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The effect of trauma and daily stressors on executive and emotion control: a study in North Ugandan teenage boys

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Abstract

Objective: Children growing up in conflict-torn areas face many stressors. However, early-life stress has an impairing effect on psycho-social functioning, in particular on executive control. Unfortunately, impaired executive control may put the mental health of the distressed individual further at risk. Current research aims at understanding the impact of post-conflict stress, in particular the death of a parent, on cognitive and emotional control in North-Ugandan adolescents. **Methods**: Sixty-eight male Ugandan students, aged 14 to 19 participated in the study. Eighteen participants had lost one or both parents. To assess cool cognitive control participants completed the Stroop Task, while the Opposite Emotions Test (OET) was developed to measure emotional control. The OET requires participants to respond with the opposite emotion to the one presented. Finally, different questionnaires were administered to measure trauma (IESR), anxiety and depression (HSCL-37A) symptoms. **Results**: Contrary to our expectations, orphaned students did not display impaired performance on the Stroop task or OET, nor did they experience more anxiety, trauma or depression symptoms than their peers who still have both parents. However, emotional interference on executive control did increase in this orphaned group when trauma symptoms elevated. Furthermore, different practice effects were found depending on parental loss and executive control task. **Conclusion**: Executive control may be an interesting focus point for interventions in war-torn countries to counteract stressful experiences such as the loss of close relatives. The Stroop test and the OET may support diagnostic and therapeutic measures in post-conflict regions once its reliability and validity is further proven here.

Acronyms and Abbreviations

CCVS = Centre for Children in Vulnerable Situations, LRA = Lord Resistance Army
OET = Opposite Emotions Test, HSCL-37A = Hopkins Symptom Checklist-37A, IESR = Impact of Events Scale Revised, PTSD = Post-Traumatic Stress Disorder, ELS = Early-Life Stress,
RM ANOVA = Repeated Measures Analyses of Variance

Samenvatting

Doelstelling: Kinderen die opgroeien in een met conflict beladen omgeving worden geconfronteerd met verscheidene stressoren. Stress in de kinderjaren heeft echter een nefast effect op het algemeen psychisch functioneren en onder meer op executieve controle. Verstoord executief functioneren kan de psychische gezondheid van het kind helaas verder onder druk zetten. Huidig onderzoek gaat de impact na van postconflictstress, in het bijzonder ouderlijk verlies, op cognitieve en emotionele controle bij Noord-Oegandese adolescenten. **Methoden:** Achtenzestig mannelijke, 14 tot 19-jarige Oegandese studenten participeerden in deze studie, waarvan 18 wees. Cognitieve controle werd gemeten via de klassieke Stroop test. De Opposite Emotions Test (OET) werd ontwikkeld om emotionele controle na te gaan. Verschillende vragenlijsten werden afgenomen om symptomen van trauma (IESR), angst en depressie (HSCL-37A) te achterhalen. **Resultaten:** Tegen de verwachting in vertoonden weeskinderen niet meer moeite met de Stroop of OET test. Ze vertoonden ook niet meer trauma-, angst- of depressiesymptomen in vergelijking met kinderen die geen ouder(s) verloren hebben. Niettemin steeg de emotionele interferentie op executieve controle met meer traumasymptomen bij weeskinderen. Verder werden er verschillende leereffecten gevonden afhankelijk van de soort test (OET of Stroop) en het al dan niet wees zijn. **Conclusie:** Executief functioneren kan een belangrijk aandachtspunt zijn voor hulporganisaties in ontwikkelingslanden en in oorlogsgebieden om het nefast effect van stressvolle ervaringen, zoals het verlies van een geliefde, tegen te gaan. De Stroop en OET kunnen diagnostische en therapeutische interventies in probleemgebieden bijstaan eens hun validiteit en betrouwbaarheid hier verder onderbouwd zijn.

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Directing the Attention towards Early-life Stress in Children Living in Developing and (Post-) War-Torn Areas

Recent disasters in the developed world, such as the terrorist attack on the WTC towers on 11 September 2001 and hurricane Katrina in New Orleans in 2005, have drawn our attention to the effect of these catastrophes on the psycho-social functioning of citizens. Research and practice on the psycho-social effect of adversity have flourished in the developed world (Balaban, 2006; Benjet, 2010). Even though all members of a society are negatively affected by adversity, children – as individuals under the age of 18 (Unicef, 2008c) – could be especially vulnerable as their developing and neuroplastic brain is susceptible to the impairing effects of early-life stress (Greenough, Black and Wallace, 1987; Hart & Rubia, 2012; Shonkoff, 2011). This concern for developing individuals is not without foundation. Western research has established a robust effect between childhood adversity and psycho-social impairment. Green and colleagues (2010) for example reported that 45% of childhood onset and one third of later onset psychiatric disorders in the US are accounted for by childhood adversity, such as abuse, parental loss, parental mental illness, domestic violence or poverty. Longitudinal research has displayed a long-term impact of early-life stress, with increased symptoms of depression and impaired physical health in adulthood (Danese et al., 2009). Although our concern for our children in the West is touching, the majority of the world's youth live in impoverished, developing countries and is challenged by many stressors (Population Reference Bureau, 2009). Children in the developing world are confronted with natural disasters, ethnic cleansing, genital mutilation, war-related violence, child soldiering, child labour, poverty, institutionalization and parental loss (Benjet, 2010). More than 1 billion children – of which 300 million are under the age of 5 – live in war-affected countries, constituting nearly one sixth of the global population (Unicef, 2009d). Nonetheless there has been little research conducted on the effect of natural or man-made disasters on the psycho-social functioning of the members of these developing countries (Benjet, 2010). The current paper hopes to raise the attention on this important issue by focussing on the effect of war on children in the developing world.

Historically, wars were fought between combatting armies. However, new technology and a shift to civilian combat zones in modern warfare have led to an increase in victims and a shift in victim population from combatant to civilian. By 1990 nearly 90% of war casualties were civilian (Shivard, 1996). Furthermore, wars increasingly target children. Nearly half of the

civilian casualties were children and many more were victimised by armed fire, bomb attacks, landmines, sexual abuse or torture. Many children were also abducted, became child-soldiers and were forced into the perpetration of atrocities (Albertyn, Bickler, van As, Millar & Rode, 2003; Annan, Blattman & Horton, 2006; Unicef, 1996a, 2009d; Werner, 2012; Wessells, 1998a, 2006b). Unicef (1996a) has summarised the effect of war on the developing child and estimates the death of 2 million children in 10 years (1986-1996) of war. Of those who survived, "4-5 million were disabled, 12 million left homeless, more than 1 million orphaned or separated from their parents and some 10 million psychologically traumatised" (Unicef, 1996a, p13). Children living in (post-)war torn areas further lack basic needs such as protection, food, water, education and health care, exposing them to poverty, illiteracy, disease, hunger and malnutrition (Albertyn et al., 2003; Annan et al., 2006; Unicef, 1996a, 2009d; Wessells 1998a, 2006b). An important consequence of armed conflict affecting children is parental separation. Children may be separated from their parents by force such as in abductions, others might become lost in the chaos of the war, be abandoned and placed in institutions or lose one or both parents to death. In their daily struggle, orphaned or abandoned children often become homeless, live on the streets, beg for food and resort to crime, prostitution or child labour (Albertyn et al., 2003). The number of orphans, conceptualized as children under the age of 18 that have lost one or both parents (e.g. Unicef, 2004b), in the developing world is atrocious. By 2003, 143 million orphans were estimated in 93 third world countries. Sub-Saharan Africa hosts the biggest proportion of orphaned children. By 2003, 43.4 million or 12.3% of all sub-Saharan African children had lost 1 or both parents and this number is still increasing. By 2010, Unicef estimated a total number of 50 million orphans in Sub-Saharan Africa. Two of the main causes for the high orphanhood in Africa are AIDS and armed conflict (Foster, 2002b; Unicef, 2004b).

We can conclude that children living in (post-) war-torn countries are exposed to multiple stressors (Albertyn et al., 2003). Notwithstanding the extensive needs discussed above, psycho-social help remains scarce and less available in these war-affected third world areas while aid programs seem to focus on economic growth and rebuilding the infrastructure (e.g. Albertyn et al., 2003). Research on the psychological development of war-affected children is vital for stimulating, guiding and supporting psychosocial aid in conflict-torn third world areas. One geographical region particularly affected by continued war and conflict is the African continent (Albertyn et al., 2003). War has been fought in nearly 20 African countries in the last 40 years, affecting 20% of the South Saharan African population (Elbadawi &

Sambanis, 2000). One such African country hit by 2 decades of war is Uganda (Annan et al., 2006), the post-conflict area where current research was conducted.

Uganda

Since 1986, an armed conflict between the governmental National Resistance Army and the rebel Lord Resistance Army (LRA - led by Joseph Kony) affected the North-Ugandan population for more than 2 decades (Annan et al., 2006; Wessells, 2006b). The effect on the Ugandan population is great; "nearly 2 million people are displaced and impoverished, tens of thousands of youths kidnapped, and untold thousands killed" (Annan et al., 2006, p1). A mortality rate in excess of 1000 deaths per week – of which 40% were under the age of 5 – was found in the Acholi region of Northern Uganda in 2005 (World Health Organization, 2005). Children were also actively involved in the war. Ninety per cent of the recruitment of the LRA consisted of children (Derluyn, Broekaert, Schuyten & Temmerman, 2004). A recent review article (Vindevogel et al., 2011) estimates the amount of child soldiers abducted by the LRA to be at least 25,000 to 38,000 children. The Ugandan war had in particular a devastating effect on family structure. When child soldiers returned from their captivity by the LRA, 84% of the children's families were displaced (n=1426), 26% of the children had lost their father (n=514) and 12% their mother (n=236) while 6% (n=126) had lost both parents (Vindevogel et al., 2011). Recent studies estimate that 14% of the total Ugandan child population - nearly 2.5 million - is orphaned (Foster, 2002b; Kalibala & Elson, 2009; Unicef, 2004b). Based on multiple indicators such as poverty, parental loss, poor health and no schooling, 96% of the Ugandan child population is considered vulnerable, of which 8 million are considered moderate to critically at risk (Kalibala & Elson, 2009). We can conclude that the majority of Ugandan children experience multiple, chronic and severe daily stressors. Unfortunately, early-life stress (ELS) is known to have a vast negative effect on the mental health of children, such as on psycho-social, cognitive and emotional functioning (Albertyn et al., 2003; Barenbaum, Ruchkin & Schwab-Stone, 2004; Paardekooper, de Jong & Hermanns, 1999; Unicef, 2009d; Werner, 2012; Wessells, 1998a, 2006b).

The Effect of Early-life Stress on Mental Health

Consistently in research (cf. Bayer, Klasen & Adam, 2007; Benjet, 2010; Betancourt et al., 2010; Derluyn, 2011; Derluyn et al., 2004), a high prevalence of psychological and social problems is found amongst children exposed to early-life stress or trauma – such as in abused, displaced, refuged, orphaned or soldiering children. The World Mental Health Survey Initiative of the World Health Organization – conducted by Kessler et al. in 2010 – displayed the association between 12 different childhood adversities and 20 mental disorders in 21 low, middle and high income countries. Across countries, nearly 30% of all mental disorders - occurring at childhood, adolescence or adulthood - were accounted for by childhood adversity (Kessler et al., 2010). War-affected children in particular face multiple stressors (e.g. Albertyn et al., 2003). A systematic review of Attanayake and colleagues (2009) concluded that Post-Traumatic Stress Disorder (PTSD) is the most prominent outcome, with an overall prevalence rate of 47%, in war-affected children over multiple countries. PTSD is an anxiety disorder characterized by (1) the re-experience of trauma through nightmares, flashbacks or intrusive memories, (2) the avoidance of events or people that remind them of the traumatic event and (3) hyperarousal as reflected in hypervigilance, irritability and difficulty sleeping or concentrating (American Psychiatric Association, 2000). Furthermore, elevated symptoms of anxiety (27%) and depression (43%) were found in war affected children (Attanayake et al., 2009). Besides concurrent effects, war-related experiences have long term effects on physical and mental health. War-related exposure in childhood has been linked to poor sleep, increased obesity, psychological distress, post-traumatic stress and poor health in adulthood (Llabre & Hadi, 2009). We can conclude that early-life stress may have a vast negative effect – concurrent and long term – on psychological functioning in a significant proportion of war-affected children. However, past research on ELS in developing countries focuses on a limited spectrum of mental health problems, specifically on PTSD, anxiety and depression (Benjet, 2010). Other important aspects of the development of war-affected children, such as cognitive functioning, have not been of focus. Nonetheless, the parents of war-affected children report a delay in cognitive development in their children (Paardekooper et al., 1999). Research has indeed displayed the impairing effect of ELS - such as abuse, maltreatment or neglect - on a broad variety of cognitive functions, ranging from memory, IQ, academic performance to attention (Hart & Rubia, 2012; Pechtel & Pizzagalli, 2011). One important factor of adaptive cognitive functioning is executive control. In the next section we will first attend to the conceptualization of executive functioning before investigating the effect of ELS.

Hot and Cool Executive Control and its Relationship to Early-life Stress

Executive functions, synonym to cognitive control and executive control, are defined as "a collection of top-down control processes used when going on automatic or relying on instinct or intuition would be ill-advised, insufficient or impossible" (Diamond, 2013, p136). Cognitive control is necessary when displaying change, resistance or planning and is used for reasoning, goal directed behaviour and problem solving. Executive functions contain 3 top-down mental processes: inhibition, working memory and cognitive flexibility (e.g., Diamond, 2013; Lehto, Juujärvi, Kooistra & Pulkkinen, 2003; Miyake et al., 2000). While cognitive flexibility is needed to 'think outside the box', working memory keeps information actively in mind to be mentally worked on. Inhibitory control is inter alia necessary in self-control, discipline and conducting a task successfully without interference of distracting stimuli (Diamond, 2013). One line of research has focused on the interference of concurrent emotion processing on executive control and will be discussed next.

The review article by Mueller (2011) summarizes behavioural, neuro-cognitive and neuro-chemical evidence for the impairment of cognitive control during concurrent, task-irrelevant emotional processing. Emotional distracting stimuli, reward, induced mood and anxiety or depressed traits were found to moderate cognitive control and the activation of associated brain regions. The interfering effect of emotion processing is found in multiple executive control functions, such as working memory, inhibitory control and task switching. Furthermore, emotional valence has a differential effect on executive control. In contrast to reward, pleasant stimuli and positive emotions, negative emotions or stimuli have an impairing effect on cognitive control (Mueller, 2011). The effect of emotional interference on cognitive control is apparent in both adults and children as young as 4 (Lagattuta, Sayfan & Monsour, 2011; Mueller, 2011). Consistent with the different development trajectories of brain regions, in particular the slow maturation of the prefrontal cortex in contrast to the rapid development of the limbic system, the effect of emotion on cognitive control may be enlarged in children and adolescents compared to adults (Mueller, 2011; Tottenham, Hare & Casey, 2011).

Some researchers have made a distinction between hot and cool executive functioning to capture the effects of emotion processing on executive control described above. Cool executive functioning is cognitive control used in abstract problem solving (such as naming the colour font of a colour word in the Stroop Task, discussed below) while the hot counterpart - also referred to as 'emotional control' in this study - is more active when emotional, affective or motivational aspects are involved (such as in delayed gratification tasks) (e.g.

Hongwanishkul, Happaney, Lee & Zelazo, 2005; Zelazo & Carlson, 2012). Hot executive control is inter alia necessary when regulating ones emotions and motivations. Although profoundly working together, hot and cool executive functioning are associated with different neural paths (e.g. Zelzazo & Carlson, 2012). Consistent with the notion that the executive control of children and adolescents is more influenced by affect than adults' (Mueller, 2011), Prencipe and colleagues (2011) conclude that hot executive control develops slower than cool executive control. Performance on all executive tasks improve with age, but improvement in cool executive functioning occurs earlier and is more robust than improvement in hot cognitive control (Prencipe et al., 2011). Now we shall turn to the effect of early-life stress on executive control.

Executive functioning is critical in daily life and predicts important factors such as academic performance, job success, social functioning, physical and mental health and overall quality of life (Diamond, 2013; Moffitt et al., 2011). Importantly, good executive functioning is a protective factor when faced with adversity. Children with better self-regulation and cognitive control are more able to cope with early-life stress and display better adjustment (Lengua, 2002; Shonkoff, 2011; Raver, 2004). Unfortunately, the neuroplasticity of the developing brain makes it vulnerable to stressful environments (Pechtel & Pizzagalli, 2011; Shonkoff, 2011) and executive functions are one of the first to be affected by stress and adversity in life (Diamond, 2013). Multiple studies illustrate impaired hot and cool executive functioning in subjects with a history of maltreatment, neglect or institutionalization, even when controlling for psychopathology, IQ and socioeconomic status. In particular impaired inhibitory control, working memory, task switching, reward processing, emotion recognition, emotion regulation and an attentional bias to negative valenced faces and threat-related cues are apparent in a distressed population (De Bellis, Hooper, Spratt & Woolley, 2009; DePrince, Weinzierl & Combs, 2009; Hart & Rubia, 2012; Mueller et al., 2010; Mueller et al., 2012; Navalta, Polcari, Webster, Boghossian & Teicher, 2006; Pechtel & Pizzagalli, 2011; Pollak, Cicchetti, Hornung & Reed, 2000; Sonuga-Bark & Rubia, 2008; Watts-English, Fortson, Gibler, Hooper & De Bellis, 2006).

