded to longer lists up to a maximum of five. There were four trials for each list length and participants needed to get a minimum of 3 out of 4 trials correct before proceeding to the next level. Total trials correct (a maximum score of 20) were scored. Cronbach's alpha for reliability of this task was .78.

Non-verbal ELWM was assessed using an adapted version of The Odd-One-Out Task (Henry, 2001), which is a visuospatial test comparable to the Listening Span task described above. Participants were presented with a series of laminated cards containing two identical visual items, and one similar but slightly different item. Participants pointed to the one which was different (processing), the card was then turned over and the participant was then asked to recall the spatial location of the 'odd-one-out' by pointing to a blank response board depicting the relevant number of empty cards (storage). Trials commenced with lists of one

item and proceeded to lists of six items with four trials per list lengths. A minimum of 3 out of 4 trials correct was needed in order to proceed to the next level. Total trials correct were scored (a maximum score of 24). Cronbach's alpha for this task was .79.

Fluency.

Verbal fluency was measured using The Verbal Fluency Test, taken from the Delis-Kaplan Executive Functioning System, (Delis, Kaplan & Kramer, 2001). Two conditions were used: Letter Fluency required individuals to generate in 60 seconds as many words as possible in an effortful, phonemic format using individual letters from the alphabet (F, A and S in separate conditions); and Category Fluency required participants to generate words from designated semantic categories (animals and boys' names), again with 60 seconds for each condition. Verbal fluency was the average raw score taken from all five tasks.

Non-verbal fluency was measured with The Design Fluency Test (Delis et al., 2001). Two conditions were used: Filled dots required participants to draw in a response booklet as many different designs as possible in 60 seconds by connecting filled dots using four straight lines; and empty dots was the same, but participants were instructed to connect only empty dots and to ignore the filled dots. Design fluency was the average raw score from both conditions. Test-retest reliabilities are reported as: letter (.67), category (.70), filled dots (.66) and empty dots (.43) (Delis et al., 2001).

Switching.

Verbal switching was measured using the Category Switching task in the Verbal Fluency Test (Delis et al., 2001).This evaluates the ability to generate as many words as possible in 60 seconds whilst simultaneously shifting between two different semantic categories (fruits and furniture). Verbal switching 'cost' was the average raw score from the category fluency task

(see verbal fluency task above), minus the raw score from the switching task. Test-retest reliability is reported as 0.53-0.65 (Delis et al., 2001).

Non-verbal switching was also measured by using the switching condition of the Design Fluency Test (Delis et al., 2001). For this, participants had to switch between filled and empty dots when producing as many drawings as possible in 60 seconds. Non-verbal switching 'cost' was the average raw score between Conditions 1 and 2 (see Design fluency task above) minus the raw score from Condition 3. Test-retest reliability is reported as 0.13 (Delis et al., 2001).

Inhibition.

A similar task to The Verbal Inhibition/Motor Inhibition task (VIMI) (Henry, et al., 2012) was used to test for inhibition. Two conditions were used: Copy and Inhibit. In condition one, the experimenter said the words either 'day' or 'night' out loud and participants had to copy by repeating the word. In condition two, the participants were told to inhibit this copying response by saying the opposite to the assessor (i.e. if assessor said 'day', participant said 'night' and vice versa). Each condition had 20 trials, and the sequence was then repeated for both the Copy and Inhibit conditions (Conditions 3 and 4), making a total of 80 trials. The combined number of errors on each task represented the measure of inhibition. Cronbach's alpha for this task was .91 showing high internal consistency.

The non-verbal motor task followed the same format (loosely based on Luria's hand game (Luria, Pribram & Homskaya, 1964), but words were replaced with actions. Two conditions were used: Copy and Inhibit. For condition one, participants were asked to copy the assessor by either making a pointed finger or a clenched fist, and then in condition two do the opposite. Each of the conditions had 20 trials which were then repeated (Conditions 3 and 4).

The combined number of errors on each task represented the measure of inhibition. Cronbach's alpha for this task was .89, showing good reliability.

Directed attention.

