An Uncontrolled Pilot Study Examining Changes In Physiological and Psychological Outcomes among Adolescents with High-Risk of Behavioral Disorders Following the *Destress For Success* Program

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Abstract

The main goal of this study was to implement and assess the potential changes following the Destress for Success program in adolescents with high-risk of psychosocial disorders living in residential care. This program aims at providing adolescents with innovative ways to deal with stress. We have previously validated this program in a community sample and showed that it was mostly beneficial to adolescents starting high school with high levels of anger. In the current study, we measured the following outcome variables in 29 adolescents: levels of the stress hormone cortisol in saliva samples, the ability to recognize facial expressions of emotion, depressive symptomatology, perceived stress and self-esteem. Whereas no change in saliva cortisol levels was found, we observed increased self-esteem, decreased perceived stress, decreased depressive symptoms, and changes in the ability to detect emotion following the program. Those encouraging results need to be replicated in a randomized controlled trial.

Keywords: cortisol; preventive intervention; behavioral disorder; depression; facial expression; adolescents

Abbreviations: CD (conduct disorders) HPA axis (hypothalamic–pituitary–adrenal axis) AUC (area under the curve) CAR (cortisol awakening response) CSHS (centre for studies on human stress) ADHD (attention deficit and hyperactivity disorders) ODD (oppositional defiant disorder) HI (high impulsivity)

1. Introduction

Response to stress involves activation of the hypothalamic-pituitary-adrenal axis, which leads to the release of glucocorticoids (cortisol in humans). Cortisol functions to mobilize energy in the form of glucose metabolism at the expense of other biological systems such as reproduction, immunity, inflammation, and growth. Given the lipophilic properties of cortisol, it can easily cross the blood-brain barrier and enter the brain, where it can influence brain function, behavior and mental health by way of binding to different receptor types. Recent prospective studies have found that atypical cortisol activity, particularly an increased cortisol awakening response, is a significant risk factor for the development of anxiety and major depressive disorders in adolescents and young adults (Adam et al., 2010; Adam et al., 2014; Doane et al., 2013). To prevent adolescents from developing psychopathologies, one needs to provide them with ways to manage and cope with stress in order to counterbalance this atypical cortisol activity. Intervention studies measuring either basal, reactive or even one-time point cortisol levels have started emerging in populations of adults with various conditions (Branstrom, Kvillemo, & Akerstedt, 2013; Corey et al., 2014; Hsiao et al., 2014). In the general population, recent and innovative interventions have also included cortisol measures and have observed reduced awakening cortisol response, and reduced cortisol reactivity following the intervention (Bottaccioli et al., 2014).

Although, adolescence is an important period of transition that generates high levels of stress (Lupien, King, Meaney, & McEwen, 2001), studies targeting cortisol activity are scarce. A pilot study recently suggests that higher levels of cortisol 30 minutes after a conflict task are associated with greater depression symptoms improvement in response to interpersonal psychotherapy in depressed participants (Gunlicks-Stoessel, Mufson, Cullen, & Klimes-Dougan, 2013). In addition, another study has found that a mindfulness based stress reduction programs may attenuate a cortisol increase as the academic terms progressed (Sibinga et al., 2013). While the implementation of cortisol measures intervention studies starts providing auspicious results, very few studies have specifically targeted the situational determinants that activate the HPA axis, and even less in adolescents.

In the Centre for Studies on Human Stress, we have created a short program based on the discoveries made in the last 35 years in the field of psychoneuroendocrinology: the *Destress for Success* program. Recent research in psychoneuroendocrinology has identified four situational determinants that activates the HPA axis, namely novelty (N), unpredictability (U), threat to personality (T) and a sense of low control (S) [hence the acronym 'NUTS' in the *DeStress for Success Program*, see supplemental materials for further details] (Dickerson & Kemeny, 2004; Lupien et al., 2013; Mason, 1968). In a recent study performed in 504 adolescents from an intervention school (284) and a control school (220), we found that the program significantly influences HPA activity in more than 25% of participants from the intervention school. Indeed, we reported that adolescents starting high school with high levels of anger responded to the *Destress for Success* intervention with a significant decrease in cortisol levels. Moreover, we found that adolescents who took part in the intervention and showed decreasing cortisol levels following the intervention were 2.45 times less at risk to suffer from clinical and subclinical depressive states three months post-intervention in comparison to adolescents who did not show decreasing cortisol levels following the intervention (Lupien et al., 2013). In the current study, we propose to implement the program in adolescents with high-risk of behavioral disorders living in residential care, and to validate feasibility of such a study.