Diamond (2013) suggests that the adverse effects of early-life stress on cognitive and emotion control can be administered both at a neurological level – such as deficits in the development and functioning of the prefrontal cortex, basal ganglia and amygdala (e.g. Hart & Rubia, 2012; Mueller et al., 2010, Pechtel & Pizzagalli, 2011) – and a behavioural level – such as

impairment in reasoning, problem-solving, planning, emotion regulation, emotion recognition and reward processing (e.g. De Bellis et al., 2009; Pechtel & Pizzagalli, 2011). Indeed, adolescents marked by ELS show impaired performance and increased activation in cerebral cognitive control centres while conducting cognitive control tasks (Mueller et al., 2010) – suggesting disruption in both emotional and cognitive processing (Mueller, 2011; Mueller et al., 2012). Interestingly, the same brain functions are found disrupted in clinical samples when conducting a cognitive control task, such as in PTSD patients (e.g. Carrion, Garrett, Menon, Weems & Reiss, 2008; Falconer et al., 2008; Hart & Rubia, 2012; Mueller et al., 2010). Because similar cognitive deficits are found in maltreated samples with and without PTSD (e.g. De Bellis et al., 2009), hot and cool executive impairment in maltreated children may be a risk for later psychopathology (De Bellis et al., 2009; DePrince et al., 2009; Diamond, 2013; Hart & Rubia, 2012; Majer, Nater, Lin, Capuron & Reeves, 2010; Mueller, 2011; Pechtel & Pizzagalli, 2011; Tottenham et al., 2010). Consistently, Mueller and colleagues (2010) suggest that neural circuits of cognitive control may play an important role in the relationship between maltreatment or stress and psychopathology. Indeed, the relationship between adversity and psychopathology has at least partially been mediated by impaired executive functioning for some disorders (Colvert et al., 2008). Youth burdened by adversity may therefore not only be impaired in their executive functioning, but this latter factor may also put their mental health further at risk (Figure 1). Executive impairment has been linked to different psycho-social problems later in life, such as crime, substance dependence, risk taking behaviour, breaking the rules, violence, poor academic performance, emotional instability, impulsivity, attention deficit hyperactivity disorder, conduct disorder, PTSD, anxiety, depression, obsessive compulsive disorder and schizophrenia (Aupperle, Melrose, Stein & Paulus, 2012; Diamond, 2013; Moffitt et al., 2011; Mueller, 2011). Because of the neuroplasticity in developing youth and the important role of executive functioning in psycho-social wellbeing, preventive and resilience enhancing programs could tackle executive impairment in children affected by ELS (Zelazo & Carlson, 2012). While impaired executive control could put the mental health of the distressed child at risk, improved executive control may protect the child when faced with subsequent adversity (Shonkoff, 2011). The current study will therefore investigate the relationship between ELS, hot and cool executive control and mental health in Ugandan adolescents.

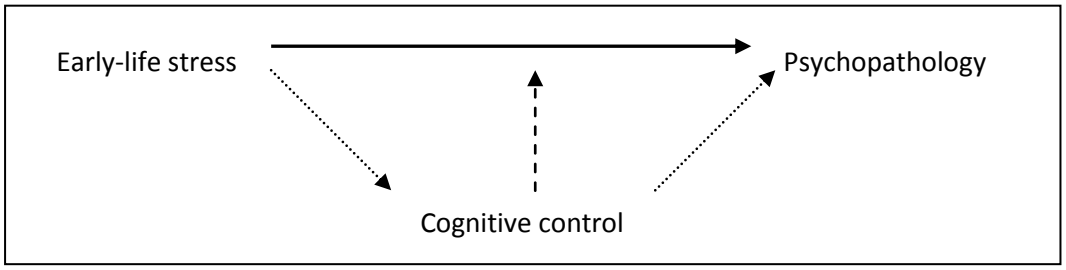

Figure 1. Hypothesised relationship between ELS, cognitive control and psychopathology.

As we have now discussed the *what* of focus, hot and cool executive control, we are now going to discuss the *how*, the methods of investigating the executive performance of Ugandan adolescents. Cool executive functioning has been investigated using many different tasks, of which the Stroop Task (Stroop, 1935) is a popular test for inhibitory control. The test measures someones ability to ignore irrelevant information when conducting a task (Banich, 2009; DePrince et al., 2009; Diamond, 2013; Stroop, 1935). It requires participants to name the colour in which the word is printed regardless of the word they read. However, the meaning of the word conflicts with the colour font (e.g. **blue**), therefore causing cognitive interference and prolonged latency when naming the colour - also referred to as the Stroop interference effect. The default response is to read the word, the participant has to inhibit this tendency to successfully name the colour in which it is printed – cognitive control is needed to succeed in this task (Banich, 2009; DePrince et al., 2009). On the contrary, when the participant is instructed to read the same list of colour words printed in the non-corresponding colours, the interference results are not replicated as reading speed is not influenced by the conflicting input. Thus, the conflicting input does not interfere with the reading performance but does hamper the naming of the colour (e.g. MacLeod, 1991; Stroop, 1935). Stroop (1935) assigned this differential effect of interference to a difference in learning and proficiency. Reading is a well learned skill, while naming colours is not practised as much during development. Stroop's explanation comprises the ideas of 2 dominant theories on the Stroop interference effect: the relative speed of processing and the automaticity view. The first view underlines the fact that words are read faster than colours are named. When naming a colour, we need to translate the perceptual code into a verbal code, therefore increasing the processing time. Such transformation is not needed when processing a written word. The word and colour response tendencies then compete in producing the answer. Interference is the time cost by this response competition. The automaticity hypothesis in turn concerns the effect of learning history. During our development, we have much more practice in reading words then naming

colours. Reading a word occurs more automatically while colour naming requires much more attention. The more automatic skill, reading the word, will therefore conflict with the less automatic response tendency, naming the colour – causing a delay in responding (MacLeod, 1991). This explanation is consistent with the well supported finding that the amount of interference in the Stroop Task depends on proficiency in the reading skill. The Stroop effect diminishes in very young samples as their reading skills are not yet automatized, therefore causing less interference with the colour naming (Leon-Carrion, García-Orza & Pérez-Santamaría, 2004; MacLeod, 1991; Schiller, 1996). Another, more contemporary explanation of the Stroop interference effect is that of the perceptual conflict. It proposes that our limited processing capacity is overloaded when asked to deal with both relevant colour and irrelevant meaning of the word, therefore increasing the total processing time (Alansari & Baroun, 2004; MacLeod, 1991). Whatever the exact process, researchers agree that there is cognitive interference in the Stroop task and executive functioning is required to successfully fulfil the task. Cool executive control is assessed in current research by comparing the performance in a congruent trial to that in an incongruent Stroop trial. The participants are asked to read a list of colour words printed in corresponding colours, therefore causing all items to be congruent (e.g. **red**). The other trial is incongruent as participants are requested to name the colour of a colour word printed in a conflicting colour font (e.g. **red**). Congruent trials are expected to be easier compared to incongruent trials as the former only requires reading skills and the latter demands executive control.

The Stroop task has been used in many different populations, with ages ranging from 6 to 80 (Golden, 1987; MacLeod, 1991). Any literate child who can recognize the colours can conduct the Stroop Task. The Stroop test has furthermore been used in healthy and in troubled or psychiatric samples (Golden, 1987; MacLeod, 1991). Stroop interference increases with more adverse life events (Lovallo et al., 2013) and in PTSD patients (Aupperle et al., 2012; LaGarde, Doyon & Brunet, 2010). Ugandan children burdened by ELS are therefore expected to perform worse on the cool executive Stroop task than their less distressed peers in current research.

Research has primarily focused on cool executive control, but hot cognitive control is finally earning its name in becoming a *hot* topic (e.g. Hongwanishkul et al., 2005). One popular way of investigating hot executive control is by modifying the cool Stroop Test to incorporate an emotional dimension. In the Affective Stroop Task, the respondent is asked to name the

colour of emotion or threat-related words – such as "**smile**", "**captivity**" or "**blood**" (MacLeod, 1991). This emotional load may cause interference by distracting the participant from relevant colour information, therefore delaying the performance of colour naming. The resting activation level of emotional words might also be higher than that of colour words, therefore impairing the ability to ignore the emotional information and causing interference with the colour naming response (Williams, Mathews & MacLeod, 1996). The Affective Stroop Task has been used both in healthy samples (Gilboa-Schechtman, Revelle & Gotlib, 2000) and in clinical populations. A review by Williams and colleagues (1996) concludes that patients suffering from diverse mental illnesses - ranging from general anxiety disorder, panic disorder, phobia, obsessive compulsive disorder, PTSD to depression - show impaired executive functioning on an emotional Stroop task in which they were asked to name the colour of clinical relevant words (e.g. **spider**). Moreover, the emotional interference effect was larger in PTSD patients than in any other disorder. Multiple studies have underscored the distracting potential of trauma related words in PTSD samples (e.g. Moradi, Taghavi , Neshat Doost, Yule, & Dalgleish, 1999). However, a meta-analysis by Cisler et al. (2011) nuances this result and explains that both PTSD and non-PTSD diagnosed persons with trauma exposure show increased interference on PTSD relevant Stroop words, compared with a control group that is not exposed to trauma. There is no significant difference between the two trauma groups suggesting that the attentional bias to threat-related stimuli is more due to trauma exposure then PTSD diagnoses. It seems that trauma exposure not only has a significant impairing effect on cool executive functioning but also on hot executive control. Neurobiological evidence has indeed indicated that early-life stress causes structural and functional changes in both the fronto-striatal-cerebellar network – home to cool executive functioning – and the fronto-limbic network – responsible for emotional and motivational processing of problems and home to hot executive control (Hart & Rubia, 2012; Mueller et al., 2010; Pechtel & Pizzagalli, 2011; Watts-English et al., 2006).

We must not forget to take the cultural climate in which the current study is conducted into account. Although frequently used in Western countries (e.g. review of Williams et al., 1996), the *Affective Stroop Task* using threat-related stimuli might be too sensitive to use in a post-war country. Recalling the threatening situation may be distressing and harmful to the child, therefore instigating the risk of re-traumatisation. The current research has adopted another test to investigate the effect of emotional interference on executive control in war-affected Ugandan adolescents.

The "*Sad-Happy*" Task - designed by Lagattuta and colleagues in 2011 - is an interesting alternative as it is an adequate but less threatening test of hot executive control. It is a Stroop-like card task where participants are required to say 'happy' to a picture of a sad face or say 'sad' to a picture of a happy face. This test measures hot executive functioning as inhibitory control is needed to say the correct opposite emotion. The automatic response of naming the emotion presented is inhibited in order to give the correct opposite emotion. Furthermore, working memory is activated to keep the rules in mind (Diamond, Kirkham & Amso, 2002). Indeed, the Sad-Happy task was proven a reliable test of hot executive control in both children and adults and did not exhibit floor or ceiling effects for either group (Lagattuta, Sayfan & Monsour, 2011).

The Sad-Happy test was modified and expanded in current research. To make the test of hot executive control more appropriate for adolescents, the opposites hate-love and pride-shame were added to the classic sad-happy opposition in the novel Opposite Emotions Test (OET). The choice of emotion opposites is justified by their conceptual relationship: sad and happy are positioned at opposite sides of the dimensions of valence and arousal in the circumplex model of emotions (Russell & Barrett, 1999). Multiple studies have further supported the opposite dimensions of love-hate (Benjamin, 1996) and pride-shame (Nathanson, 1987) in the emotional structure. As the semantic relationship between the correct (e.g. say 'love' when you see hate) and inhibited (e.g. say 'hate' when you see hate) response may increase the inhibitory demand (Diamond et al., 2002), we can expect participants to have difficulty naming the correct emotion opposite. The current study compared the incongruent trial of naming the opposite emotion with a congruent trial of reading a list of emotion terms to assess hot executive control in Ugandan students. As executive functions are necessary in the incongruent trial while only automatized reading skills are required in the congruent, incongruent trials are expected to be more challenging than congruent trials. Moreover, as trauma-exposed youth may exhibit impaired hot executive control (e.g. Cisler et al., 2011) and the structure of emotion terms amongst abused children is less systematic and orderly than their non-abused peers (During& McMahon, 1991), Ugandan students exposed to ELS are expected to have more difficulty in saying the correct emotion opposite and to display impaired performance on the OET compared to their less affected peers in current research.

Up until now we have outlined the aim of the research in discussing the impairing effect of early-life stress on cool and hot executive control. But how do we conceptualize "early-life stress"? War is a very stressful environment raising many different kinds of stressors that children have to deal with. Stressors range from physical health issues, malnutrition, hunger, poverty, safety hazards, exposure to violence, disruptions in the community, educational challenges, parental loss, institutionalization, abduction, child soldiering to abuse and neglect. The loss of a parent – from diseases such as AIDS or war casualty – is an important and frequent daily stressor for children living in (post-) war areas (e.g. Dowdney, 2000; Foster, 2002b; Nyamukapa et al., 2010; Unicef, 2004b) and will be the focus of this study. Although the effects of losing a parent have been investigated in the western world, the psycho-social functioning of orphaned children in developing countries has not been the focus of extended research to date, even though Africa hosts most of the orphaned children (Foster, 2002b; Unicef, 2004b).

Parental Loss as an Early-Life Stressor

Losing a parent is known to be psychologically a very distressing experience (Nyamukapa et al., 2010) as well as an important risk factor for the academic performance and psycho-social well-being of the individual (Coyne & Beckman, 2012; Downdney, 2000; Kendler, Sheth, Gardner, & Prescott, 2002). Beyond the unmet basic needs such as food and education, Tanzanian and Ugandan orphans have significantly more internalizing problems, including an increased likelihood of experiencing anxiety, depression and anger symptoms and a higher prevalence of suicidal thoughts, compared to their non-orphaned peers (Atwine, Cantor-Graae & Bajunirwe, 2005; Makame, Ani & Grantham-McGregor, 2002; Sengendo & Nambi, 1997). As if losing a parent is not distressing enough, orphaned children are at increased risk of experiencing additional traumatic events (Mels, Derluyn, Broekaert & Rosseel, 2009a; Whetten, Ostermann, Whetten, O'Donnell & Thielman, 2011). Unfortunately, a dose-response relationship exists with cumulative adverse experiences producing worse psychological outcomes (e.g. Werner, 2012) – therefore putting the mental health of orphans even more at risk. Additionally, with more traumatic exposure, the prevalence of anxiety symptoms increased more within the orphaned group compared to their abandoned peers (Whetten et al., 2011). These results suggest that orphans may not only experience additional stressors but may also be more affected by them. One way in which parental loss may increase vulnerability to

physiological stress is through impaired self-regulatory abilities, including emotional and cognitive control (Luecken & Lemery, 2004). DePrince and colleagues (2009) demonstrate that familial trauma (physical, sexual abuse or witnessing domestic violence) impairs executive functioning more than non-familial traumas, such as car accidents or natural disasters. The interpersonal character of familial trauma seems to increase the impairing effect of adversity on executive control. We can therefore expect that the loss of a parent, as the most extreme familial trauma, may have a critical effect on the executive development of the child. However, to our knowledge no research has directly examined the effect of parental loss on executive control in children. Nonetheless, research on adopted or institutionalized youth has suggested an impairing effect of social deprivation on executive functioning.

Parental loss during sensitive periods of development may cause deficits in the neural wiring, such as in the prefrontal cortex, therefore impairing the cognitive development and executive functioning of orphans. Indeed, children with a history of early institutionalization display impaired memory and executive control compared to children with no institutional care (Bos, Fox, Zeanah & Nelson III, 2009). These cognitive delays are already visible in 23-50 months old orphaned babies (Kaler & Freeman, 1994) and persist into adolescence for a significant portion of institutionalized children (Beckett et al., 2006). Former institutionalized children adopted from all over the world display significant impairment in executive functioning - beyond decreased intelligent scores - on various executive control measures investigating inhibitory control, working memory and cognitive flexibility (Behen, Helder, Rothermel, Solomon & Chugani, 2008; Hostinar, Stellern, Schaefer, Carlson & Gunnar, 2012). Methodologically interesting, Colvert and colleagues (2008) investigated the executive functioning of Romanian adoptees with the Stroop test. Their results suggest an increased cognitive interference among those children who are deprived by early institutionalization, compared to their non-institutionalized Romanian and English peers that are adopted at 6 months or younger. In line with these results on social deprivation, the current research expects Ugandan orphans to perform worse on the Stroop task than their non-orphaned peers. Moreover, research has not only displayed the impairing effect of social deprivation on cool executive control, results on impaired hot executive control have also slowly emerged.

Behaviour and emotion regulation difficulties have been found in ex-institutionalized, socially deprived children (Gunnar, Bruce & Grotevant, 2000). Prolonged institutional care was related to impaired response inhibition in the presence of affective distractors in an emotional Go-No Go test of executive control (Tottenham et al., 2010). Compared to a control group,

institutionalised children made more errors when presented with negatively valenced faces. Consistently, Pollak and colleagues (2000) indicate impaired emotion processing and recognition in abused and neglected children. However, prolonged institutionalization in Tottenham and colleagues' research (2010) was associated with increased false alarm to negative expressions rather than actual misses, leading the researchers to attribute their results to impaired self-regulation (false alarm errors) when exposed to emotional stimuli rather than having difficulty in identifying emotions (misses). Furthermore, performance of institutionalized youth was more affected by valence (positive versus negative) and stimulus type (distractor versus target) compared to the control group. Institutionalized children responded faster when responding to neutral faces while being distracted by negative faces, and reaction time increased when responding to neutral faces while distracted by positive valenced faces. The researchers conclude that these bereaved children are more affected by their emotional environment than other children. The susceptibility and hypersensitivity to emotional stimuli was supported by neurobiological evidence of an enlarged amygdala – an important structure in processing, responding to and learning from emotional stimuli – in children that resided longer in institutionalization (Tottenham et al., 2010). These enlarged amygdala volumes are further consistent with an increased risk of internalizing disorders in post-institutionalized children (Ellis, Fisher, & Zaharie, 2004; Tottenham et al., 2010). Research has in such laid the basis for a link between social deprivation, psychopathology and executive control. When conceptualizing parental loss as an early-life stressor, we can adapt the previous model (p7) to figure 2. Orphaned children are not only expected to experience more mental health problems, they may also display impaired hot and cool executive control which may put their psychosocial health further at risk. The current study will therefore investigate the relationship between parental loss, hot and cool executive control and mental health in Ugandan adolescents.

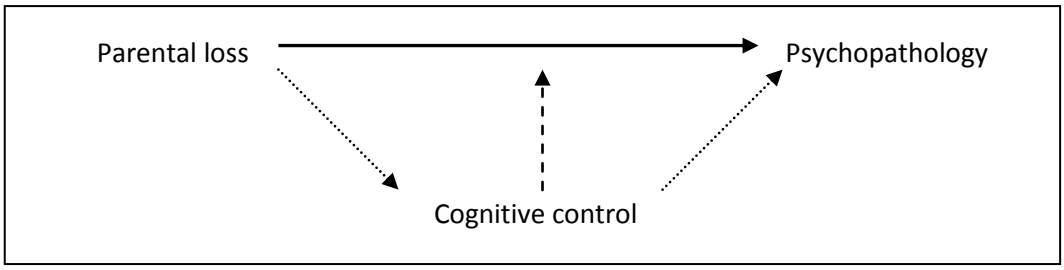

Figure 2. Hypothesised relationship between parental loss, cognitive control and psychopathology.