An additional task used to measure inhibition was the D-KEFS Color-Word Interference Test (Delis et al., 2001). To distinguish between the VIMI and this task, it will hereafter be referred to as Directed Attention. Three conditions were used: Color naming, when participants were asked to say the colour of a series of squares (either red, blue or green); word naming, when the participant was asked to read the words 'red', 'blue' or 'green'; and Inhibition (based on the original Stroop test, Stroop, 1935), where the participant must inhibit reading words in order to name the dissonant ink colours in which those words are printed (e.g., the word 'red' is written in blue ink, and the correct response is to say 'blue'). Scoring was based on completion times, and number of errors made. The 'directed attention time cost' was measured by subtracting the colour time (Condition 1) from the inhibition time (Condition 3); and the 'directed attention error cost' was measured by subtracting the colour errors (Condition 1) from the inhibition errors (Condition 3). Internal consistency of this task is moderate to reasonably high (.62 - .79) with good to high test-retest reliability for children and adolescents (.77 - .90) (Delis et al., 2001).

Inner speech test.

The EF task to assess the use of inner speech was the Tower task (Delis et al., 2001) with two conditions: Articulatory suppression (AS) and foot tapping. Based on Wallace et al.'s (2009) study, a four disc Tower task was used. After one practice problem using no interference, 6 experimental problems were given at three levels: two 2-move problems; two 3-move problems and two 4-move problems. Each pair of problems used both an AS condition (participants had to repeatedly say the word "Monday" whilst simultaneously

planning/conducting their moves) and a foot tapping condition (to ensure that results could not be attributed to more general dual-task interference rather than disruption of inner speech usage). Foot-tapping is thought to be a good control task because, like AS, it incorporates a motor component and an attentional component. AS and foot-tapping have been shown to exert equal general dual task demands suggesting the only important difference is that AS prevents the use of inner speech (Lidstone et al., 2012). At each level, participants alternated between the AS condition and the foot tapping condition (i.e. Level 1: first problem with AS, second problem with foot tapping etc.).

Scores were calculated by measuring the total percentage of extra moves taken by the participant over the minimum number of moves possible. This involved dividing the number of extra moves taken by the participant by the minimum number of moves required for each condition. For the three problems in the AS condition the minimum number of moves possible was 15, and for the three problems in the tapping condition it was 23, so the final score was 'xx' divided by either 15 or 23, expressed as a percentage, where a low percentage indicates better performance.

e.g. $\frac{number\ of\ extra\ moves}{15\ or\ 23\ depending\ on\ condition}\ x\ 100\%$ = **final performance score**

Note that one limitation of alternating between AS and foot tapping conditions on the tower test trials in strict sequential order was that the first problem in each pair of problems at a particular level was slightly easier than the second pair (in terms of number of moves). We considered that the advantage of maintaining exactly the same problems under exactly the same conditions for every participant slightly outweighed the potential benefits of counterbalancing problems and conditions across participants, but this does mean the data from each condition were not directly comparable. However, data from the foot tapping

condition were used as covariates in our analyses of data from the AS condition, so the two conditions were never directly compared.

Analyses

A MANCOVA analysis was used for the EF measures with planned Helmert contrasts to test a sequence of theoretically relevant differences: TD versus all other groups; neglect only vs. abuse/neglect and abuse only; and abuse/neglect vs. abuse only. An ANCOVA using a similar approach was used for the inner speech analysis as there was only one dependent variable.

Results

EF Tasks

The means, standard deviations and ranges of the four different groups on each of the EF measures are shown below in Table 2, in addition to the results from a MANCOVA, with IQ as a covariate, which confirmed that there was a significant multivariate effect: Pillai's Trace = .62, F (10, 66) = 4.07, p < .001. As can be seen from Table 2, when the TD group was compared to the three maltreatment groups (neglect only; abuse only; and abuse/neglect combined) for each of the 10 EF measures, there were significant univariate differences in verbal ELWM (F (1,77) = 12.67, p < 0.001, partial η^2 = .14), non-verbal ELWM (F (1,77) = 15.91, p < 0.001, partial η^2 = .17), verbal Fluency (F(1,77) = 9.70, p < 0.01, partial η^2 = .11), non-verbal Fluency (F(1,77) = 9.81, p < 0.001, partial η^2 = .11), verbal Inhibition (F(1,77) = 10.71, p < 0.01, partial η^2 = .12), non-verbal Inhibition (F(1,77) = 13.48, p < 0.001, partial η^2 = .15), Directed Attention cost (F(1,75) = 4.33, p < 0.01, partial η^2 = .06) and Directed Attention error (F(1,75) = 6.11, p < 0.01, partial η^2 = .08). However, there were no significant differences in switching between the groups. To investigate this further, Helmert