Indeed, anger has been reported as a temperamental path increasing the risk of behavioral disorder along development (Nigg, 2006). In addition, studies in adolescents with behavioral disorders have consistently shown that levels of basal cortisol are substantially impaired (particularly lowered) among them compared to age-matched controls (Oosterlaan, Geurts, Knol, & Sergeant, 2005; Popma et al., 2007; Shoal, Giancola, & Kirillova, 2003; van de Wiel, van Goozen, Matthys, Snoek, & van Engeland, 2004; van Goozen, Matthys, Cohen-Kettenis, Thijssen, & van Engeland, 1998). Whether low basal cortisol concentrations are the cause or the consequence of behavioral disorders is still debatable. One explanation could be that low cortisol would result from chronic exposure to contextual stressors (Fries, Hesse, Hellhammer, & Hellhammer, 2005), as children with behavioral disorders have a higher risk of having been exposed to chronically stressful social environments (Murray & Farrington, 2010). Interestingly, studies investigating children who had gone through stressful experiences have also reported low basal cortisol levels (King, Mandansky, King, Fletcher, & Brewer, 2001). In adolescents with behavioral disorders, intervention targeting cortisol activity should increase basal cortisol levels in order to normalize it - this phenomenon is already observed in recent intervention studies (Branstrom et al., 2013; Klein et al., 2014). The aim of our study was to influence cortisol activity by administering the *Destress for Success program* to a sample of male adolescents living in residential care, and whose main motive of placement was serious behavior problems, i.e. behaviors that compromise male adolescents' security and/or development. As adolescents with behavioral disorders living in residential care, we assume that they experience a low sense of control (S) since they are under intensive supervision, threats to the ego (T) since they may feel rejected by their family and also by the community, and more unpredictability (U) since they need to adapt to various changing conditions. Teaching these adolescents what stress is, how to recognize it and how to understand situational determinants in order to better control them may lead to a change (i.e. an increase) in their basal cortisol levels.

Cortisol levels have been recently found to modulate judgment of facial expressions (Feeney, Gaffney, & O'Mara, 2012) and adolescents with behavioral disorders are known to show deficits in recognizing displays of facial affect, particularly fearfulness (Fairchild, Van Goozen, Calder, Stollery, & Goodyer, 2009; Marsh & Blair, 2008). Such deficits have also been related to early adversity (Leist & Dadds, 2009). We thus hypothesized that administrating *Destress for Success* may lead to a change in facial affect recognition.

Adolescents with behavioral disorders are a population at-risk of depression. Indeed, in a meta-analysis using child and adolescent community samples, it was reported that 5.8–14.7% met criteria for oppositional defiant disorder or conduct disorder and 1.8–8.0% met criteria for depression (Angold & Costello, 1993). In reference to comorbidity, however, 8.5– 45.4% of those with oppositional defiant disorder or conduct disorder also met criteria for depression (Angold & Costello, 1993). Among studies of clinic-referred youth, authors even reported that 76% of the adolescents with conduct disorders met the diagnosis of a mood disorder (Arredondo, 1994). Furthermore, adolescents belonging to a trajectory of chronic or increasing delinquency are more at risk of developing depression a few years later (Miller, Malone, Dodge, & Conduct Problems Prevention Research, 2010). Since we have found a decrease in depressive symptoms following the Destress for Success program in a subgroup of a community sample, characterized by a high level of anger, we could expect to find such change with a sample of adolescents with behavioral disorders in the current pilot study.

In this pilot study, we hypothesized that we would be able to implement the *Destress for Success* program in a sample of adolescents with high risk behavioral disorders, and that we would be able to observe significant changes following the *Destress for Success* program in stress outcomes (assessed either with cortisol levels in saliva samples or with a self-reported scale), and that this change in stress outcomes would be accompanied by changes in face recognition ability as well as symptoms of depression.