As motivated in this introduction, the main research question of this study concerns whether Ugandan orphans exhibit more executive control difficulties compared with their non-orphaned peers. Current research used the Stroop Task and the new Opposite Emotions Task to investigate hot and cool executive functioning of Ugandan adolescents. Both can be considered tests for executive control as an automatic reading response needs to be inhibited and an opposite response (another colour or opposite emotion) needs to be activated in the incongruent trials. Each test has a congruent reading trial and a cognitively demanding incongruent trial. The first 2 hypotheses in current research concern the efficacy of these 2 tests in the Ugandan adolescent sample. The first hypothesis investigates the main effect of congruency. Consistent with past research (e.g. MacLeod, 1991), performance in congruent trials (reading emotions in OET or reading colour words when printed in the corresponding colour font in Stroop) is expected to be better than in incongruent trials (naming the opposite emotion in OET or naming the colour font which conflicts with the word meaning in Stroop). The second hypothesis concerns the main effect of task. Consistent with research on the impairing effect of emotions on executive control (e.g. Lagattuta et al., 2011; Mueller, 2011), reaction times are expected to be longer on the OET than on the Stroop task, as the first adds emotional interference to the classical Stroop task of executive control. Furthermore, parental loss is expected to influence executive performance. Consistent with previous research (e.g. Bos et al., 2009), a main effect of parental loss is expected to exhibit the global impairment in executive functioning in the orphaned sample compared to students that still have both their parents. In line with previous research on the impairing effect of ELS and social deprivation on hot and cool executive control (e.g. Cisler et al., 2011; Colvert et al., 2008), performance on both the Stroop and OET is expected to be worse in the orphaned group compared to the non-orphaned group. However, as research has displayed the increased effect of emotion on executive control in institutionalized children (e.g. Tottenham et al., 2010), a significant interaction effect between task and parental loss is anticipated to demonstrate poorest performance in the orphaned group on the OET. Besides executive impairment, orphaned students are expected to have more mental health problems and exhibit more symptoms of traumatisation, depression and anxiety (e.g. Atwine et al., 2005). Last, a relationship between executive performance and mental health is expected in the orphaned group. The methodology used to explore the above mentioned hypotheses will be discussed next.

Methodology

The current research is a quasi-experiment of cross-sectional format. The research was conducted from September up to and including November 2013 in Lira, Northern Uganda, with the help and support of a local psychosocial NGO, the Centre for Children in Vulnerable Situations (CCVS) – a practice-oriented project set up by the Belgian interuniversity collaboration under the same name and headed by the associated faculty, Prof. Dr. Ilse Derluyn. All testing materials are attached in the Appendix.

Participants

With the help of CCVS, a local secondary school was selected based on criteria such as feasibility (e.g. location), willingness to co-operate, educational level and boarding status (day school, half or full boarding). Doctor Obote College, the selected school, is a full boarding secondary school located in Lira, Northern Uganda and has 1095 students. There are 6 academic levels, ranging from senior 1 to senior 6. Senior 5 is an all-male level consisting of 154 students, divided over 3 classes. As families are scattered around the district, all students board and only go home for the holiday periods.

The project outline, its purpose and its goal were thoroughly discussed with the school principal, after which the principal gave his permission and signed the consent form. The project was announced in senior 5 and 75 male students from this level agreed to participate. However, 7 data samples were excluded during data cleaning, reducing the sample to 68. Four participants were excluded as the instructions for the tests were not understood or the participant had difficulty in naming the colours. Another 2 data sets were deleted as they had too many missing items and the data of 1 student was excluded as it was considered an outliner with 2 standard deviations above the mean. All participants were male between the ages of 14 and 19. Eighteen of the participants were orphaned, with one or both parent(s) deceased, while 50 students still had both parents. Each student participated voluntarily and signed an informed assent form before participating. The approval of the Ethical Committee of the Faculty of Psychology and Pedagogical Sciences, Ghent University was obtained as well as local ethical approval from the Uganda National Council for Science and Technology.

Material

Post-traumatic stress symptoms.

Horowitz, Wilner and Alvarez designed the self-report scale *The Impact of Events Scale (IES)* in 1979, which was revised in 1997 by Weiss and Marmar. The questionnaire assesses Post Traumatic Stress symptoms as an indicator for PTSD – as conceptualized by The Diagnostic and Statistical Manual of Mental Disorders, 4th Edition (American Psychiatric Association, 2000). Although it was originally designed for adults, it has also been frequently used for adolescents (Balaban, 2006). It has 22 items in which the respondent is asked to rate on a scale from 0 (not at all), 1 (a little bit), 2 (moderately), 3 (quite a bit) to 4 (extremely) how distressed they are at the moment of assessment and/or have been within the past month by the enlisted difficulties after experiencing a stressful life event. A visual probe was added to clarify the growing intensity of the answer (increasing plus marks from 0 to 4). Three subscales are measured: avoidance (8 items, maximum score: 32), hyperarousal (7 items, maximum score: 28) and intrusion (7 items, maximum score: 28) (Weiss & Marmar, 1997). The total (maximum score: 88) and subscale scores are calculated by adding the score on the indicated items.

This trauma measure has been used in many cultural contexts – such as in Rwanda (Dyregrov, Gupta, Gjestad & Mukanoheli, 2000), Congo (Mels, Derluyn, Broekaert & Rosseel, 2009a, 2010b, 2010c), Japan (Asukai et. al., 2002) and in Ugandan adolescents (Amone-P'Olak, Garnefski & Kraaij, 2007; Derluyn et al., 2004). Previous research translated the IESR successfully into Lango, the local North-Ugandan language – test reliability and internal consistency of this Lango-version was strong (McMullen, O'Callaghan, Richards, Eakin, Rafferty, 2012). Prior to the testing, the Lango translation was rechecked in current research by a local translator in Lira during September 2013. The Cronbach alpha reliability coefficients for the subscales in the present study range from 0.65 for the avoidance subscale, 0.68 for the hyperarousal subscale to 0.81 for the intrusion subscale. Cronbach alpha for the total scale is estimated at 0.87.

Anxiety and depression.

The *Hopkins Symptom Checklist-37A (HSCL-37A)* is a 37-item self-report questionnaire that measures a variety of possible mental health problems in adolescents (Bean, Eurelings-Bontekoe, Derluyn & Spinhoven, 2004). The participants are asked to rate how often they have

experienced the enlisted feelings or actions within the past month on a 4-point Likert scale (never = 1, sometimes = 2, often = 3, always = 4). The items are assisted by a visual probe to clarify the quantity and strength of the feelings or the frequency of actions described. Three symptom dimensions can be calculated: 12 items measure externalizing problem behaviour and 25 items measure internalizing problems, including symptoms of anxiety (10 items) and depression (15 items), as conceptualized by the Diagnostic and Statistical Manual of Mental Disorders, 4th Edition (American Psychiatric Association, 2000). However, only the depression and anxiety subscales of the HSCL-37A were used in current research.

The HSCL-37A has shown high validity and reliability scores in adolescent samples from diverse cultural backgrounds (Bean, Derluyn, Eurelings- Bontekoe, Broekaert & Spinhoven, 2007). Adapted versions of the test have been used in multiple third-world countries such as Uganda and Congo, with adequate reliability and validity scores in these war affected countries (Mels et al., 2010b, 2010c; Ovuga, Oyok & Moro, 2008). Furthermore, previous researchers have translated the HSCL-37A test reliably into Lango (Ovuga et al., 2008). The translated questionnaire was rechecked by a local translator in September 2013 for its use in the current research. The Cronbach alpha reliability coefficient was 0.73 for the anxiety subscale and the 0.78 for the depression subscale in current research.

Cool executive control.

As alluded to in the introduction, the *Stroop Test* has frequently been used to assess executive functioning (e.g. Golden, 1987; MacLeod, 1991; Siegrist, 1997). The Stroop task has also been used in various cultures, such as in Kuwait (Alansari & Baroun, 2004), South-Africa (Oosthuizen & Phipps, 2012), Lebanon (Dalrymple-Alford & Budayer, 1966) and in China (Biederman & Tsao, 1979) – suggesting that the Stroop interference effect occurs pan-culturally. In the present version, the cumulative reaction time was recorded on a congruent (reading) and incongruent (naming the colour) Stroop trial. The difference in reaction time between the incongruent and congruent Stroop trial is expected to display cool executive control. Both congruent and incongruent trials consisted first of 2 practice trials of each 40 items and then 2 experimental trials of each 60 items – all items were randomly distributed on laminated sheets. However, practice trials were not used in the analyses; only experimental trials were used to assess cool executive performance.

Incongruent Stroop trial.

The incongruent Stroop trial consisted of printed xxxxxxxxxx strings, each x being a coloured colour word (e.g. **red blue green brown purple brown blue green purple red**). Consistent with the original design (Stroop, 1935), only the 5 colours red, blue, green, brown and purple were used and no colour was printed in the colour it names, causing all items to be incongruent (e.g. **blue**). The adolescent was instructed to name the colour in which the word was printed while ignoring the meaning of it (e.g. **blue** – saying green instead of blue).

Before testing took place, the participant would practise naming the colours. He was asked to name the 5 colours green, blue, brown, purple and red previously indicated in the classroom. When this was successful, the participant would practise naming the colour font of 3 incongruent items (**blue – brown – green**) on laminated cards. Then he would practise 5 incongruent items in the test booklet. If the participant made any errors and the experimenter judged that the participant may have forgotten the rules, he was reminded of them, corrected and administered another practice item. Practice was ceased when the experimenter judged that the participant had fully understood the instructions and was at ease with the colour naming. After this introduction, the 2 practice trials and 2 experimental trials were conducted – without further correction or extra explanation.

Congruent Stroop trial.

The congruent Stroop trial consisted of a list of colour words printed in the corresponding colour (e.g. **red**) - causing all items to be congruent. The student was asked to read the list of colour words. Before testing took place, the participant would practise the naming of the colours. He was asked to name the 5 colours green, blue, brown, purple and red as indicated in the classroom and then in the test. Then the testing booklet was opened, the 2 practice trials and 2 experimental trials commenced without further help or guidance.

Hot executive control.

The *Opposite Emotions Test* is a variation of the Emotional Stroop test and is based on the Sad-Happy test (Lagattuta et al., 2011). It was specially developed for the current research to measure emotional interference on inhibitory control in Ugandan adolescents. The OET was composed by repeating xxxxxxxxxx strings, with each x being a randomly selected emotion word (e.g. sad happy hate love pride happy shame love pride sad). Three emotion opposites were included: love-hate, happy-sad and pride-shame. Two test booklets were made of which

the first 2 pages were practice trials, each practice page consisting of 4 strings of each 10 items. The last 2 pages of the test booklets were experimental trials, both with 6 strings of 10 items. However, practice trials were not used in the analysis; only experimental trials were used to assess hot executive control. The participant is requested to name the opposite emotion in one test booklet (incongruent trial) but asked to read the emotion words in the other test booklet (congruent trial). The difference in reaction time between the incongruent and congruent OET trial is expected to display hot executive control.

Incongruent opposite emotions trial.

The incongruent OET trial required participants to respond with the opposite emotion to the one presented. For example, when you read "love", "hate" is the expected correct answer. Participants were trained in how to play the 'game'. The 3 emotion duos happy-sad, love-hate and pride-shame were written on opposite sides of laminated cards to make the task more visual and comprehensible. While rehearsing the opposites, the Lango translation (Yom Cuny, Mara or Awaha) was mentioned. The instructions from Lagattuta et al. (2011) were adjusted for the *Opposite Emotions Test*: 'Now, we are going to play an opposite emotions game. Here are 3 emotions: Happy (Yom Cuny), Love (Mara) and Pride (Awaha) *(shown on the laminated cards).* Each of these emotions has an opposite: the opposite of Love (Mara) is Hate (Adage) *(turn card),* the opposite of Happy (Yom Cuny) is Sad (Cwer Cuny) *(turn card)* and the opposite of Pride (Awaha) is Shame (Lewic) *(turn card).* I would like you to name the opposite emotion to the one I'm going to show you on the card. So let's practise it: what is the opposite of love? And the opposite of happy? And the opposite of pride? The opposite of hate is? And the opposite of sad? And of shame?" The 3 emotion duo cards were practised each 3 times in both directions. Then the test booklet was opened and the participant was instructed to name the opposite emotion word to the one presented in the test. An example was given, "When you read 'love' in the list I want you to say 'hate', when you read 'sad' – 'happy'". The first line in the test, consisting of 10 items, was practised. If the participant made any errors or the experimenter judged that the participant may have forgotten the rules, he was reminded of them, corrected and administered another practice item. Practice ceased when the experimenter judged that the student had fully understood the instructions. The 3 opposites and the instructions were repeated one more time after which the experiment began, consisting of 2 practice trials and 2 experimental trials, without further correction or extra explanation.

Congruent opposite emotions trial.

The incongruent OET trial was complemented with a congruent set of emotion words to establish a baseline: the participant was instructed to read a comparable list of emotion words in English. Prior to testing, the 6 emotion words and their translation in Lango were repeated.

Procedure

To determine the feasibility of the study protocol, a small pilot study was carried out in Belgium on 5 participants prior to the launch of the study in Uganda. Repiloting was conducted in Uganda on local counsellors to optimize the testing procedure and adjust it to the sample and culture.

Prior to the testing, all 75 students were seated in one classroom and completed the questionnaires (HSCL-37A and IESR) at the same time. All questionnaires were available in both English and Lango. Fifteen students conducted the questionnaires in Lango while 60 participants filled in the English version. Students were instructed to work alone. The experimenter, translator and teacher kept a watchful eye over the group to ensure no collaboration occurred and help was offered where needed. After completion of the questionnaires, each student was individually asked if he understood the questions and missing data were completed where possible. Students were thanked, given a small gift and an appointment was arranged for individual testing.

After the classical completion of the questionnaires, the Stroop Task and OET were conducted individually on different days. Three students could be individually tested per day in a small classroom between 4.20 pm and 7 pm. The experimenter sat opposite the participant and the translator sat on the other side of the table (Figure 3). All the tests were administered individually and instructed by the same experimenter. The testing proceeded in English but the translator was present during the entire testing procedure to offer additional support and to maximize comprehension. The participant was encouraged to ask questions and stop the experimenter if he did not understand. Much attention was paid to explaining the testing procedure thoroughly, after which the testing began. The order of the Stroop versus OET and congruent versus incongruent trials was randomly distributed amongst the participants in order to control for order effects.

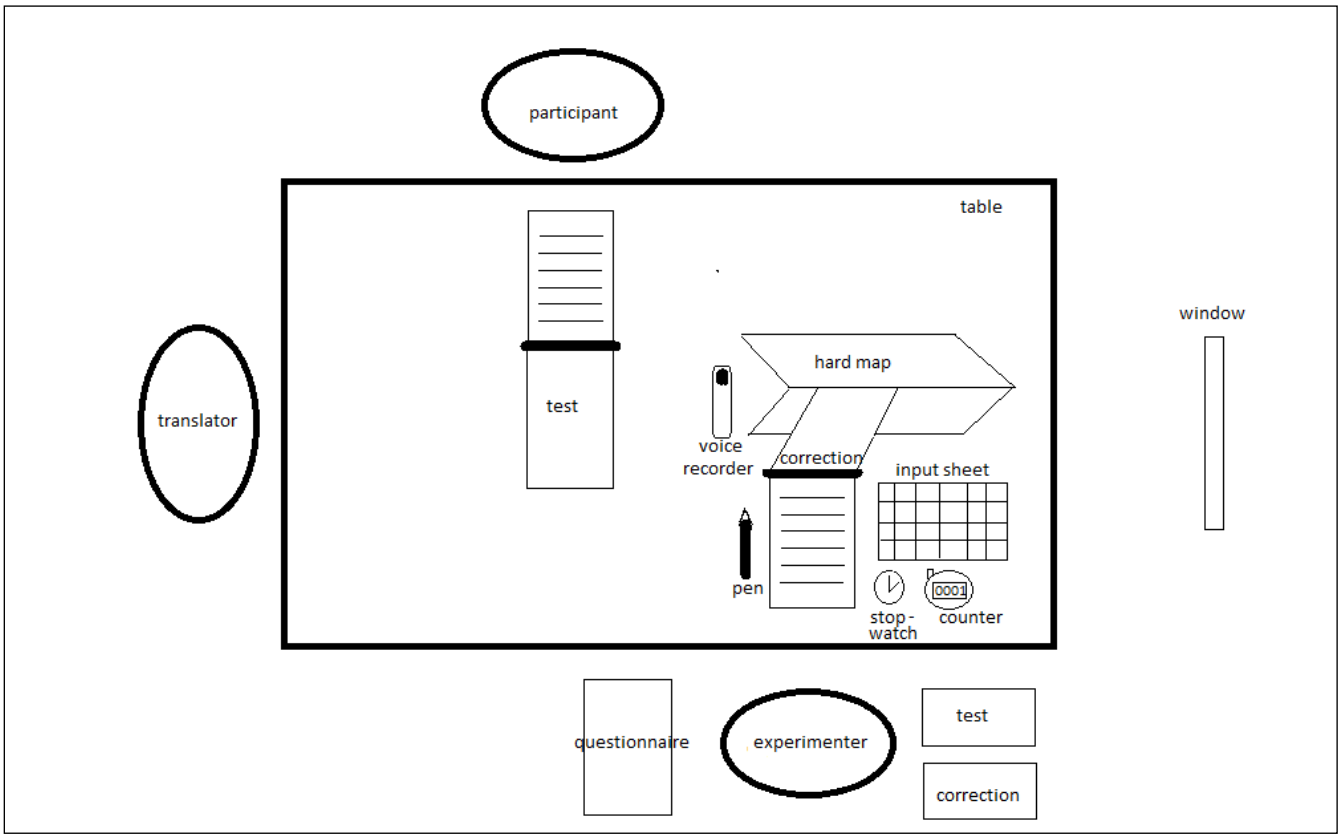

Figure 3. Positioning of the testing material, participant and research staff.

A voice recorder was used so the testing could be listened to again and the data could be checked. The use of the voice recorder and the stop watch was explained and consent for its use was asked prior to the testing. It was emphasized that only the researchers would listen to the recordings and no names would be mentioned. Due to the sensitivity of the topic, anonymity and confidentiality were stressed. Furthermore, each student was reassured that they could bring their participation to an end at any given time and withdraw from the study without any further consequences.