planned contrasts were examined to see whether any of the maltreatment groups performed differently than the other two groups (neglect only vs. abuse/neglect and abuse only; abuse/neglect vs. abuse only). The results indicated that whilst there were no significant differences between groups for ELWM (verbal and non-verbal), fluency (verbal and non-verbal) and verbal inhibition, the neglect only group scores were significantly positively different from the other two groups in non-verbal inhibition and directed attention (errors), suggesting that they performed better in these tasks. Similarly, the abuse only group scores for directed attention (cost) were significantly positively different from the abuse/neglect combined group, suggesting that they performed better in this task.

- Table 2 about here -

Inner Speech

Table 3 below shows the means, standard deviations and ranges for scores on the inner speech task, in addition to the results from an ANCOVA using Helmert planned contrasts which was carried out to assess planning performance when inner speech was prevented (i.e. using AS). IQ and the planning performance scores from the foot-tapping condition (to factor out general planning ability under conditions without AS but with a motor distractor task) were entered as covariates; group (TD vs. abuse alone, neglect alone, neglect/abuse combined) was entered as a fixed factor, and final performance score under AS was entered as a dependent variable. This revealed a significant difference between groups: F (3, 72) = 3.49, $p < 0.05$, partial $\eta^2 = .07$. Helmert planned contrasts revealed that the TD group scored lower (indicating better performance) than all three maltreatment groups, suggesting that they were less vulnerable to disruptions in inner speech. When examined further, it became apparent that the neglect only group obtained significantly higher scores (indicating worse

performance) than the other two maltreatment groups, suggesting that the neglected participants were more vulnerable to disruption to inner speech.

- *Table 3 about here* -

To summarise, when the TD group was used as a reference group, the maltreatment group as a whole demonstrated significant impairments on most EF tasks, and showed a greater level of vulnerability to disruption to inner speech during a planning task. Further investigation indicated that whilst the neglect only group was less impaired than the other two maltreatment groups on some EF tasks, they were more vulnerable to the disruption of inner speech.

Discussion

Previous research has demonstrated that maltreated youngsters have impairments in EF compared to TD youngsters (e.g. De Prince et al., 2009; Kirke-Smith et al., 2014; Webster et al., 2009). The findings from this study support this literature, reflecting generally lower EF performance in all of the maltreated groups in relation to the TD group. However, the current findings also add to this literature by showing that when comparisons are made between subgroups of maltreated adolescents, subtle variations in the pattern of EF difficulties can be identified. More specifically, although all three maltreatment groups showed impairments in most aspects of EF, those in the 'neglect alone' category showed fewer difficulties in comparison to the other two maltreatment groups with respect to non-verbal inhibition and directed attention (errors); and the abuse only group showed fewer difficulties than the abuse/neglect combined group in directed attention (cost). This implies that adolescents with experience of abuse alone or abuse/neglect combined may have greater difficulties than adolescents who had experienced neglect with respect to concentration and the inhibition of irrelevant/unsuitable behaviours, which may explain their inability to focus in the classroom.

However, the findings also suggest that a cumulative effect of abuse and neglect combined is more damaging to directed attention than abuse only. These findings provide limited support for previous research in demonstrating that abused youngsters may have different cognitive profiles to neglected children, and that the cumulative effect of neglect combined with abuse may be more harmful than neglect or abuse alone (Nolin & Ethier, 2007).

The inner speech analyses indicated that there were group differences in planning performance when inner speech was prevented (in the AS condition) when all maltreatment groups were contrasted with the TD reference group. Further investigation demonstrated that those in the neglect alone group showed significantly worse performance (i.e. a greater number of extra moves were needed). This suggests that adolescents who had been neglected were actually *more* vulnerable to the disruption of inner speech than those who had been abused, or those who had been subjected to a combination of abuse and neglect. This finding implies that they may rely on inner speech to a greater extent than other maltreated youngsters and supports Nolin and Ethier's (2007) suggestion that because neglected children need to depend on themselves to a much greater extent, they develop internal thought processing to monitor their situation. However, it does not support the supposition that, because language development is often more impaired in neglected children than abused children (e.g. Culp et al., 1991), greater impairments in inner speech will necessarily follow. Perhaps in the absence of interactions with caregivers, the internalisation of speech takes precedence over expressive and receptive language development for neglected children?