2. Methods

2.1. Participants

Thirty-four male adolescents aged 12 to 15 years (mean age: 13.51 ± 0.82 years) were recruited among adolescents placed in residential care from Quebec youth centres: public institutions responsible for providing specialized assistance to young people and their families experiencing serious difficulties. Since this is a pilot study, we chose to recruit males only in order to reduce variability in cortisol levels attributable to menstrual cycle. Participants originated from a centre in Montreal, Quebec, from which they received services by virtue of the Youth Protection Act. They were selected according to the following three criteria: (a) male, (b) less than 15 years of age, and (c) belonging to one of the 4 units targeted by our intervention: Unit 1 (n=7), Unit 2 (n=7), Unit 3 (n=11), and Unit 4 (n=9). The participating adolescents were placed in the youth center for an average duration of 600 days. Those units have been chosen since they corresponded to the same type of supervision, and they represented a homogeneous group of participants. The main motive of the placement was serious behavior problems, that is, behaviors that compromised male adolescents' security and/or development. Based on clinical reports, severity of behavior problems was high, and a majority of the participants were diagnosed with a conduct disorder. Every participants had at least one diagnosis, and comorbidity was high and included attention deficits and hyperactivity disorders, oppositional and defiant disorders, and Tourette syndrome.

The final sample was composed of 29 male adolescents out of 34 possible participants [Unit 1 (n=6), Unit 2 (n=7), Unit 3 (n=10), and Unit 4 (n=6)] who participated in both collection waves: the first wave was completed one week before the administration of the *Destress for Success program*, while the second wave was completed one month after the end of the program, approximately 9 weeks later. Characteristics of the sample are provided in Table 1.

The ethics committee at the Montreal Youth Centre Institute approved this study (#CER CJM-IU: 11-07/009). Adolescents' parents signed a consent form, while the adolescents signed an assent form.

2.2. Measures

Diurnal Salivary cortisol. Participants were provided with saliva tubes (Sarstedt ©, tubes Part No. 62.558.201). Detailed oral and written instructions were given to adolescents and social workers. Participants were instructed to refrain from smoking and exercising on the day of collection. They were instructed not to eat, drink or brush their teeth one hour prior to saliva sampling. In addition, participants were instructed to provide saliva samples on two consecutive days at awakening, 30 minutes after awakening, 14:00 h, 16:00 h and at bedtime. Participants' compliance regarding timing of saliva sampling and quality of the sample was ensured by social workers who supervised the time and manner in which adolescents provided their sampling. In fact, all participants were awoken at the same time as usual in this kind of units. Participants provided 2mL of pure saliva (no cotton swab) in each saliva tube. Samples were immediately placed into a freezer after collection.

At the end of each data collection wave, saliva samples were stored in freezers at -20ºC at the Centre for Studies on Human Stress (www.humanstress.ca) until determination using a high sensitivity enzyme immune assay kit (Salimetrics® State College, PA, Catalogue No. 1-3102). Frozen samples were brought to room temperature to be centrifuged at 15000xg (3000rpm) for 15 minutes. The range of detection for this assay is between 0.012 - 3ug/dL. Upon receiving duplicate assay values for each sample, we averaged these values together. Two measures of the diurnal cortisol pattern were used as outcomes: the cortisol awakening response (CAR (Clow, Thorn, Evans, & Hucklebridge, 2004)), and the Area Under the Curve (AUC, a summary measure that captures total diurnal cortisol secretion over the course of the day (Pruessner, Kirschbaum, Meinlschmid, & Hellhammer, 2003)). The CAR was calculated as the percentage increase between the immediate awakening value and the 30 minutes after awakening cortisol value.

Perceived stress. The Perceived Stress Scale (PSS) was designed to measure "the degree to which individuals appraise situations in their lives as stressful"(Cohen, Kamarck, & Mermelstein, 1983). Items evaluate the degree to which people find life unpredictable, uncontrollable, or overloaded. The questions are quite general in nature and hence relatively free of content specificity for any population subgroup. The questionnaire includes 14 items and self-administration takes 5 minutes. This questionnaire has been validated and used in different cultures and in adolescents (Cohen et al., 1983; Rondo, Souza, Moraes, & Nogueira, 2004; Siqueira, Diab, Bodian, & Rolnitzky, 2000).

Self-Esteem. Considering the role of self-esteem in stress (Gruenewald, Kemeny, Aziz, & Fahey, 2004; Zorrilla, DeRubeis, & Redei, 1995), the Rosenberg Self-Esteem Questionnaire (Rosenberg, 1965) was used in our study. The Rosenberg scale is a 10-item self-report measure of global self-esteem. It consists of 10 statements related to overall feelings of self-worth and self-acceptance. The items are answered on a four-point scale ranging from "strongly agree" to "strongly disagree". The Rosenberg Self-Esteem Scale was originally developed to assess self-esteem among adolescents. It is a brief and one-dimensional measure of global self-esteem. The Rosenberg Self-Esteem Scale has demonstrated good reliability and validity across a large number of different sample groups. The scale has been validated for use with both male and female adolescents, as well as adult and elderly populations (Rosenberg, 1965).