The participant was encouraged to fulfil both the Stroop and the Opposite Emotions Task as fast as possible while making as few mistakes as possible. He was recommended to use his finger to indicate the current item so that he would not skip or repeat a word. He was reassured that it would be normal to make mistakes but that he should just go on to the next word. He was instructed not to correct himself, repeat an item or go back in the line, but to finish the whole page without stopping. The participant was appraised or reassured only in the first line of the first practice trial but no corrections or extra instructions were given once the testing began.

When one test – the Stroop or OET – was fully conducted, each participant was offered a small 5 minute break. After participation each student was thanked and given a few gifts as a token of appreciation for their participation. In supporting the students and reducing the barrier to psychosocial help, each participant was given the contact card of a local psychosocial NGO (CCVS) and could enlist for a classical psychosocial sensitization session organized by CCVS at school. After analyzing the data, a debriefing letter was sent to the school and CCVS in which the anonymous and general results, the purpose of the experiment and the relevance for further research and practice were explained.

Data Management and Analysis

A Repeated Measures Analyses of Variance (RM ANOVA) was performed to investigate mean and interaction effects, with a 2 (task: Stroop versus Opposite Emotions Test) by 2 (congruency: congruent versus incongruent trials) by 2 (run: page 1 versus page 2 of the experimental trial) by 2 (parental loss: yes versus no) design. Task, congruency and run were within subject factors while parental loss was a between subjects factor. Paired Samples T-Tests and Fischer's Exact Chi Square were used to compare the means of the different conditions to each other. The practice effect is the difference in performance between page 1 and page 2 of the experimental trial. However, this practice effect should not be confused with the practice trials (the first 2 pages of each test) as they were not used in the data analyses. The effect of task is the difference between cumulative reaction time on the Stroop versus the OET. Error rates were very low in the data and were not further analysed; only the cumulative reaction times were used to assess the performance on the tasks. The congruency effect is the difference in cumulative reaction time between congruent (reading task) and incongruent (colour or emotion opposite naming) trials. The emotional interference effect is the difference between the congruency effect in the Stroop task and the congruency effect in the OET. The effect of parental loss is the difference between the performance of orphaned and non-orphaned students. Pearson correlations were further used to assess the relationship between mental health and emotional interference.

Results

Demographics

The distribution of the means in Table 1 suggests an increase in both trauma and depression symptoms in the orphaned group compared to the students that still have both their parents. However, these mean differences were not statistically significant as RM ANOVA found no significant relationship between orphanhood on the one hand and HSCL anxiety (F(1,66)=2.35, *n.s.*), HSCL depression (F(1,66)=2.20, *n.s.*), IESR avoidance (F(1,66)=2.46, *n.s.*), IESR hyperarousal (F(1,66)=2.27, *n.s.*), IESR intrusion (F(1,66)=2.72, *n.s.*) and IESR total scores (F(1,66)=3.30, *n.s.*) on the other hand.

Table 1. *Mean (SD) age and mental health in orphaned and non-orphaned students.*

Parental		**HSCL-37A**		**IESR**			
loss	**Age**	**Anxiety**	**Depression**	**Avoidance**	**Hyperarousal**	**Intrusion**	**Total trauma**
Yes (N=18)	16.67 (1.19)	16.98 (3.74)	28.67 (7.67)	16.44 (7.16)	10.44 (6.83)	14.83 (8.95)	41.72 (20.16)
No (N=50)	16.72 (0.81)	18.67 (4.66)	26.04 (5.95)	13.66 (6.18)	8.16 (4.93)	11.48 (6.78)	33.30 (15.57)

Performance Measures

RM ANOVA found a significant three way interaction effect between task, run and parental loss (F(1,66)=7.24, p<.01, η^2= .10, see Figure 4). Figure 5 and Paired Samples T-tests indicate that orphaned students exhibit more variability in their performance over time. Performance enhanced significantly from the first to the second page of the OET in orphaned students (t(17)=2.96, p<.01). In contrast, the students who still have both their parents did not exhibit a significant practice effect on the OET (t(49)=1.81, *n.s.*). Both groups displayed an impaired performance on the second page compared to the first page of the Stroop test (t(17)=-4.31, p<.01 for the parental loss group, t(49)=-2.14, p<.05 for the non-parental loss group). This slowing of performance over time in the Stroop test was however bigger in the orphaned group than in the non-orphaned group (t(66)=2.75, p=.008, Figure 5). Nonetheless, there was no significant main effect of parental loss on the performance on the tasks, F(1,66)=1.74, *n.s.*, η^2=.03. Furthermore, the two-way interaction effect between parental loss and task was not statistically significant, F(1,66)=1.34, *n.s.*, η^2=.02.

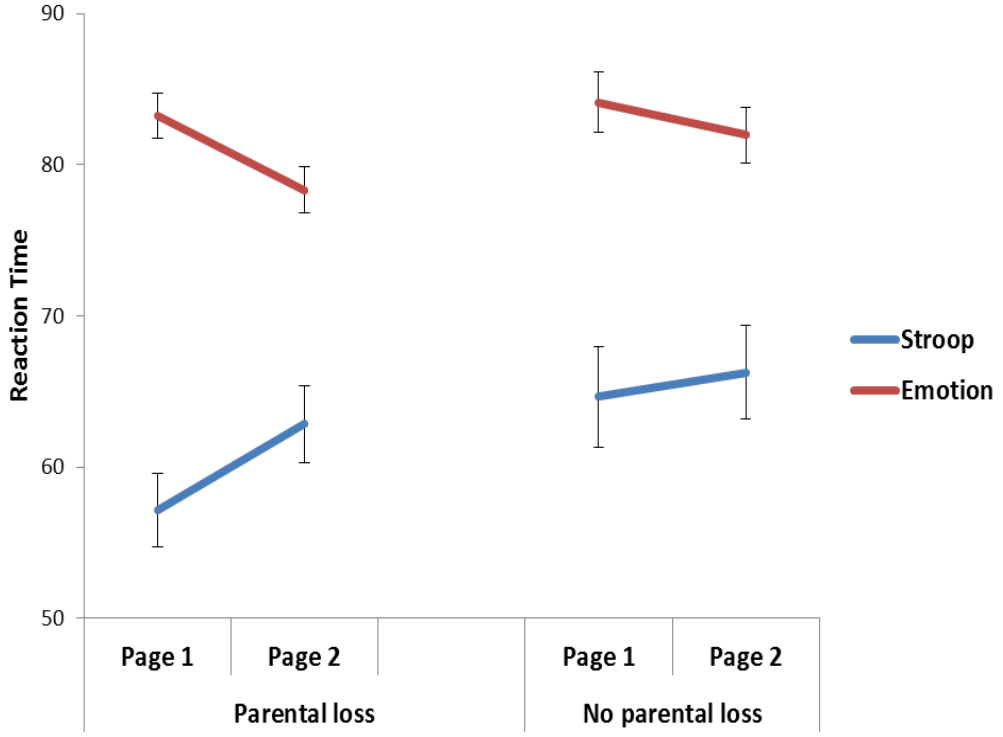

Figure 4. Three-way interaction between task, run and parental loss.

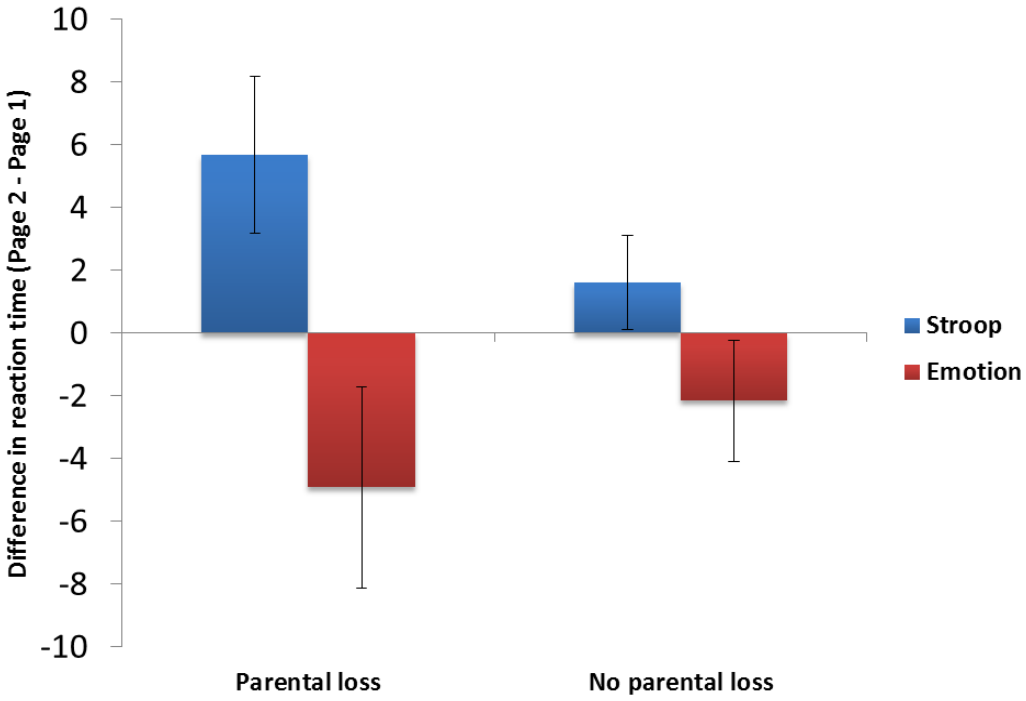

Figure 5. Effects of parental loss on Stroop and OET performance split by page. Negative scores indicate that performance improved on page 2 relative to page 1 while positive scores indicate a slowing in performance with time. The data show that performance improved in the OET from page 1 to page 2 while it slowed in the Stroop task for both groups. This performance difference over time was bigger for the parental loss group relative to the non-parental loss group.

Next, a three way interaction effect between task, congruency and run was significant ($F(1,66)=8.65$, $p<.01$, $\eta^2=.12$). As apparent in Figure 6 and confirmed by Paired Samples T-tests, there was a differential effect of practice depending on type of task and congruency. Performance increased from page 1 ($M=40.54$, $SD=8.76$) to page 2 ($M=37.06$, $SD=7.29$) in the congruent OET ($t(67)=6.76$, $p<.01$). A similar practice trend was apparent in the congruent Stroop task ($t(67)=2.32$, $p<.05$), as performance enhanced from page 1 ($M=37.03$, $SD=7.67$) to page 2 ($M=36.29$, $SD=7.28$). However there was no significant performance difference between page 1 ($M=127.19$, $SD=24.87$) and page 2 ($M=124.91$, $SD=23.96$) in the incongruent OET ($t(67)=1.18$, $p=.24$). Moreover, reaction times were slower on the second page ($M=94.43$, $SD=17.38$) compared to the first page ($M=88.31$, $SD=17.08$) in the incongruent Stroop task ($t(67)=-4.61$, $p<.01$).

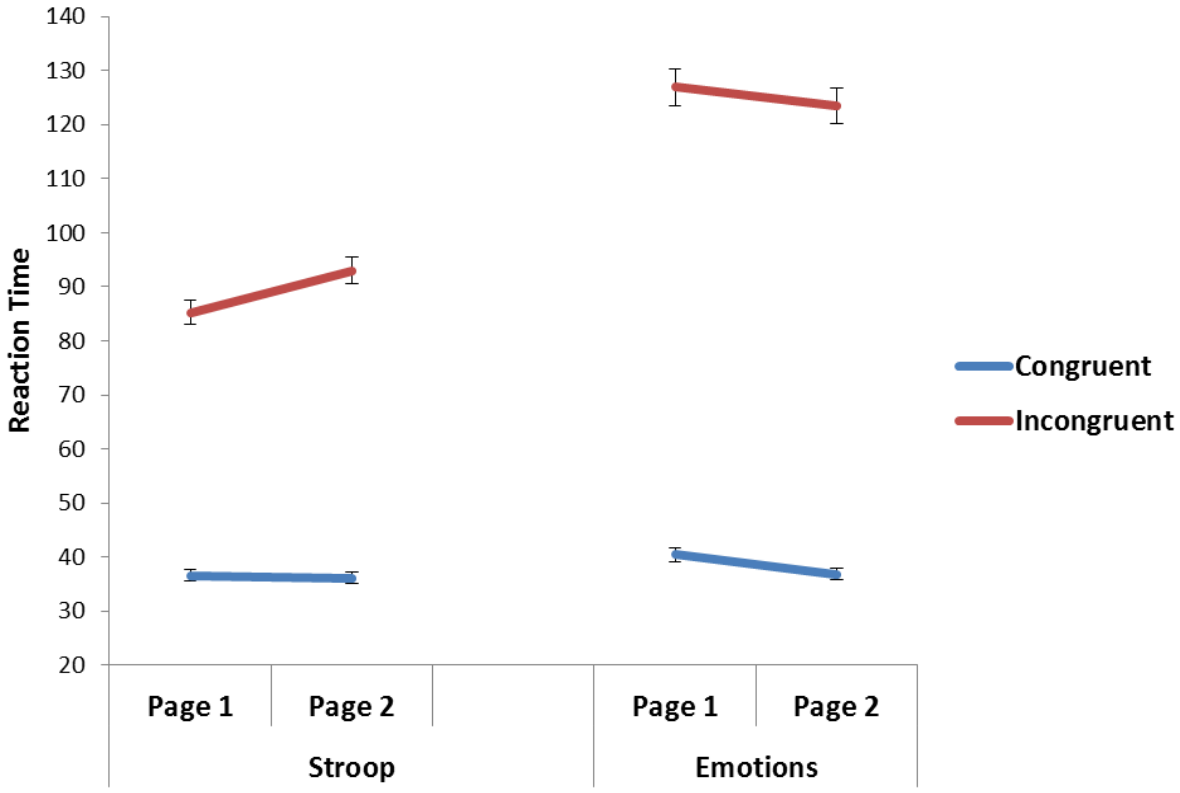

Figure 6. Three-way interaction of task by congruency by run.

The RM ANOVA further revealed three statistically significant 2-way interaction effects in the data. There was a significant interaction effect of task by congruency ($F(1.66)=147.90$, $p<.01$, $\eta^2=.69$). Paired Samples T-Tests explained that both the OET ($t(67)=-31.78$, $p<.01$) and Stroop task ($t(67)=-31.50$, $p<.01$) displayed an effect of congruency, with incongruent trials being more difficult than congruent trials. However, figure 7 and Paired Samples T-Test demonstrate an increased effect of congruency in the Opposite Emotions Test compared to the Stroop task ($t(67)=-13.27$, $p<.01$). Participants performed much slower in the incongruent emotions condition ($M= 126.05$, $SD=23.09$) compared to the incongruent Stroop condition ($M=91.37$, $SD=16.34$), $t(67)= -14.62$, $p<.01$. Also, there was a significant increase in the reaction time on the congruent emotions condition ($M=38.80$, $SD=7.77$) compared to the congruent Stroop condition ($M=36.66$, $SD=7.36$), $t(67)=-3.70$, $p<.01$. However, as Figure 7 suggests, the increase in the congruent trials was smaller than the increase in the incongruent trial ($t(67)=-13.27$, $p<.01$), thus enlarging the congruency effect in the Opposite Emotions Task.

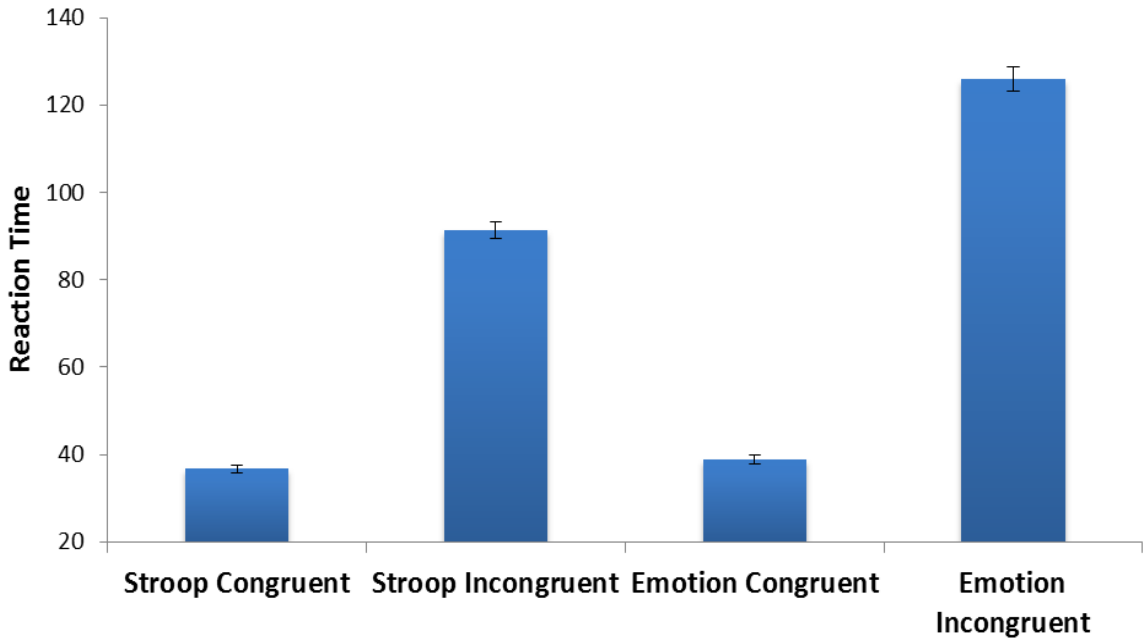

Figure 7. Interaction effect of task by congruency.

Beyond this first two-way interaction, a second two-way interaction between congruency and run was significant ($F(1,66)=9.71$, $p<.01$, $\eta^2=.13$, see Figure 8). A different practice effect was found depending on congruency: A classic practice effect was apparent in the congruent trials, as Paired Samples T-test displayed significant larger reaction times on the first page ($M=38.79$, $SD=7.65$) than on the second page ($M=36.68$, $SD=6.91$), $t(67)=7.10$, $p<.01$. However, no practice effect was found in the incongruent conditions as there was no significant mean difference in the reaction time on the first ($M=107.75$, $SD=17.63$) and second page ($M=109.67$, $SD=18.55$) of the incongruent trials, $t(67)=-1.64$, *n.s*. However, on both page numbers, the performance in the incongruent trials was significantly slower compared to the congruent trials ($t(67)=-34.95$, $p<.01$ for the first page, $t(67)=-34.94$, $p<.01$ on the second page).