The current findings suggest that maltreatment causes impaired performance on behavioural tests of EF and changes in reliance on inner speech when comparisons are made with a TD group, and also that there were subtle differences between maltreatment groups. However, these findings need to be considered in relation to the limitations of this and similar investigations. Most notable is the fact that because of the frequent co-morbidity between

maltreatment types, it was difficult to be absolutely certain that the samples were 'pure' (i.e. a child's records may only show neglect, but in reality they may also have suffered from abuse). The inclusion of a formal assessment of the characteristics and history of the non-maltreated group in future research would also increase confidence about group allocation. A related and perhaps equally important issue is that the effect of differences in type of maltreatment may have been confounded with the extent and severity of the maltreatment, and this is something that is extremely difficult to take account of in statistical analyses. Together, these issues raise questions about the utility of trying to make comparisons between maltreatment types, and we believe that these issues need serious consideration in future research. Thus, while we agree with McCrory et al. (2010) that delineating of maltreatment type is of theoretical importance, such research remains challenging.

In respect of our study, it also should be acknowledged that sample sizes were relatively small and unequal once groups of maltreated adolescents had been subdivided, potentially leading to a power problem. Further, because the maltreated sample was recruited from specialist EBD schools, they may represent the more severe end of the spectrum of maltreated individuals, and the results reported here may not transfer to maltreated children in mainstream schools. Finally, we are unable to determine cause and effect from the analyses, and confounding variables, such as differences in home circumstances between families of neglected versus abused children, may also have had an impact on the findings. It should also be noted, that although the test-retest reliability of the Design Fluency Test was very low, it was felt worthy of use in order to gain the necessary comparison between verbal and non-verbal fluency abilities.

Nonetheless, the implications from this study should be of value in helping to create better structures to help maltreated adolescents both inside and outside the classroom. Deficits in EF, which are part of the regulatory system that will affect behaviour such as inhibition and

poor attention skills, could also lead to impairments in information processing systems causing impaired functioning in the classroom and other situations. Knowing that different types of maltreatment have broadly similar but some subtle differential consequences for EF could be used to help improve the educational outcomes of maltreated adolescents and close the achievement gap that currently exists. For example, knowing that youngsters with histories of abuse (rather than neglect) may have greater impairments in inhibition means that they can be helped by maintaining routines, keeping everything as structured as possible, giving lots of short breaks, and trying to adapt tasks to suit the child's ability to concentrate. Similarly, the finding that youngsters with histories of neglect (rather than abuse) may have strengths in their use of inner speech can be used for learning activities which allow them to become more aware of their thought processes in general and cognitive decision-making in particular. This is based on the premise that when youngsters are asked to explain and justify their thinking they are better able to plan, problem-solve, and evaluate their cognitive behaviour (Zakin, 2007).

Conclusion

The current findings demonstrate the differential impact of maltreatment type on EF and the use of inner speech. Contrary to prediction, the cumulative effects of abuse and neglect appeared to be greater than the effects of neglect only on EF, whereas the effects of neglect only appeared to provide strengths in the use of inner speech in comparison with the other two maltreatment groups. These findings could be used to target specific interventions to help maltreated adolescents with both their behavioural regulation and cognitive achievements, and improve their educational outcomes.

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Table 1

Demographic information by maltreatment group

Maltreatment Type	Girls (n = 14)	Boys (n = 26)	Total (n = 40)
Physical	42.85%	38.46%	40%
Sexual	42.85%	26.92%	32.5%
Neglect	57.14%	53.85%	55%
Witnessing domestic violence	28.57%	19.23%	22.5%

N.B. Percentages add up to more than 100% because some children experienced more than one type of maltreatment.