Facial affect recognition task. Recognition of facial emotion was assessed with the Montreal Set of Facial Displays of Emotion: MSFDE (Beaupre, 2000) that involved 30 male and 24 female black and white photos of multi-ethnic faces on a grey background displaying different intensities (from 20 to 100% of the facial expression) of the following emotions: happy, angry, disgusted, sad, ashamed or fearful. After insuring that the subject knew what the words meant, we told them that they would see a face for 5s and then had 3s in which to write down which emotion was displayed. They practiced with four additional slides and the task then began. Stimulus exposure was set at 5s, the point of maximal discriminative capacity (Rosenthal, 1979). Each face was displayed randomly on a fifty-inch screen. Scores were constructed for the task: the sum of the number of slides correctly identified across all emotions and the sum of correctly identified slides for each of the six emotions. Same variables were computed but by using only low-intensity (20 to 60%) expression of emotion slides. This task has been validated in various populations, including adolescents (Diehl-Schmid et al., 2007; Pajer, Leininger, & Gardner, 2010).

Depressive symptoms. The 27-item French-validated version (St-Laurent, 1999) of Child Depression Inventory (CDI) developed for children and adolescents ages 7 to 17 (Kovacs, 1981, 1985) was administered to measure self-rated depressive symptoms. Each item contains three choices, ranging from 0 to 2, providing a possible score between 0–54. For ethical reasons, all participants were actively monitored by the research team and those who scored in the clinical (score higher than 19) or subclinical (score between 12 and 19) range of symptomatology according to the known CDI cut-off points were considered in potential need of clinical intervention and were referred to the Youth Centre psychologist for additional assessment and potential treatment. Adolescents and parents were informed about this procedure when they signed the consent and assent forms.

2.3. Protocol

The *DeStress for Success Program* is a fully manualized educational group program available from the last author. During the study, participants received five 40-min workshops as part of the *DeStress for Success Program*. The workshop presenters were researchers, trained graduate students and research assistants from the CSHS.

The program was created by members of the CSHS (www.humanstress.ca), in collaboration with educators, school nurses, counsellors and adolescents and it was based on all the available psychoneuroendocrine data obtained in humans in the last 35 years. Table 2 presents a short description of the workshops. *Destress for Success* has been validated within a large community sample study, and is fully described therein (Lupien et al., 2013). For the purpose of the current study, and in collaboration with professionals from the Youth Centre, the program has been adapted by creating PowerPoint presentations to maintain the program's animated nature and help retain participants' focus. One workshop was administered per week.

Testing Sessions. The *DeStress for Success Program* was administered for 5 weeks. Adolescents from the four units were tested for cortisol levels and psychological variables during weekdays on two occasions, i.e. pre-intervention (1 week before the beginning of the program, Time 1) and post-intervention (4 weeks following the end of the program, Time 2). Saliva sampling for cortisol assessment was monitored by social workers, and psychological assessment was obtained following a 40-min testing session in each unit. This study was first designed to validate feasibility of such a study in the context of the Quebec Youth Centre. Due to local constraints, the program and its measurements were administered in November-December for 2 units (Émerillon and Entreprise) and in January-February for the remaining 2 units (Port-Joli and Oasis). We were aware that this design could create a potential confound related to a cohort effect. As such, we provided preliminary analysis comparing units for physiological and psychological outcomes at Time 1 and we introduced Units as a covariate when needed.

2.4. Data analyses

We analyzed data using Statistical Packages for the Social Sciences software (version 20.0, SPSS Inc., Chicago, IL). Physiological and psychological variables were examined for outliers, defined as values ±3 standard deviations from the mean. The analyses were run on Winsorized distributions. Units were first compared on physiological and psychological outcomes at Time 1 using one-way between subjects ANOVA. For the study's primary objective, we used one-way within subjects ANOVA to evaluate changes in physiological and psychological outcomes between Time 1 and Time 2. A two-way within-subjects ANOVA was used when units needed to be entered in the analysis. All physiological and psychological outcomes were continuous variables, but we also considered depressive symptoms as the presence or absence of a depressive state based on the established CDI cut-off scores (Kovacs, 1981, 1985). In this case, we used McNemar's test for repeated measure in order to determine whether distribution of clinical, sub-clinical, and non-clinical participants differed between Time 1 and Time 2. We set statistical significance at p value <.05 for all analyses and did not include cases with missing data in the analyses.