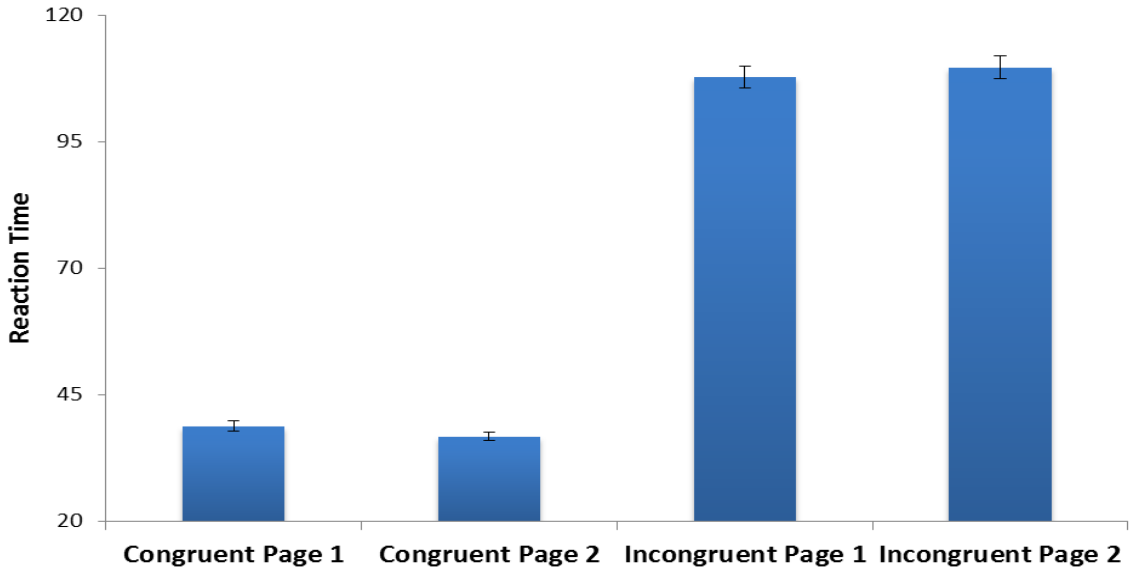

Figure 8. Interaction effect of congruency by run.

The last significant interaction effect was found between task and run ($F(1,66)=31.88$, $p<.01$, $\eta^2=.33$, see Figure 9). Depending on the task a different practice effect was found. Paired Samples T-Test demonstrated a classic practice effect over time in the OET; participants performed better on the second page ($M=80.99$, $SD=13.19$) than on the first page ($M=83.87$, $SD=14.00$), $t(67)=2.93$, $p<.01$). However, slowing of performance was found in the Stroop test as participants were faster on page 1 ($M=62.67$, $SD=10.83$) than on page 2 ($M=65.36$, $SD= 10.83$), $t(67)=-3.93$, $p<.01$. Overall, performance was better on the Stroop task compared to the OET, both on the first ($t(67)=-14.15$, $p<.01$) and on the second page ($t(67)=-13.19$, $p<.01$).

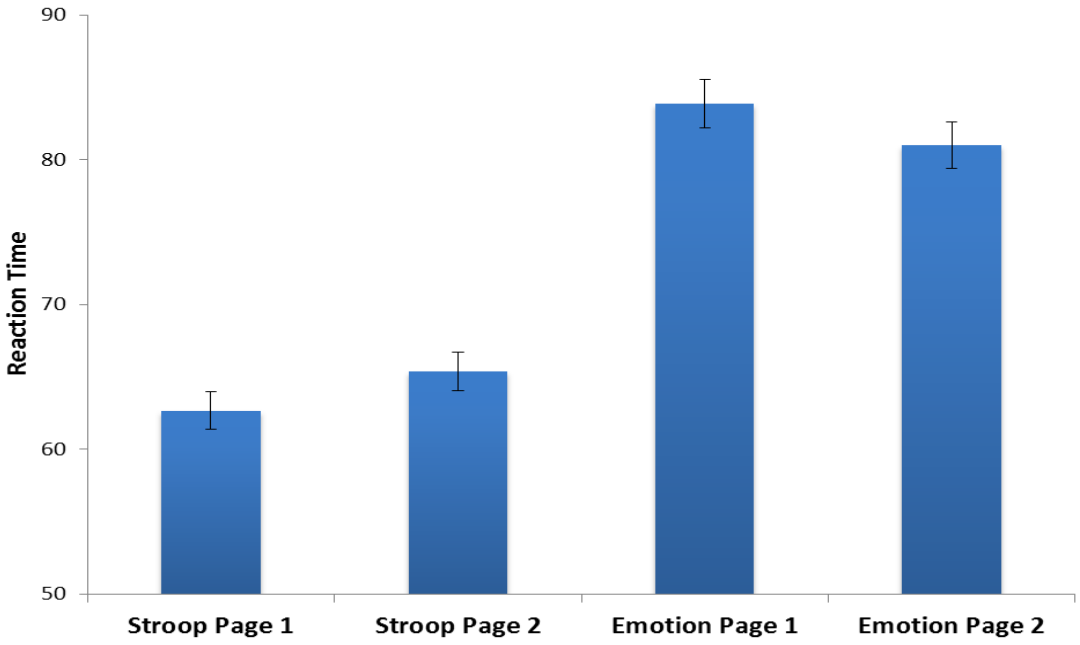

Figure 9. Interaction effect of task by run.

The RM ANOVA output further revealed a significant main effect of task ($F(1,66)=194.17$, $p<.01$, $\eta^2=.75$), as performance was found significantly slower in the Opposite Emotions test ($M=81.89$, $SD=1.79$) compared to the Stroop test ($M=62.73$, $SD=1.41$). Furthermore, there was a significant main effect of congruency ($F(1,66)=1010.38$, $p<.01$, $\eta^2=.94$), with averaged reaction times on the incongruent trials ($M=107.14$, $SD=2.38$) being significantly slower than on the congruent trials ($M=37.49$, $SD=.99$).

Effects of Psychopathology

The interaction effects between IESR and task on the one hand and HSCL and task on the other hand were not significant ($F(1,65)=.63$, *n.s.* for IESR, $F(1,65)=.74$, *n.s.* for HSCL). However, a significant Pearson correlation was found between emotional interference – as the difference in congruency effect between the Stroop and the OET – and IESR in the parental loss group ($r(18)=.49$, $p=.04$). Emotional interference on executive control increased significantly when trauma symptoms elevated in the orphaned sample (figure 10). Nearly 25% of the variance in the data was explained by this relationship. However, such a relationship was not found in the non-parental loss group ($r(50)=.03$, $p=.83$, figure 11).

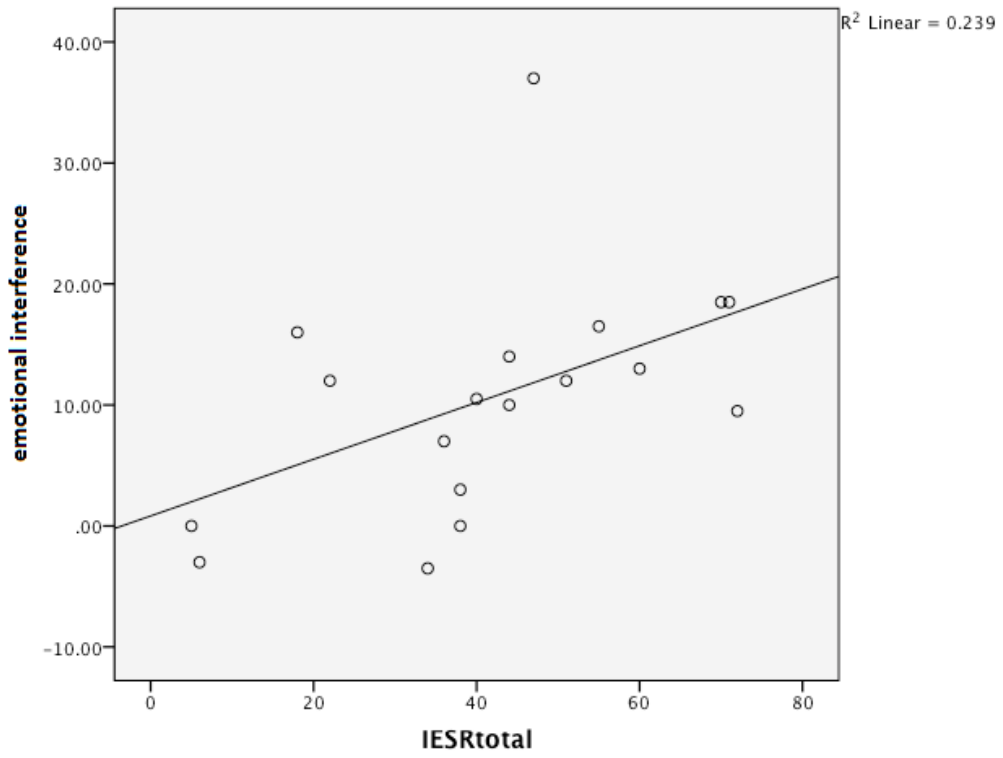

Figure 10. Increasing effect of emotional interference when trauma elevates in orphans.

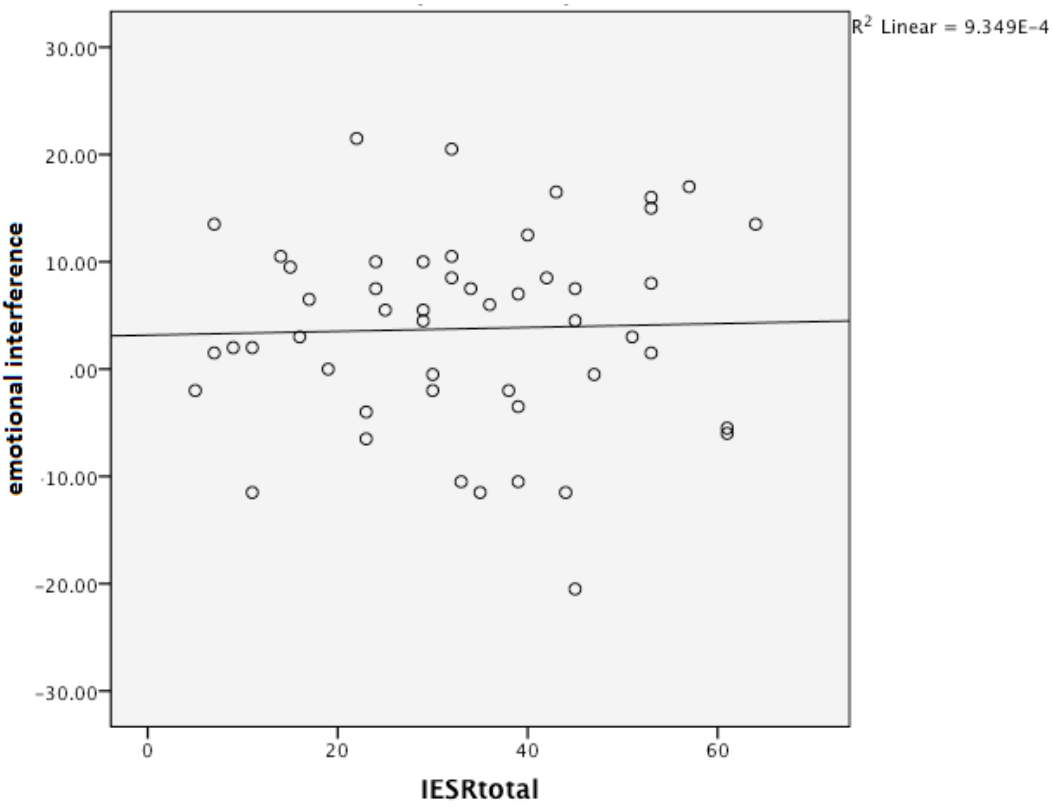

Figure 11. No relationship between emotional interference and trauma in non-orphaned group.

Discussion

Results

Based on previous research (e.g. MacLeod, 1991), we expected slower performance in incongruent trials relative to congruent trials. Given the interfering effect of emotions on executive control (e.g. Lagattuta et al., 2011; Mueller, 2011), we also expected performance in the OET to be worse compared to the Stroop. Consistent with past research on early-life stress and social deprivation (e.g. Cisler et al., 2011; Colvert et al., 2008), the parental loss group is expected to perform worse in both OET and Stroop trials compared to their peers who still have both parents. Furthermore, as social deprivation might increase the effect of emotion on cognitive control (e.g. Tottenham et al., 2010), performance in the OET is expected to be worse in the orphaned group compared to the Stroop and non-orphaned peers. In line with our model in Figure 2 (p14), orphans are expected to have impaired mental health which would positively relate to impaired executive control in these bereaved students.

The results of this research support the efficacy of the tests on Ugandan adolescents by indicating the significant main effects of congruency and task. As expected, students have a harder time conducting the incongruent trials and the emotional task. The main effect of congruency suggests that incongruent trials are more challenging and cognitively burdensome, exerting more executive control than congruent trials. In the incongruent trials, students have to inhibit the automatic response of reading the word in order to activate the colour of the word or the opposite emotion term, therefore increasing the response time. This task requires inhibitory control and working memory, while little executive control is needed to read a list of colour or emotion words in the congruent trial. These congruency results are consistent with past research on executive control (e.g. MacLeod, 1991; Stroop, 1935) and support the pan-cultural existence of the Stroop interference effect.

The main effect of task was significant as students performed better on the cool executive Stroop task than on the hot OET. This result is consistent with multiple studies indicating an interfering effect of emotions on executive control (Mueller, 2011). One explanation is a difference in semantic association strength as inhibitory demand increases when the semantic association between the correct (e.g. ‘hate’ when seeing love) and the inhibited (e.g. ‘love’ when seeing love) response strengthens (Diamond et al., 2002). As emotions are important cues when processing and responding to the world, their associative

strength might be greater than the semantic relationship between colour words. The enlarged semantic relationship between opposite emotion terms might therefore lead to an increased interference in the OET compared to the interference on a neutral, colour naming executive task. Indeed, Edinburgh Associative Thesaurus – providing empirically established norms for association strength between words – estimates stronger semantic associations between emotion opposites (sad-happy = 0.30, happy-sad = 0.35, love-hate = 0.33, hate-love = 0.55) then between colour words (e.g. green-blue = 0.08, purple-green = 0.05, brown-blue = 0.03, green-red = 0.07). However, pride and shame were not found in the thesaurus (http://www.eat.rl.ac.uk). Our results are further congruent with the research of Lagattuta and colleagues (2011) that demonstrated the impaired performance on a hot executive control task (Sad-Happy test) compared to a cool alternative (Day-Night task). However, they do not see association strength as a plausible explanation, as the Edinburgh Associative Thesaurus establishes a stronger semantic relationship for the day-night opposite than for the happy-sad opposite. They propose the emotional load as the interfering mechanism, differentiating between performance on the cool versus the hot task of executive control. This is consistent with Williams and colleagues' (1996) explanation of the Affective Stroop task. An emotional load may cause interference by distracting the participant from relevant information and therefore delaying performance on the task. Consistently, our research displayed a significant interaction effect of task by congruency as the congruency effect was bigger in the hot OET than in the cool Stroop task. The difference in performance between the congruent and the incongruent trial was enlarged when an emotional load was added to the executive control task. The results suggest that emotional interference has a disturbing effect on both congruent reading trials and cognitively burdensome incongruent trials, but it interferes more with incongruent trials. It seems that the emotional load increases the cognitive interference in a Stroop like test of executive control (Williams et al., 1996). However, further research is necessary to fully investigate the mechanisms underlining the increased impairment in an emotional task of executive control compared to a cool alternative.

Differential practice effects were found depending on congruency and task in a significant 3-way interaction effect of task by congruency by run. A significant practice effect was established in the congruent reading trials of the Stroop task and the OET as performance improved significantly from page 1 to page 2. Reading a list of emotion or colour words improves over time. It makes sense that reading the same 5 or 6 colour or emotion words

becomes easier with practice. With familiarity comes efficiency. However, familiarity may be limited in the incongruent Stroop test as there are 20 possible combinations of colour words being printed in a contrasting colour. Moreover, our results indicate that performance worsened from page 1 to page 2 in the incongruent trials of the Stroop task. This result may suggest that the Stroop test became more difficult over time for the Ugandan students. Cool executive control may be a taxing function that becomes strained over time. Exhaustion of the cool executive function may therefore lead to deteriorating performance over time. This gradual slowing of performance in the incongruent Stroop trials is, however, not consistent with previous research that displays a classic practice effect with improving performance over time in the incongruent Stroop trials (e.g. Beglinger et al., 2005; Golden, 1987; MacLeod, 1991; Stroop, 1935). In understanding this contradiction it is important to note that current research established practice effects by comparing performance consecutively on 2 pages, while the practice effects displayed in the literature on the Stroop occur over multiple trials or over longer periods of time (e.g. Beglinger et al., 2005; Golden, 1987; MacLeod, 1991; Stroop, 1935). Furthermore, our testing was challenged by various disturbing factors (see limitations) that could have biased our results. Further research may clarify the contradiction with existing literature. Our 3-way interaction effect of task by congruency by run further suggests that performance in the incongruent OET was stable over time, suggesting that the task remained difficult for the participants even after some practice. Our results in the incongruent Stroop and OET trials over time suggest that executive functioning is indeed burdensome, effortful and difficult to automate. It is easier to go on "automatic pilot" and read the word than to inhibit this tendency and name the colour or the opposite emotion (Diamond, 2013). However, further research is necessary to understand the differential practice effects in cool versus hot executive tasks. The two-way interaction effects between run-task and run-congruency are not further discussed as they are incorporated and refined in this three-way interaction effect between task, congruency and run.

These practice effects were further influenced by parental loss in the current research as an interesting 3-way interaction effect between task, run and parental loss was statistically significant. Students that still have both their parents display a more stable and consistent performance on the tasks over time. On the contrary, the orphaned group report increased variation in performance over time for both tasks. Compared to their fellow non-orphaned students, performance would worsen more over time on the Stroop task in the parental loss

group. The cool executive control task seems to become more taxing over time for these students, which may suggest reduced perseverance over time in cool executive control compared to students that still have both their parents. Past research (e.g. Bos et al., 2009) has indeed indicated that social deprivation may impair the executive development of a child. Consistently, current research suggests that the loss of a parent or both parents might have a negative effect on the perseverance of inhibitory control over time. However, other external factors such as tiredness, external distractions or eagerness to finish the test might have affected the performance of the orphaned students on the second page of the test. Further research is necessary to fully understand the effect of parental loss on cool executive control over time.