Table 2

Means, SDs, Ranges and Contrast Results between Groups. Group 1 = TD Reference, Group 2 = Neglect Only, Group 3 = Abuse Only, Group 4 = Abuse/Neglect Combined

EF Measure/type of maltreatment	**Means, SDs and ranges**	**Means, SDs and ranges**	**Means, SDs and ranges**	**Means, SDs and ranges**	**MANCOVA contrasts on EF outcomes**	**MANCOVA contrasts on EF outcomes**	**MANCOVA contrasts on EF outcomes**
	Group 1 (n = 40)	Group 2 (n=13)	Group 3 (n=18)	Group 4 (n = 9)	Group 1 vs Groups 2, 3 and 4	Group 2 vs Groups 3 and 4	Group 3 vs Group 4
ELWM * (verbal)	13.85 (2.28) 9 – 20	10.31 (2.78) 4 – 13	11.06 (2.24) 5 – 15	9.55 (2.07) 7 – 12	***p* < 0.001**	*p > 0.05(ns)*	*p > 0.05(ns)*
ELWM * (non-verbal)	22.25 (2.12) 17 – 24	16.62 (5.11) 9 – 24	17.55 (4.46) 8 – 24	15.44 (4.90) 7 – 21	***p* < 0.001**	*p > 0.05(ns)*	*p > 0.05(ns)*
Fluency * (verbal)	16.82 (2.56) 11.8 – 23.2	12.77 (3.39) 6.4 – 17.6	12.21 (5.14) 2.20 – 18	13.67 (2.93) 10.6 – 18.2	***p* < 0.01**	*p > 0.05(ns)*	*p > 0.05(ns)*
Fluency * (non-verbal)	11.34 (2.71) 7 – 17.5	8.58 (2.35) 5 – 12	7.92 (3.83) 3.5 – 16	6.44 (3.86) 2.5 – 15	***p* < 0.001**	*p > 0.05(ns)*	*p > 0.05(ns)*
Switching * (verbal)	7.00 (2.52) 2.5 – 13.5	5.38 (2.99) 1 – 10.5	6.22 (4.11) -.5 – 13	6.83 (4.00) -.5 – 12	*p > 0.05(ns)*	*p > 0.05(ns)*	*p > 0.05(ns)*
Switching * (non-verbal)	2.53 (3.48) -7 – 10.5	3.77 (2.39) -.5 – 8	3.14 (3.04) -1.5 – 11	2.00 (3.28) -.5 – 9	*p > 0.05(ns)*	*p > 0.05(ns)*	*p > 0.05(ns)*
Inhibition + (verbal)	1.2 (1.52) 0 – 5	4.77 (4.71) 0 – 16	6.22 (6.41) 0 – 24	6.00 (7.14) 0 – 19	***p* < 0.01**	*p > 0.05(ns)*	*p > 0.05(ns)*

Inhibition+ (non-verbal)	0.5 (1.01) 0 – 4	1.85 (2.15) 0 – 7	4.28 (4.51) 0 – 13	5.00 (6.20) 0 – 16	***p* < 0.001**	***p* < .01**	*p > 0.05(ns)*
Directed + attention (time cost)	21.38 (7.98) 8 – 41	31.25 (13.48) 11 – 50	30.55 (14.52) 11 – 67	45.88 (33.27) 15 – 115	***p* < 0.01**	*p > 0.05(ns)*	***p* < 0.05**
Directed + attention (error cost)	0.9 (1.3) -1 – 4	2.00 (1.86) 0 – 7	3.28 (4.04) -2 – 16	4.88 (3.56) 0 – 10	***p* < 0.01**	***p* < 0.05**	*p > 0.05(ns)*

N.B. EF measures marked * signify variables where higher scores indicate superior performance. Those marked + signify variables where lower scores indicate superior performance.

Table 3

Summary of Means, SDs and Ranges of Different Maltreatment Types and Vulnerability to Disruptions to Inner Speech.
Group 1= TD Reference, Group 2 = Neglect Only, Group 3 = Abuse Only, Group 4 = Abuse and Neglect combined.

	Means, SDs and ranges	Means, SDs and ranges	Means, SDs and ranges	Means, SDs and ranges	ANCOVA contrasts on AS performance	ANCOVA contrasts AS performance
	Group 1 (n=40)	Group 2 (n=13)	Group 3 (n=18)	Group 4 (n=9)	Group 1 vs Groups 2, 3, and 4	Group 2 vs Groups and 4
Performance score in AS condition	20.49 (17.44) 0 – 66.66	45.13 (34.01) 0 – 113.33	37.03 (19.02) 13.33 – 66.66	26.66 (17.21) 13.33 – 53.33	***p < 0.05***	***p < 0.05***

N.B. Low scores indicate superior performance.