3. Results

3.1. Preliminary analyses

Adolescents from the different units did not differ for physiological or psychological variables, except on the rate of correct answers for happiness ($F(3, 27) = 3.135$, $p < .042$), the rate of correct answers for low intensity happiness ($F(3, 27) = 3.558$, $p < .027$) and the rate of correct answers for low intensity anger ($F(3, 27) = 4.132$, $p < .016$). We entered Units as covariates in further analysis using those outcomes.

3.2. Changes following intervention

Table 3 lists descriptive data at Time 1 and Time 2, and one-way within subject ANOVA results for each physiological and psychological variable of the study. There was a significant increase in the self-esteem score ($F(1,27) = 8.223$, $p < .008$, partial $\eta2 = .23$), decrease in perceived stress scale score ($F(1, 27) = 9.580$, $p < .005$, partial $\eta2 = .26$), and decrease in the child depression inventory total score ($F(1, 27) = 5.068$, $p < .033$, partial $\eta2 = .16$) between pre and post-intervention. Although the rate of participants above a clinical or subclinical threshold of depression decreased from 60.72% to 50% between pre and post-intervention, the McNemar-Bowker test did not detect a significant difference (value = 2.8, df = 2, $p < .247$).

We also found significant differences in the Facial Affect Recognition Task between both times of measures (Figure 1), particularly when adolescents had to detect emotions that are expressed with low-intensity. There was a significant increase in their ability to detect happiness ($F(1,3,24) = 4.985$, $p < .035$, partial $\eta2 = .17$), and a significant decrease in their ability to detect fearfulness ($F(1, 27) = 7.249$, $p < .012$, partial $\eta2 = .21$).

No significant differences were found in either the cortisol awakening response, or the area under the curve variable (Figure 2).

4. Discussion and Conclusion

Aims of this study were to evaluate the possibility to implement the *Destress for Success* program in a sample of adolescents with high risk behavioral disorders, and to evaluate whether we could observe significant changes following the *Destress for Success* program in stress outcomes (assessed either with cortisol levels in saliva samples or with a self-reported scale), and related outcomes. We were indeed able to administer the *Destress for Success* program to a sample of adolescents placed in residential care. Although we did not observe any significant change in salivary cortisol levels, this pilot study suggested that exposure to the program may result in increased self-esteem, decreased feeling of perceived stress, and decreased depressive symptoms. Furthermore, adolescents showed some changes in their ability to detect happiness and in their ability to detect fearfulness in a face recognition task.

Considering that the majority of our participants have been diagnosed with conduct disorders (71%), we should have observed lower levels of salivary cortisol in our sample compared to a community sample. In fact, saliva sampling protocols to capture the diurnal cortisol profile vary widely across studies (Adam & Kumari, 2009), which limits comparability. On the other hand, cortisol awakening response (CAR) refers to the rise in cortisol by 50–75% during the first hour post-awakening (Clow et al., 2004), and this rise in cortisol reached only 13.96% in our sample before the intervention, suggesting lower levels of circulating cortisol, at least following awakening. Numerous studies have suggested that CAR serves as a marker of general hypothalamic–pituitary–adrenal (HPA) axis activity, and may thus reflect experience of adversity (see (Clow et al., 2004) for a review). It is noteworthy that a significant part of our sample has experienced either neglect or abuse during childhood and maltreatment in childhood has been associated with flattened morning cortisol secretion in adulthood (Power, Thomas, Li, & Hertzman, 2012). Normalization of CAR following psychosocial interventions has been recently observed in cancer patients (Branstrom et al., 2013) and in caregivers of Alzheimer's disease patients (Klein et al., 2014), suggesting possible resilience of the stress system. In the present pilot study, we did not detect any significant changes following the program on cortisol variables, but we observed a huge interindividual variability in cortisol levels that could hide a potential change following the intervention. This unusual variability could be explained by comorbid diagnoses and medications. Indeed, 47% of our participants have also been diagnosed with attention deficit and hyperactivity disorders (ADHD), 26% with oppositional defiant disorders (ODD) and 23% with other mental health conditions such as attachment disorders and Tourette syndrome. Recent results show that children with ADHD, and those with a comorbid condition (ADHD-ODD, ADHD-HI) have different profiles of cortisol activity (Freitag et al., 2009; Imeraj et al., 2012; Isaksson, Nilsson, Nyberg, Hogmark, & Lindblad, 2012; Ma, Chen, Chen, Liu, & Wang, 2011), explaining partly the cortisol variability we observed in our sample. As to medication, 57.14% of our participants were under medication such as Concerta©, Ritalin©, Atomoxetine©. Yet, medication could not explain low levels of basal cortisol observed in our sample since studies report either no effect of such medication (Hibel, Granger, Cicchetti, & Rogosch, 2007) or an increase in cortisol levels with Atomoxetine (Isaksson, Hogmark, Nilsson, & Lindblad, 2013), but it could explain part of our variability. Next study will have to document comorbidity in order to better analyse the effect of the program on cortisol data according to the different typologies of adolescents placed in residential care.