The 3-way interaction effect between task, run and parental loss also displays a significant practice effect in the Opposite Emotions Task for the orphaned students. In contrast, their non-orphaned peers did not display enhanced performance in the OET over time. Students that still have both their parents display the same performance over time. The results propose the emergence of a practice effect when emotions are included in a test of cognitive control, but only in the orphaned sample. This is congruent with the conclusion of Tottenham and colleagues (2010) that institutionalized children are more susceptible to their affective environment, which might lead to an increased attention to, processing of and learning from emotional stimuli - as exampled by the enlarged amygdala - and might therefore explain our results of an increased practice effect in an emotional context for orphaned students.

The differential practice effects in hot versus cool executive control in orphaned compared to non-orphaned students have not been repeated in other research to date. However, other explanations than parental loss may account for the increased variability on both hot and cool executive control tests over time in the orphaned group. Other effects of the war might have coincided with parental loss, such as increased responsibility towards siblings, economic instability or reduced social support, which might explain the increased variability in the orphaned data. Furthermore, there might be more variation in the orphaned group as double, maternal and paternal orphans were put together in one parental loss group. Losing a father, mother or both might affect executive functioning differently, therefore producing a broader variation of data. Future research may focus on this differentiation.

Despite the differential practice effects in orphaned compared to non-orphaned students, current research did not find a main effect of parental loss on executive control, which is in contrast to previous research establishing the effect of social deprivation on executive

control (e.g. Bos et al., 2009). Furthermore, the hypothesis concerning the interaction effect between parental loss and task could not be confirmed by our results. In contrast to other research (e.g. Tottenham et al., 2010), our orphaned students did not have more difficulty with a hot measure of executive control compared to a cool alternative than their non-orphaned peers. The effect of parental loss on executive control might have been missed in current research due to several factors. Firstly, our orphaned sample size was very small, which might have minimized the statistical power of our tests. Secondly, the death of a parent is only one possible stressor Ugandan children have to bear, while the majority (96%) of Ugandan children are distressed (Kalibala & Elson, 2009). The effect of other stressors - such as illness, hunger, responsibility for looking after family members, worries about paying school fees, worries about exams and pressure from family to succeed - may have masked the effect of parental loss. Future research may find an effect of parental loss when other stressors are taken into account. Lastly, the environment in which the tested children grow up is more or less stabilized across all children as all participants in the current research live in a boarding school. The contact with family is minimized in this setting and all children are separated from their parents. This might have equalized the performance of students who lost their parents to death or are separated from them in distance.

In contrast to our hypothesis and to other research (e.g. Atwine et al., 2005), orphaned children were not found to experience significantly more symptoms of anxiety, depression or traumatisation. Consistently, Dowdney (2000) concludes in her review that the minority of orphaned children are at risk for a depression or anxiety disorder. Previous research (e.g. Mels et al., 2009a) in Congo has found an effect of parental death on the mean exposure to traumatic experiences. However, no effect was found of parental death on the IESR score (Mels et al., 2009a). So parental death may have an effect on the amount of traumatic events experienced, but may not necessarily lead to PTSD symptoms. A critical review by Crook and Eliot (1980) has further questioned the proposed relationship between adult depression and parental death, while Kendler and colleagues (2002) provide an explanation for the absence of this relationship in the literature. The latter research displayed a declining risk for depression related to parental loss over time, with the highest risk in the year of parental loss. The increased risk for depression in orphans disappeared in a decade (Kendler et al., 2002). It is possible that current research missed the effect of parental loss on depression because we

used an older sample that may have lost their parents some time ago. Further research is therefore necessary in younger orphaned samples.

Further contrasting our expectations, symptoms of psychopathology (traumatisation, anxiety and depression) were not related to executive control in our study. This is consistent with Wingenfeld et al. (2011) who did not find an overall effect of anxiety, depression and early trauma exposure on interference in an Emotional Stroop task in healthy controls and psychosomatic in-patients diagnosed with a depression, anxiety or somatoform disorder. On the contrary, other research (e.g. Diamond, 2013; Mueller, 2011) has established the link between psychopathology and executive functioning. The range of symptoms in current research may not have been broad enough to capture the relationship between psychopathology and cognitive control. Indeed, research has identified multiple stressors, putting 96% of Ugandan children at risk (Kalibala & Elson, 2009).

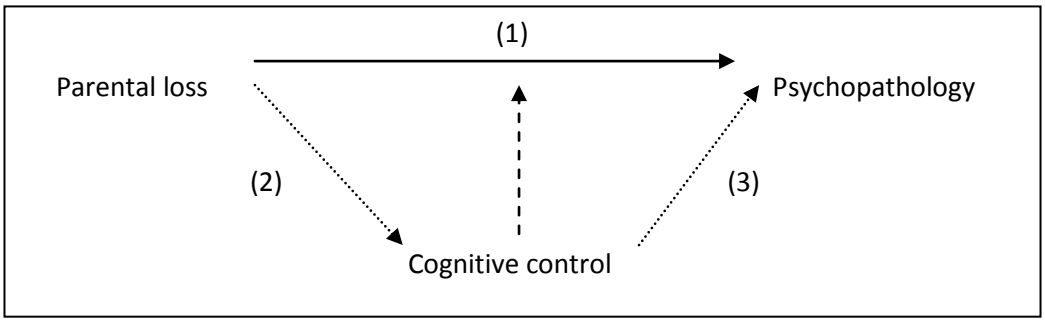

Figure 2. Hypothesised relationship between parental loss, cognitive control and psychopathology.

We can now evaluate our results in the face of our model in figure 2. Our results do not support the direct link between parental loss and psychopathology (1), as our orphaned students do not experience more anxiety, depression or trauma symptoms than the non-orphaned group. Unexpectedly, parental loss does not influence overall performance on executive control tasks in current study either (3), as executive control is not impaired in our orphaned sample compared to students that have both their parents. However, the perseverance of cool executive control over time may be compromised in orphaned children, as Stroop performance declines significantly more over time than in the tested non-orphaned students. Last, the link between cognitive control and psychopathology is not supported (3) as mental health outcomes are not related to executive performance in the present data. However, a significant correlation does occur between symptoms of PTSD and emotional interference on cognitive control in the

orphaned sample. The correlation between IESR and emotional interference in our parental loss group demonstrates that the emotional interference effect increases significantly with elevating trauma symptoms, but only in our orphaned group. The effect of emotional interference is not affected by increasing trauma symptoms in our students that still have both parents. Students that are not orphaned seem cognitively more in control. In contrast, executive functioning seems to be more susceptible to emotional interference when PTSD symptoms increase in our orphaned sample. These results suggest that it is the specific combination of elevated trauma symptoms and parental loss that makes executive functioning more vulnerable to emotional interference. Interestingly, past research also indicates an enlarged vulnerability to anxiety in orphaned students when trauma exposure increases (Whetten et al., 2011). It seems that orphaned children who experience more trauma symptoms may be at increased risk for a variety of negative mental health outcomes, inter alia increased emotional interference on executive control. However, care should be taken in interpreting the direction of the correlation; it is also possible that increased emotional interference on executive control causes orphans to be more vulnerable to trauma symptoms. Future research may investigate the direction of the relationship between trauma symptoms and emotional interference on cognitive control in orphaned students.

Implications

In line with the discussed results, it is apparent that this study has some important implications for research and practice. First of all, the appearance of the Stroop effect in this Ugandan sample supports the hypothesis that Stroop interference occurs pan-culturally (Alansari & Baroun, 2004).

This research is further innovative in its methodology. It is the first in line to compare and contrast a well-known task of executive function, the Stroop task, with an affective variant, the OET, in a sample of adolescent boys in a post-conflict region. As these tests are fast, easy to administer and age appropriate, they are ideal to examine self-regulatory control in children living in war-torn situations. However, further validation of the tests in this population is necessary. The tests might be a valuable asset to assessment but they should be complemented by other tests of mental health and culturally sensitive practices, such as talking to the individual, the family and the community. However, the assessment of executive functioning of children in a post-conflict region may be of great value for researchers and practitioners as previous

research has underlined the potential protective versus impairing role of executive control on mental health (Diamond, 2013; Shonkoff, 2011). When executive control is problematic, training and practice can stimulate and enhance this important life skill (Diamond, 2013; Diamond & Lee, 2011). Many computerized trainings have been developed which successfully enhance executive functioning of children (Diamond, 2013; Diamond & Lee, 2011). However these solutions do not seem feasible in a third world country. Another strategy is to stimulate the sensitive and responsive caregiving, executive functioning, self-regulation and mental health of care givers, service providers and teachers as they are very influential during the development of the young brain and can soften the impairing effect of early-life stress (Raver, 2004; Shonkoff, 2011). Furthermore, the executive functions of children can be improved by stimulating bilingualism (Bialystok & Viswanathan, 2009), as even infants exposed to 2 languages display improved cognitive control (Kovacs & Mehler, 2009). Unfortunately, Lango is prohibited in many Northern Ugandan schools. As their mother tongue Lango is pushed aside, English becomes their main language. However, the promotion of both English and Lango at school might enhance executive control in Ugandan children and protect them from adversity and poor mental health. In addition, some school programs – such as the Promoting Alternative Thinking Strategies that practises self-control, interpersonal problem solving and emotion regulation (PATHS; Riggs, Greenberg, Kusché & Pentz, 2006), the Chicago School Readiness Project targeting self- and emotion regulation (Raver et al., 2011), the Montesssori curriculum that stimulates self-discipline, independence, peace and order (Lillard & Else-Quest, 2006) and the Tools of the Mind curriculum based on pretend play (Diamond, Barnett, Thomas & Munro, 2007) – have also been developed which can be implemented in school to enhance executive control (Diamond & Lee, 2011). However, their usefulness in developing countries still has to be examined. Interestingly, easy measures such as practising martial arts (Lakes & Hoyt, 2004), mindfulness (Flook et al., 2010) and yoga (Manjunath & Telles, 2001) are also beneficial to executive performance and self-regulation in children. Regardless of the intervention used, children with the poorest executive functions seem to benefit the most from the program (e.g. Diamond & Lee, 2011; Flook et al., 2010; Lakes & Hoyt, 2004), suggesting that children burdened by stress, such as orphans, might benefit especially from these trainings. The improvement in executive control may then protect the child at risk and foster his/her development in other spheres, such as academic performance, success on the job market, quality of life and mental health (Diamond, 2013). This study hopes to stimulate future research in validating these executive function tests so that they can support and guide

psycho-social aid for at risk groups. Besides these strengths, this study also has its limitations which should be taken into consideration when interpreting the results.

Limitations

Conducting research in a developing country and post-war area is particular challenging. Factors such as lack of infrastructure and safety risks, among others, put restraints on testing conditions. Current research had to rely on a cross-sectional design with self-report measures. Self-report measures are important in providing personal insights and are economic and time-friendly. However, the reliability of self-report tests to investigate the effect of war on civilians is troublesome. Victims of war are often not willing to talk about their traumatic experiences due to shame, guilt or fear of re-experiencing it. Orphanhood in Africa is an especially sensitive topic as it is often linked to AIDS. Students may not admit parental loss in fear of being discriminated against by others. Next, response sets may be operative, such as social desirability or the desire to please the investigator. Others may exaggerate their experiences in the hope of gaining external support. The students might have felt obliged by the head teacher to participate or were motivated by the expectation of material or educational benefits. For others, the foreign researcher might have caused some nervousness or unease. The reliability of self-report measures to investigate the effect of war on children may for these reasons be troublesome and their results should be considered with caution (Masten & Narayan, 2012; Wessells, 1998a).

Another complication is posed by the language barrier. Although a translator was present at all times, the researcher was unable to speak the local language and information might have been lost in translation. Even though the IESR and HSCL-37A were translated into Lango, complete transparency cannot be assumed.

An additional limitation concerns the generalizability of the results. The sample was small (68 participants, of which only 18 were orphans) and recruitment was only established from one educational level in one local school. Current research did not include adolescents not attending school nor did it include girls. Generalizability to the diverse Lango population can therefore not be assured.

In addition, control over the testing environment and research paradigm could not be guaranteed. Testing was challenged by multiple factors, such as the tropical weather, background noise and many interruptions. Lighting inter alia was an issue as most students were tested after

lesson time and no electricity was available. Torches were frequently used to illuminate the test for the participant, but reflections on the laminated test sheets did cause some discomfort. Some students had difficulty with the naming of the colours. Others were sick (headaches, malaria,…) but wanted to continue with the testing regardless. Each of these challenges may have had an effect on the performance of the students and might have caused some bias in the results. However, all complications occurring during the testing were clearly noted on the data set so they could be taken into account when the data were analysed.

Finally, the establishment of a true control group was not possible as everyone was affected by the war to some extent and pre-war data were not available. Because baseline data were not available it is not possible to be certain if the measured effects are due to war, parental loss, malnutrition, disease, poverty, etc., which often coincide with the conflict and its aftermath. It is therefore more appropriate to talk about daily stressors: the war, its aftermath and coinciding factors effect the functioning of the community as a whole and the individuals in particular.

The limitations discussed above are important when evaluating the results of this study. They hope to guide future research in filling in the gaps.

Suggestions for Future Research

As parents are key actors in a child's development, parental loss was the main focus in this study. Previous research has established the important role of the surviving parent on the executive functioning of the bereaved child. Luecken, Kraft, Appelhans and Enders (2009) conclude that enhanced emotional control is found in children who lost one parent but had a loving and caring surviving parent. In contrast, mental illness in the surviving parent was linked to impaired psychosocial adjustment in orphaned children (Dowdney, 2000). Future research should therefore take the caring possibilities and mental health of the surviving parent into account. However, the caregiving entity should also be understood more broadly in African cultures. Families are bigger and parental responsibilities are often divided among multiple adults. Grandparents, uncles or other family members may take up the task of caregiving when a child has lost a parent. Although the role of the extended family in childhood psycho-social functioning has been investigated (e.g. Dowdney, 2000; Foster, 2000a, 2002b), no research to date has focused on its effect on childhood executive development, which could be the subject of future research.

Past research has further proposed a differential effect of maternal versus paternal death. Adda, Björklund & Holmlund (2011) suggest that maternal loss has more implications for cognitive skills (education and IQ) while paternal death has more effect on non-cognitive skills. Furthermore, the loss of the mother was found to elevate depression symptoms (Sengendo & Nambi, 1997) and avoidance symptoms of PTSD – especially amongst girls (Derluyn et al., 2004). Unfortunately, it was not possible to make a distinction between the loss of the mother versus the father in current research as the orphaned sample was too small (N=18). Neither were we able to include orphaned girls. However, the psychological effect of parental loss might differ with sex. Indeed, orphaned girls are found to display more internalizing problems while boys exhibit more behaviour problems (Dowdney, 2000). Furthermore, the interfering effect of emotions on executive control may differ depending on sex (Mueller, 2011). The interfering effect of emotional and violence related stimuli in the Emotional Stroop Task was enlarged in male maltreated children compared with their female abused peers (Malik, Gul & Humphreys, 2011). Future research could investigate the differential effect of sex and paternal versus maternal loss on executive functioning.

Another possible extension could be to investigate the executive performance of children not attending school, as current research only examined school-attending children. Research has profoundly reported that orphans are less likely to attend school (e.g. Makame et al., 2002). In capturing the orphan population at large, future research could look closer into the executive functioning of orphaned children not attending school. As these latter orphans miss the stimulating influence provided by school, we could expect their executive control to be worse, hence putting their overall mental health at risk.

A last important topic to discuss is cultural diversity. Western stress models and labels, such as PTSD, may not be valid in other cultures. There is cultural diversity in the conceptual meaning and expression of psychopathology and stress, its effects and the socially accepted way of responding to it (Van Widenfelt, Treffers, De Beurs, Siebelink & Koudijs, 2005; Wessells, 1998a). As Wessells (1998a, p642) notes, "stress is a socially constructed construct that exhibits considerable variation across cultures". Trauma is seen as an individual problem in the Western community. However, trauma has to be seen on a community level, as a "social disorder", in Africa and other collectivistic cultures, as it affects all individuals and the structure of the community. The relational impact of war - such as the betrayal, fear and distrust it brings with it - is more important in these cultures. Trauma has to be tackled within the existing community and social setting as the importance of an individual is only seen by his/her

utility and functioning within that social context. Transference of Western individually-focussed mental health programs and stress models, without validating their generalizability, is an important ethical issue and subject to much criticism. Local interventions should be valued and local practitioners actively involved. In supporting psycho-social aid in Uganda, it is important to understand the local conceptualization of stress and what it means to lose a parent. This could be the focus of a next line of research (American Psychological Association, 2010; Unicef, 1996a, 2008c, 2009d; Wessells, 1998a, 2006b).

Next to cultural differences in the interpretation of stress, there is also cultural diversity in the emotional lexicon and its structure. The linguistic hypothesis states that emotions will be reflected in language if they are considered culturally important and relevant (Scherer, 2005). The emotional lexicon therefore provides an interesting insight into the cultural meaning of emotions (Fontaine, Poortinga, Setiadi & Markam, 2002). While the categorization of emotions on dimensions of arousal/activation, dominance or valence is likely to be pan-cultural (Russell, 1991; Shaver, Schwartz, Kirson & O'Connor, 1987), there has been evidence of some cross-cultural variation in the prevalence and structuring of certain emotion terms (Fontaine, et al., 2002; Russell, 1991; Scherer, 2005). Of interest to current research, Indonesians positioned the emotion shame differently in the emotional structure than Dutch participants. Indonesians conceptualized shame in a more social context and positioned it more towards fear and further from anger (Fontaine et al., 2002). This raises the question of the equivalence in meaning of the Western emotion opposites love-hate, sad-happy and pride-shame in the collectivistic Ugandan culture. These concerns were supported by difficulties in disentangling love-happy and hate-shame-sad by the local practitioners during the local pilot study. Valence was perceived the more important categorizing factor while disentangling the sub-categories was more difficult. In the aim of making the Opposite Emotions Test more culturally sensitive, it would be interesting to investigate how local people structure the English and Lango emotional lexicon. Assuming cross-cultural equivalence in the emotional lexicon could result in effects that are artefacts of the research process instead of real effects of emotional interference on executive control.

Last, research has suggested cultural differences in the performance on the Stroop Task. A cross-cultural study by Alansari and Baroun (2004) demonstrated increased interference on the Stroop test in Kuwaiti students in comparison to British students. Increased Stroop interference was further found in Chinese speaking participants (Biederman & Tsao, 1979) and in Arabic speaking Lebanese (Dalrymple-Alford & Budayer, 1966) compared

to English speaking individuals. The Stroop effect seems to differ depending on the language, which raises questions for the current study. The Stroop effects could have been diminished in this research because the task was conducted in English. Potentially stronger interfering effects might have been found if the Stroop Task was administered in the participants' mother tongue, Lango. As English is the second language for the research participants, the interfering effect of the conflicting colour might have been minimized as the English reading response might be less automatized. This comment is consistent with research on bilingual participants that reported Stroop effects in both languages, but interference effects depended on familiarity with the language. Interference declined when familiarity with the language decreased (MacLeod, 1991). It would be interesting to compare current results with a Lango version of the tests. However, our results support the cross-cultural appearance of the Stroop interference effect.

Because of the cultural diversity described above, it is important to interpret the results of Western instruments with caution. Pre-existing Western instruments can be seen as a starting point, but need to be adjusted to the culture and sample at hand. The local population may not be familiar with Western research paradigms, so that quantifying measures such as Likert scales and reaction times do not easily translate and may not exert the same meaning (Van Widenfelt et al., 2005). The HSCL-37A and the IESR were culturally validated in past research in Sub-Saharan Africa, including inter alia Congo and Uganda (e.g. Derluyn et al., 2004; Mels et al., 2009a, 2010b, 2010c). However, the Opposite Emotions Test is an entirely novel test designed for this research and the Stroop Test has not been used, to our knowledge, in Northern Uganda before to assess cognitive control. Therefore, it would be advisable for further research to culturally adapt the Stroop and Opposite Emotions Test and to assess their reliability and validity in the Ugandan population.

Conclusion

Current research hopes to direct the attention of policy makers, researchers and social workers to the high demand and need for psychological assistance in disaster struck developing countries, and in particular to the affected young population. Children growing up in developing and war-torn areas are confronted with many stressors. Unfortunately, much research has displayed the impairing effect of early-life stress on psycho-social and cognitive functioning (e.g. Pechtel & Pizzagalli, 2011). Current research focuses on the mental health of orphaned Ugandan adolescents, as the combining effects of war and AIDS have left 1 out of 7 Ugandan children

without a parent (Unicef, 2004b). In accordance to other research (e.g. Nyamukapa et al., 2008, 2010) parental death can be seen as a risk factor for the psycho-social development, because orphans are confronted with more stressors and these stressors have more impairing effects on their mental health (Whetten et al., 2011). In particular, current research aims at understanding the effect of parental loss on executive functioning, as executive control is important in physical and mental health, academic performance, job security and many other important life domains (Diamond, 2013). Contrary to our expectations and to literature on social deprivation (e.g. Atwine et al., 2005; Bos et al.,2009; Tottenham et al., 2010), our orphaned sample did not exhibit impaired hot or cool executive control nor more symptoms of anxiety, traumatisation or depression. However, emotional interference on executive control did increase in this orphaned group when trauma symptoms elevated, suggesting an increased vulnerability of traumatised orphans. Furthermore, perseverance of hot executive control improved over time, while the perseverance of cool executive control was more impaired over time in the orphaned students compared to the students that still have both parents. The results presented in this paper should however be interpreted with caution as the testing procedure was challenged by various difficulties and the sample may not be representative of the larger Lango population. Nonetheless, executive functioning may become an interesting focus point for aid programs, as research has conceptualized executive control as a protective factor when faced with adversity (Shonkoff, 2011) and as a risk factor for future mental health once impaired (Diamond, 2013). Stimulation of cognitive control, by inter alia martial arts (Lakes & Hoyt, 2004), mindfulness (Flook et al., 2010) or yoga (Manjunath & Telles, 2001), may foster the resilience of orphaned and other vulnerable children in increasing their ability to cope with adversity and therefore launch a positive circle of adaptation and mental health. The easy, time-limited and low-cost Stroop and OET may be of help to local social workers in war-torn areas to give them an indication of the cool and hot executive functioning of orphans and other vulnerable children. However, further research is necessary in supporting the reliability and validity of the Stroop test and the OET in war-torn countries.

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Appendix

Annex 1. Informed Consent Form for Principal - English

Dear Sir, Madam,

Thank you for showing interest in our research about emotions and cognition. Your school …… is about to participate in this research carried out by Ghent University in Belgium. This research has been officially approved by the Uganda National Council for Science and Technology (UNCST) and the Ethical Commission for Psychology and Educational Sciences of Ghent, Belgium. In this letter we would like to tell you a bit more about the research.

What does the research consist of?

Students will be individually asked to conduct 2 games that test cognitive and emotional performance, following some short questionnaires. In the first game the student will be asked to name the colour in which the words are printed while ignoring the meaning of the words. This task will be conducted in English and in Lango. The second game requires the student to name the opposite emotion word to the one presented – first in English, then in Lango.

During the task a translator will be available at all times. All questionnaires and tests will be available in English and in Lango. Please note that, whenever any participant feels like bringing her/his participation to an end and withdraw from this study, this is possible without any consequences. The purpose and relevance of the current research will be available for the participants after participation. The results will be analysed anonymously, meaning that we will not use names and that we will not be able to identify the results afterwards. We will not share information about identity with anyone else. The results will be only used for current research. If you have any questions, please do not hesitate to ask for more information or help.

Consent Form

One of the most important rules for participating in this research is that you (teacher/principal) state that you understand and agree with this information and give the researchers permission to use this information for their research. We therefore ask you to sign this form whereby you give your informed consent.

I, …….. (name), principal of
the school named ……

declare that

(1) The researcher has explained sufficiently to me what will happen during the experiment and why this is important.
(2) I accept the participation of the teachers/students in this research.
(3) I understand the information gathered from this research is strictly confidential and will only be available for the researchers.
(4) I understand that any participant may stop the participation at any given time without having to provide a reason.

Read and approved on …….. (date),

Signature:

Annex 2. Informed Consent Form for Principal – Lango

Adwong/Imat

Apwoyi pi nyuto mita ni I kom ikweda wa alubere kede kwo kede yabo jami kan aler. Cukul ameri…….dong cok cako tic ikom I kweda man ame dul me Ghent University I lobo Belgium. Ikweda man dul me Uganda National Council me Science kede Technology (UNCST) kede Ethical Commission pi Psychology kede Educational Science me Ghant, Belgium.

Idul otin kwan me aryo mere obino arayo ngat acel acel me tuko aryo me temo diro kede nyuto kil kwo maber, alubere kede apenmo ocego cego. Iyi tuko me acek ibuni kwayo atin kwan acel acei me tuco rangi ame ogo nyukta iye kun pe oparo ngo ame nyukta nono gonyo.

Man obino timo ileb munu kede Lango. Tuko me aryo mito ni atinkwan myero cak nying nyukta/kop ame oketo ping ame porekede en oketo me acel ileb munu, kede ileb Lango.

Ikare me tic man agony leb bino bedo atye icawa ducu. Peny ducu kede peny me timere ducu bino bedo ileb munu kede Lango. Timber inge ni, ka a tin kwanoro winyo ni emito weko kwan oko romo ya oko man twere abongo kit dicoro keken. Gin ame mite ikom ikkweda wa me tutunu ni obino miyo bot jo atye akwan iyonge tyeko kwan me peny obino cano iyore yore, tere ni pe obino tic kede nying, dok dang wan, pe obino ngeyo poko a dwongi peny iyonge.

Wan pe obino nywako me miyo ngec bot ngattoro keken. Adwong peny man obino nywako me miyo ngec bot ngattoro keken. Adwong peny man obino tic kede tutunu ikom ikweda man. Ka itye kede apenyopo keken, pe myero ilwor me penyo pi ngec onyo kony.

Ngec mot

Gin ocel apire tek I cik me donyo itic me ikweda man, tye ni tin, acalo apwony kob ni iniang dang dok iyee kede ngec ame omio dang do kite miyo jo me ikweda twero me tic kede ngec man pi ikwedagi. Dong pi man okai me keto cingi piny kan, me wek imi ngec ducu akwaki

An……..(nying)
Apwony/atel me cukuloro nono……..
Tuc ni,

1) Dano me ikweda otito bota acil ngo ame bino timere ikare me temo kede ngo omio man pire tek.
2) Aye me tic opwonye/otiro kwan I kweda man.
3) Amang iom ngec ame orao ikome ikweda man ateteni obedo me imung, dang obino miyo bot jo me ikweda keken.
4) Anaing dang ni oteino keken room ireko tic icawa moreo keken abongo miyo pingo moro.

Akirano ate moko inino dwe……

Cing

Annex 3. Student Questionnaires – English

PARTICIPANT NUMBER:

Questionnaire
English Version

An English and Lango version is available

Content:

- Informed assent
- Demographic information
- Daily Stressors Scale
- Impact of Events Scale Revised
- Hopkins Symptom Checklist-37A

1. Informed assent

Dear Student,
Thank you for showing your interest in our research. You are about to participate in a study that is being carried out by Ghent University in Belgium. This research was officially approved by the Uganda National Council for Science and Technology (UNCST) and the Ethical Commission for Psychology and Educational Sciences of Ghent, Belgium. In this letter we would like to tell you a bit more about the research. The task contains 3 parts.

PART 1:
First, some questionnaires will be given to you which are available both in English and Lango. All answers can be given in Lango or in English.

PART 2:
Then you are asked to read a list of colours. Following, a game will be played in which you are asked to name the colour in which the words are printed while ignoring the meaning of the words. These 2 tasks will be conducted in English.

PART 3:
In the last task you will be asked to read a list of words used for emotions. Next we will play a game where you will name the opposite emotion word of the one appearing on the card. These 2 tasks will be conducted in English.

During the task you may ask any questions and a translator will be available at all times. The purpose and relevance of the current research will be available after participation. Your results will be analyzed anonymously, meaning that we will not use your name and that we will not be able to identify your results afterwards. We will not share information concerning your identity with anyone else. Your results will only be used for the current research. Note that if you feel like bringing your participation to an end at any time you may withdraw from this study without any consequences.

Assent
One of the most important rules for participation in this research is that you declare your understanding and agreement with this information and give the researchers permission to use this information for their research. We therefore ask you to sign the form below thus lending your informed assent.

I, …….. (name),
Declare that

(1) The researcher has explained sufficiently to me what will happen during the experiment and why this is important.
(2) I am willing to participate in this research but do not feel under any obligation.
(3) I understand the information collected from this research is strictly confidential and will only be available to the researchers.
(4) I understand that I may stop my participation at any given time without having to provide a reason.

Read and approved on …….. (date),
Signature:

2. Demographic information

Below is a list of questions about you.
Where " ……. " appears, write the response to the question,
e.g. Question: What is your Age? Answer: … 18 …
Where " 0 " appears, colour the circle which most applies to you,
e.g. Question: What is your Sex? Answer: ○ Male
● Female

Question	Your answer
What is your age?	…….
What is your sex?	0 Male
	0 Female
What is your district and sub-county of origin?	…… ……
What is your native language?	0 Lango
	0 Lango
	0 Other: …… ……
What is your current place of residence?	…… ……
What is your religion?	…….
What is your occupation? (Do you go to school? Are you a student? Do you have a job? What sort of job is it?)	…… ……

Were you ever abducted?	0 Yes
	0 No
If you were abducted, for how long were you abducted?	……
Did you live in an IDP-camp?	0 Yes
	0 No
If you did live in an IDP-camp, for how long?	……
How many people are in your family?	……
Who do you live with?	…… ……
a) Is your father still alive?	0 Yes
	0 No
If yes, do you live together with him?	0 Yes
	0 No
b) Is your mother still alive?	0 Yes
	0 No
If yes, do you live together with her?	0 Yes
	0 No
c) How many brothers and sisters do you have?	……
How many brothers and sisters do you live with?	……

3. Daily Stressors Scale: List of difficulties

The following is a list of difficulties that people sometimes experience.
Where "0" appears, colour the circle which most applies to you,
e.g. Question: Not enough food? ○ No
● Yes

	Question	No	Yes
1	Feeling of insecurity	0	0
2	Not being able to pay school fees	0	0
3	Not enough food	0	0
4	Not enough clothing	0	0
5	Sickness in the family	0	0
6	Lack of care possibilities	0	0
7	Worrying about family	0	0
8	Too much work	0	0
9	Physical punishment	0	0
10	Others talking ill of you and your family	0	0
11	Being discriminated against	0	0
12	Being persecuted by bad spirits	0	0
13	Abandonment by family	0	0
14	Abandoned by society	0	0
15	Forced into marriage	0	0
16	Do not know my father	0	0
17	Disagreement with family	0	0

4. Impact of Events Scale Revised

Instructions

Below is a list of difficulties people sometimes have after stressful life events. Please tell us how much you were distressed or bothered by these difficulties now and within the past month, by colouring the circle that most applies to your experiences.

e.g. Question: Did you experience that any reminder brought back feelings about it?

Answer: ○ Not at all
○ A little bit
○ Moderately
○ Quite a bit
● Extremely

Nr.	Question	Answer				
	How much were you distressed by …?	**Not at all** **- - -**	**A little bit** **+**	**Moderately** **+ +**	**Quite a bit** **+ + +**	**Extremely** **+ + + +**
1.	Any reminder brought back feelings about it	**0**	**0**	**0**	**0**	**0**
2.	I had trouble staying asleep	**0**	**0**	**0**	**0**	**0**
3.	Other things kept making me think about it	**0**	**0**	**0**	**0**	**0**
4.	I felt irritable and angry	**0**	**0**	**0**	**0**	**0**
5.	I avoided letting myself get upset when I thought about it or was reminded of it	**0**	**0**	**0**	**0**	**0**
6.	I thought about it when I didn't mean to	**0**	**0**	**0**	**0**	**0**
7.	I felt as if it hadn't happened or wasn't real	**0**	**0**	**0**	**0**	**0**
8.	I stayed away from reminders about it	**0**	**0**	**0**	**0**	**0**

Nr.	Question	Answer				
	How much were you distressed by …?	**Not at all** **- - -**	**A little bit** **+**	**Moderately** **+ +**	**Quite a bit** **+ + +**	**Extremely** **+ + + +**
9.	Pictures about it popped into my mind	**0**	**0**	**0**	**0**	**0**
10.	I was jumpy and easily startled	**0**	**0**	**0**	**0**	**0**
11.	I tried not to think about it	**0**	**0**	**0**	**0**	**0**
12.	I was aware that I still had a lot of feelings about it, but I didn't deal with them	**0**	**0**	**0**	**0**	**0**
13.	My feelings about it were kind of numb	**0**	**0**	**0**	**0**	**0**
14.	I found myself acting or feeling like I was back at that time	**0**	**0**	**0**	**0**	**0**
15.	I had trouble falling asleep	**0**	**0**	**0**	**0**	**0**
16.	I had waves of strong feelings about it	**0**	**0**	**0**	**0**	**0**
17.	I tried to remove it from my memory	**0**	**0**	**0**	**0**	**0**
18.	I had trouble concentrating	**0**	**0**	**0**	**0**	**0**
19.	Reminders of it caused me to have physical reactions, such as sweating, trouble breathing, nausea, or a pounding heart	**0**	**0**	**0**	**0**	**0**
20.	I had dreams about it	**0**	**0**	**0**	**0**	**0**
21.	I felt watchful and on guard	**0**	**0**	**0**	**0**	**0**
22.	I tried not to talk about it	**0**	**0**	**0**	**0**	**0**
23.	I see or hear things that aren't there (combat boots, gun(shots), …)	**0**	**0**	**0**	**0**	**0**
24.	Spirits of killed or dead people disturb me	0	0	0	0	0

5. *Hopkins Symptom Checklist-37A*

Instructions
Below is a list of different feelings and behaviours of young people. Please tell us how often you have had these feelings or have acted this certain way now and within the past month, by colouring the circle that most applies to your experiences.

e.g. Question: How many times did you feel suddenly scared for no reason?
Answer: ○ Never
○ Sometimes
● Often
○ Always

Nr.	Question	Answer			
	How many times did you experience…?	**Never** **- - -**	**Sometimes** **+**	**Often** **+ + +**	**Always** **+ + + + +**
1.	Feeling suddenly scared for no reason	**0**	**0**	**0**	**0**
2.	Feeling restless, can't sit still	**0**	**0**	**0**	**0**
3.	Becoming angry easily	**0**	**0**	**0**	**0**
4.	Drinking alcohol	**0**	**0**	**0**	**0**
5.	Feeling fearful	**0**	**0**	**0**	**0**
6.	Blaming myself for things	**0**	**0**	**0**	**0**
7.	Bullying or threatening others	**0**	**0**	**0**	**0**
8.	Smoking cigarettes	**0**	**0**	**0**	**0**
9.	Faintness, dizziness or weakness	**0**	**0**	**0**	**0**

Nr.	Question	Answer			
	How many times did you experience…?	**Never** **- - -**	**Sometimes** **+**	**Often** **+ + +**	**Always** **+ + + + +**
10.	Crying easily	**0**	**0**	**0**	**0**
11.	Destroying or breaking things that belong to others	**0**	**0**	**0**	**0**
12.	Nervousness or shakiness inside	**0**	**0**	**0**	**0**
13.	Starting fights	**0**	**0**	**0**	**0**
14.	Feeling low in energy, slowed down	**0**	**0**	**0**	**0**
15.	Heart pounding or racing	**0**	**0**	**0**	**0**
16.	Poor appetite	**0**	**0**	**0**	**0**
17.	Intentionally hurting someone	**0**	**0**	**0**	**0**
18.	Trembling	**0**	**0**	**0**	**0**
19.	Difficulty falling asleep, staying asleep	**0**	**0**	**0**	**0**
20.	Arguing often	**0**	**0**	**0**	**0**
21.	Feeling tense or keyed up	**0**	**0**	**0**	**0**
22.	Feeling hopeless about the future	**0**	**0**	**0**	**0**
23.	Feeling no interest in things	**0**	**0**	**0**	**0**

Nr.	Question	Answer			
	How many times did you experience…?	**Never - - -**	**Sometimes +**	**Often + + +**	**Always + + + + +**
24.	Headaches	**0**	**0**	**0**	**0**
25.	Feeling blue	**0**	**0**	**0**	**0**
26.	Using sleeping pills or sedatives	**0**	**0**	**0**	**0**
27.	Spells of terror or panic	**0**	**0**	**0**	**0**
28.	Feeling lonely	**0**	**0**	**0**	**0**
29.	Thoughts of ending my life	**0**	**0**	**0**	**0**
30.	Feeling of being trapped or caught	**0**	**0**	**0**	**0**
31.	Worrying too much about things	**0**	**0**	**0**	**0**
32.	Stealing things	**0**	**0**	**0**	**0**
33.	Feeling everything is an effort	**0**	**0**	**0**	**0**
34.	Feelings of worthlessness	**0**	**0**	**0**	**0**
35.	Using drugs (opium, marihuana, chewing on leaves)	**0**	**0**	**0**	**0**
36.	Feelings of mistrust and suspicion	**0**	**0**	**0**	**0**
37.	Isolating myself	**0**	**0**	**0**	**0**
38.	Running away from home	**0**	**0**	**0**	**0**
39.	Not taking care of my personal hygiene	**0**	**0**	**0**	**0**
40.	Not wanting others to tell me what to do	**0**	**0**	**0**	**0**

Thank you for participating!

Annex 4. Student Questionnaires – Lango

NUMBER ME PYONYERE:

APPENY
Me lebluo

Leb mono kere lebluo tye

Ngec:

- Yee ni igamo apeny
- Stroop test
- Opposite Emotions Test
- Apeny akwako yin
- Daily Stressors Scale
- Impact of Events Scale Revised
- Hopkins Symptom Checklist-37A

1. Yee ni igamo apeny

Atinkwan,
Apwoyi pi nyuto mitani ikom i kwedawa. in icok bedo dano ace lame bino timo ikweda keda Ghent University ilobo Belgium. Ikweda manobin omoko, kun dul me Uganda Naitonal Council me Science kede Technology (UNCST) kede Ethical Commison me Pscyology kede pwonyere me Science me Ghent, Belgium. I balu man omito titi ginoro anonok alubere kede i kweda man.

Me acel:
Akwayi me kwano rangi ame areo. Ekatuko moro atukere ame obino penyi ni itit rangi ame oco kede nyukta kun pe iparo ngo ame nyukta gonyo. Man bino timere ileb munu kede Lango.

Me aryo:
Iyi man me aryo ni abino kwayi ni ikwan nyukta ame otio kede itam kede iwing man. Enokene obino tuko tuko moro kwen ame ibino tito alungtuke me kop ame bino bedo icad. Aryo ni ducu bino timere ileb munu kede Lango.

Me adek:
Me agikimere apenyogo obino miyi ame tye ileb munu kede Lango. Iromo miyo agami ileb munu kede Lango.

Ikare me tic man itwero penyo apenyoro keke kede agony leb bino bedo atye icawa ducu. Pencop pi ikweda man me tutuno bino bedatye iyonge kwan man. Adwogi me peny obino cano iyore yore, tere ni pe obino tic kede nyingi. Dok dang wan pe obino ngeyo poko adwogi peny iyonge. Wan pe obino nywako me miyo ngec bot ngattoro keken. Adwogi penyi obino tic kede iyi ikweda wa me tutuunu nge ni ka imito weko kwan man icawa moro keken iromo weko abong peko moro keken .

Ngec
Gin ocel apiretek icik me tic kom ikweda man, tye ni yin ibino tito kan aler niangere kede moka wa alubere kede ngec ame oco ping. Kan kede me miyo jo me ikweda twer me tic kede ngec ikom I kwedagi. Dong pi man okway me keto cingi ite papara man kun iketo nyingi.
An ……..(nying)
1) Atic me ikweda otito bota acil ni gin ame bino timere icare me nwongo diro kede ikweda ngo omio man pire tek.
2) Adyere me tic ikom ikweda man kun pe awinyo kit gigi mogo keken
3) Aniang ni ngec ducu ame arao ikom ikweda man, dok ateteni tye imung
4) Aniang dong ni obino weko tic man i cawa moro. Keken abongo miyo pingo mere.

Kwano kede moko inino dwe:

Ketcingi:

2. Apeny akwako yin

Piny kan tye apeny akwako yin.

Kwene " …….. ", co agam me apeny,

Aporere. Apeny: Mwaka ni tye adi?

Agam: … 18 …

Kwen ame " 0 **", ling kala me gin ame kwako yin**,

Aporere.. Apeny: Yin ibedo icoo ya dako?

Agam: ○ Icoo

● Dako

Apeny	**Agam**
Mwaka ni tye adi?	……
Yin ibedo icoo onyo dako?	0 Icoo
	0 Dako
Dictrik ni obedo mene? Gombola ni obedo mene?	…… ……
Ngo obedo lebi okene?	0 Lango
	0 Lango
	0 Enokene:…… ……
Aman ibedo kwene?	…… ……
Dini ni olwongo ningo?	……
Tici obedo ngo? (Ikwano, onyo itye itic? Akwako ngo?)	…… ……

Odui, onyo joo akony rik omaki?	0 Ee
	0 Pe
Ka omaki, iri botgi gi kare aromkwene?	……
Ibin ibedo ikema?	0 Ee
	0 Pe
Ka ibedo iye, pi kare arom kwene?	……
Joo me paco dyekal wu tye adi?	……
Ibedo kede nga?	…… ……
a) Papi tye kwo?	0 Ee
	0 Pe
Ka tye kwo, ibedo kede idyekal acel?	0 Ee
	0 Pe
b) Mama ni tye kwo?	0 Ee
	0 Pe
Ka tye kwo, ibedo kede idyekal acel?	0 Ee
	0 Pe
c) Itye kede omega kede amege adi?	……
Omege ni kede amege ni adi ame ibedo kedgi?	……

3. Daily Stressors Scale: List of difficulties

Gin oryeo ping obedo gami mogo atego ame jo cawa okene beo iye.
Kwene "0" anen ling cana oguro ame rwate kede peki ni,
Aporere: Apeny: Cem pe romo? ○ Pe
● Ee

	Apeny	**Pe**	**Ee**
1	Winyo ni peko oguri	0	0
2	Pe twero culo kwan	0	0
3	Cem pe romo	0	0
4	Ruk pe romo	0	0
5	Two iyi paco	0	0
6	Pe twero gwokere	0	0
7	Para ikom paco	0	0
8	Tic adwong adwonga	0	0
9	Apwod me kom	0	0
10	Jo okene loko arac ikomi kede paco ni	0	0
11	Apokapoka mogo oketo ikomi	0	0
12	Cwing arac ame lubi	0	0
13	Paco ni oweki oko	0	0
14	Jo aguri oweki oko	0	0
15	Dic me nyomere	0	0
16	Pe angeo papa	0	0
17	Gemo iyi paco	0	0

4. Impact of Events Scale Revised

Gin amyero itim:
Piny kan tye kwone kwo atek apapat ame joo obeo itam tek bedo kede. Tim ber ikobiwa kit ame kwo-ni tye kede alubere kede ameaminwongo kede ayela kun ya ikwo atek apapat ame ibeo iye ikare okato?

Apor acel. Apeny: Onyo ginoro ame poyo wi ikom gin otimere ikare okato poyo wii ikom tamoro akwako ginaca?

Agam: ○ Pe atwal
○ Anonok
○ Idyeredyere
○ Atetek
● Atekateka

Nr.	Apeny	Agam				
	Jami ipinyi obin oyelo kwo ni aromene…?	**Pe atwal** **- - -**	**Anonok** **+**	**Idyeredyere** **+ +**	**Atetek** **+ + +**	**Atekateka** **+ + + +**
1.	Ginoro ame dwogo tami ikom ginoro arac ame rik otimere	**0**	**0**	**0**	**0**	**0**
2.	Abedo kede peko me nino	**0**	**0**	**0**	**0**	**0**
3.	Jami mogo timere ame poyo wia ikom ginaca	**0**	**0**	**0**	**0**	**0**
4.	Yia wang ate nwongo akemo	**0**	**0**	**0**	**0**	**0**
5.	Agengo tama ibale ka atamo pi gin arac arik otimere	**0**	**0**	**0**	**0**	**0**
6.	Atamo pi gin arac arik otimere kadi pe amito tamo	**0**	**0**	**0**	**0**	**0**
7.	Awinyo icunya bala pe otimere onyo pe otimere ateni	**0**	**0**	**0**	**0**	**0**
8.	Abedo abor igin ame twero poyo wia igin otimere con	**0**	**0**	**0**	**0**	**0**

Nr.	Apeny	Agam				
	Jami ipinyi obin oyelo kwo ni aromene…?	**Pe atwal** **- - -**	**Anonok** **+**	**Idyeredyere** **+ +**	**Atetek** **+ + +**	**Atekateka** **+ + + +**
9.	Cal agin arik otimere bino itama	**0**	**0**	**0**	**0**	**0**
10.	Abedo itam ape opye kede yia wang oyot	**0**	**0**	**0**	**0**	**0**
11.	Atemo pe me tamo pi gin arac arik otimere	**0**	**0**	**0**	**0**	**0**
12.	Onwongo ngeo ni atye kede tam adwong ikom ginaca ento pe anwongo yore me tyeko	**0**	**0**	**0**	**0**	**0**
13.	Tama ikom ginaca onwongo tye ato onyo rweny oko	**0**	**0**	**0**	**0**	**0**
14.	Anwongo ni anwongo atye atimere onyo winyo bala atye icawa ame ginaca otimere	**0**	**0**	**0**	**0**	**0**
15.	Nino imako wanga bedo atek	**0**	**0**	**0**	**0**	**0**
16.	Tam atek ikom ginaca bedo bino iwia	**0**	**0**	**0**	**0**	**0**
17.	Atemo me kwanyo ginaca oko iwia	**0**	**0**	**0**	**0**	**0**
18.	Keto cunya itimo ginoro bedo atek	**0**	**0**	**0**	**0**	**0**
19.	Poyo wia iginaca mia abedo kede alokaloka ikoma cam kwok maka, weo atek, onyo itao na ipukere	**0**	**0**	**0**	**0**	**0**
20.	Abedo leko ginaca ame rik otimere	**0**	**0**	**0**	**0**	**0**
21.	Abedo atera dang agwokere	**0**	**0**	**0**	**0**	**0**
22.	Atemo pe me lok ikom gin arik otimere	**0**	**0**	**0**	**0**	**0**
23.	Aneno gigi mogo bino iwanga	**0**	**0**	**0**	**0**	**0**
24.	Tipo/Cen ajoo oto yela	0	0	0	0	0

5. *Hopkins Symptom Checklist-37A*

Gin amyero itim:

Piny kan tye jami apapat ame joo atino winyo timere icuny-gi onyo gin kwo-kede. Tim ber ikobi wa tyen adi (pi kare aromene) ame jami-ni obedo timere kede ikwo-ni idwe ame okato, kun iguro agam ame cimo gin ame otimere ikomi. Aporere bala apeny ni ene.

Aporere. Apeny: Tyen adi ame iwinyo ikwo-ni lworo maki kitoro keken abongo
ginoro itimere?
Agam: ○ Pe atwal
○ Icawa okene
● Polkare
○ Ikareducu

Nr.	Apeny	Agam			
	Tyen adi ame gini otimere ikwo-ni…?	**Pe atwal** **- - -**	**Icawa okene** **+**	**Polkare** **+ + +**	**Ikare ducu** **+ + + + +**
1.	Bedo kede lworo icawamoro keken kun nwongo gin otimere pe tye	**0**	**0**	**0**	**0**
2.	Bedo ame cunyi pe opye	**0**	**0**	**0**	**0**
3.	Akemo maki oyotoyot	**0**	**0**	**0**	**0**
4.	Mato kongo	**0**	**0**	**0**	**0**
5.	Bedo kede lworo	**0**	**0**	**0**	**0**
6.	Ngolo kop ikomi keni	**0**	**0**	**0**	**0**
7.	Wuno onyo yelo joo okene	**0**	**0**	**0**	**0**
8.	Mato taba	**0**	**0**	**0**	**0**
9.	Wile, awira-wic onyo goro gom	**0**	**0**	**0**	**0**

Nr.	Apeny	Agam			
	Tyen adi ame gini otimere ikwo-ni?	**Pe atwal** **- - -**	**Icawa okene** **+**	**Polkare** **+ + +**	**Ikare ducu** **+ + + + +**
10.	Kok oyotoyot	**0**	**0**	**0**	**0**
11.	Balo onyo turo jami a joo okene	**0**	**0**	**0**	**0**
12.	Myel kom onyo komi poo	**0**	**0**	**0**	**0**
13.	Cako lweny	**0**	**0**	**0**	**0**
14.	Gupu rweny ikomi onyo timo jami mot	**0**	**0**	**0**	**0**
15.	Itao-ni pukere onyo myel	**0**	**0**	**0**	**0**
16.	Cem pe mito cunyi	**0**	**0**	**0**	**0**
17.	Wango cuny dano kun iti ingeyo onyo tektek	**0**	**0**	**0**	**0**
18.	Kom amyel ikwel kwel	**0**	**0**	**0**	**0**
19.	Nino pe mako angi onyo pe inino aber	**0**	**0**	**0**	**0**
20.	Pyem me laro lok atekateka	**0**	**0**	**0**	**0**
21.	Iwinyo ni cunyi pe opye onyo pe itye agonya	**0**	**0**	**0**	**0**
22.	Tamo ni gin aber pi kare me anyim pe tye	**0**	**0**	**0**	**0**
23.	Pe iketo cunyi ijami	**0**	**0**	**0**	**0**

Nr.	Apeny	Agam			
	Tyen adi ame gini otimere ikwo-ni?	**Pe atwal** **- - -**	**Icawa okene** **+**	**Polkare** **+ + +**	**Ikare ducu** **+ + + + +**
24.	Abar wic	**0**	**0**	**0**	**0**
25.	Iwinyo cuny agoro	**0**	**0**	**0**	**0**
26.	Mwonyo yat nino onyo en ami ibedo mot	**0**	**0**	**0**	**0**
27.	Iwinyo ni ikare ducu peko tye onyo lworo tye	**0**	**0**	**0**	**0**
28.	Iwinyo icunyi ni itye keni-ken	**0**	**0**	**0**	**0**
29.	Tam me deye	**0**	**0**	**0**	**0**
30.	Winyo ni kwo omoko oko onyo tek	**0**	**0**	**0**	**0**
31.	Paro ami atek ateka	**0**	**0**	**0**	**0**
32.	Kwalo jami	**0**	**0**	**0**	**0**
33.	Winyo ni jami ducu ducu nwongo tye amito tic atek	**0**	**0**	**0**	**0**
34.	Winyo ni konyi pe	**0**	**0**	**0**	**0**
35.	Mato jai onyo mwodo oboke	**0**	**0**	**0**	**0**
36.	Winyo ni pe igeno dano onyo akalakala tye ikwo-ni	**0**	**0**	**0**	**0**
37.	Bedo kena kena	**0**	**0**	**0**	**0**
38.	Ngwec oko ipaco	**0**	**0**	**0**	**0**
39.	Pe gwoko cil koma	**0**	**0**	**0**	**0**
40.	Pe mito ni joo okene koba gin amyero atim	**0**	**0**	**0**	**0**

Apwoyo Gamo Apeny!

Annex 5. Stroop Test - Congruent Trial

Practice trial:

red blue green purple brown green blue brown red purple

blue red green brown purple blue purple green red brown

red green brown purple blue blue green brown red purple

brown purple green red blue green red purple brown blue

green blue purple red brown red green brown purple brown

blue green brown purple red green brown red blue purple

purple red green blue purple green blue red brown blue

red blue purple brown green blue purple red brown green

Experimental trial:

brown red green blue brown blue red brown purple blue

red brown blue green purple blue red brown green blue

purple green blue purple red blue brown purple red green

red blue brown purple red blue purple green brown blue

brown purple blue red green blue brown green blue purple

purple red green blue red purple blue brown red green

brown blue purple red green blue brown red blue red

green brown red green purple brown purple green red purple

purple red blue green red brown purple green blue brown

red brown purple brown green purple red brown green blue

green red purple blue purple green red purple brown green

green brown red green brown purple brown blue purple green

Annex 6. Stroop Test - Incongruent Trial

Practice trial:

purple green red brown blue green brown blue red purple

red purple blue green purple red brown blue brown green

red blue brown green green red purple blue purple brown

purple brown blue green purple green red purple blue brown

green blue purple red brown purple red green brown blue

blue brown green brown purple red blue green brown red

purple red green purple red green blue brown blue brown

blue green red blue brown purple red green purple red

Experimental trial:

brown red blue purple brown red green blue brown purple

brown green blue red purple blue purple green red green

green red blue brown purple red brown green red blue

brown green red purple red brown brown red blue green

purple green brown blue red brown purple blue green purple

purple brown red brown purple red blue brown brown red

red purple red blue brown blue purple green blue purple

purple green brown green blue purple blue green brown green

blue purple red green purple brown blue green purple blue

blue red brown blue red green blue green red brown

green brown green purple red green purple green red purple

blue green red brown purple blue brown blue red purple

Annex 7. Opposite Emotions Test – Congruent Trial

Practice trial:

love shame happy pride sad hate pride hate happy love

love shame happy pride sad hate pride sad shame love

hate sad pride happy love shame hate sad shame happy

shame sad love pride love sad shame hate happy love

sad hate pride happy love shame sad pride hate happy

pride love sad pride hate happy shame hate happy shame

love happy hate sad shame sad love pride happy hate

hate sad shame happy shame love pride hate sad pride

Experimental trial:

happy hate sad pride hate happy hate sad shame sad

sad shame love pride love sad love pride sad pride

pride shame happy pride sad pride love shame sad shame

pride love shame sad love sad shame sad shame pride

hate happy love sad pride hate shame happy hate happy

love happy hate sad hate happy shame hate sad love

shame happy hate shame hate happy love pride hate happy

love happy shame happy hate sad love shame happy love

love pride hate happy hate happy pride hate sad love

hate pride love shame hate happy pride happy shame love

shame happy hate pride sad love shame sad love pride

happy shame love pride sad shame hate pride sad pride

Annex 8. Opposite Emotions Test - Incongruent Trial

Practice trial

hate happy love shame sad pride hate sad love shame

love happy pride hate sad shame hate sad love pride

sad hate pride love shame happy love sad hate pride

hate sad love shame hate sad pride happy love happy

sad pride happy hate shame happy shame sad love pride

hate sad shame happy pride love pride happy shame love

hate shame happy pride sad hate shame happy pride love

shame love happy pride hate shame sad love pride happy

Experimental trial:

love sad pride sad hate shame hate sad love pride

happy pride love happy shame happy love happy pride happy

happy shame sad pride hate pride sad hate shame sad

pride love pride happy shame sad shame love happy pride

love shame hate pride sad shame hate shame sad love

hate happy love pride hate sad love pride hate happy

sad shame hate pride sad hate shame happy love sad

love pride sad shame happy hate happy shame love shame

love sad hate shame love pride sad pride happy hate

pride love happy pride hate shame sad love shame hate

happy hate shame sad pride hate sad hate happy love

happy shame love shame happy love sad pride happy hate