As previously documented, adolescents with behavioral disorders constitute a population at-risk of depression (Angold & Costello, 1993; Arredondo, 1994). By comparing the total score of the Child Depression Inventory in our study (12.32) with the same variable in our previous study dealing with a community sample (6.88 to 8.02, (Lupien et al., 2013), we can note that adolescents from our study reported more depressive symptoms. The number of participants above the clinical and sub-clinical threshold of depression in our sample was high, 17.8% and 60.7% respectively, which indicates that adolescents placed in residential care represent a clinically relevant population for depression. Because our sample was a clinically relevant population as to depression, it is thus not surprising to observe a high-level of perceived stress in our sample compared to the level previously observed in our community sample study (27.50 vs 25.55, (Yarcheski & Mahon, 2000). Furthermore, stressful events and the way adolescents manage them have been related to depressive symptoms in adolescence (Garber, 2006; Turner & Lloyd, 2004). Low levels of self-esteem in our participants (31.19 vs 32.84-33.12, (Lupien et al., 2013) was also expected since the presence of a psychiatric disorder, such as conduct disorder, has already been related to decreased self-esteem in adolescents (Guillon, Crocq, & Bailey, 2003; Sprott, 2000), and low self-esteem represents a significant risk factor for depressive symptoms in adolescents (Orth, Robins, & Roberts, 2008).

Despite the absence of significant change in cortisol levels following the *Destress for Success* program, which could be partly attributed to the high variability we get in cortisol levels, a potential finding of this study is the significant change observed in the depression scores following the *Destress for Success* program. This significant change is consistent with the results obtained in the subsample of our community sample, that was characterized by a high level of anger (Lupien et al., 2013). Although the effect size is small (0.16), it is worth noting that the *Destress for Success* program is very short (only 5 workshops of 40 minutes each), targets exclusively the topic of stress, and was addressed to a clinical population. According to results, the decrease in the number of depressive symptoms may be accompanied with changes in self-esteem scores, and in perceived stress scores, with higher effect sizes (respectively, .23 and .26). These variables are known to be related to depression in adolescents (Garber, 2006; Guillon et al., 2003; Kashani, Vaidya, Soltys, Dandoy, & Reid, 1990; Muscatell, Slavich, Monroe, & Gotlib, 2009; Orth et al., 2008; Turner & Lloyd, 2004). Considering the absence of a control group in our experimental design, those changes might be the result of other interventions even if only 20% of the participants followed individual psychotherapy and 47% did not participate to any specific interventions during our study. The association between the program and those changes has to be tested in an experimental and larger-scale study.

As to recognition of facial expression, we expected a deficit in the ability to recognize fear in our sample of adolescents with behavioral disorders (Marsh & Blair, 2008). Although it is difficult to compare results of previous studies with our own data since protocol varies greatly, accuracy rates for this expression are typically around 60-70% in healthy populations (Elfenbein & Ambady, 2002), and around 45-55% in antisocial populations (Marsh & Blair, 2008). Our results at baseline appear to be in the antisocial population range. The ability to recognize happiness was quite low in our sample since expected accuracy rates for this expression are around 85-95% for healthy or antisocial populations (Marsh & Blair, 2008) but it is typical of a sample with a high level of depression (Dai & Feng, 2012; Joormann & Gotlib, 2006). Interesting results are the potential changes observed in the ability to recognize emotion, particularly the increase in the ability to recognize a happy face following the *Destress for Success* program, and the possible decrease in the ability to recognize a fearful face. These changes were clearer when emotions were expressed with low intensity on the face, and could be considered in relation to an improvement in depressive symptoms. Indeed, previous research has shown that depressed adolescents required significantly greater intensity of emotion than did control participants to correctly identify happy expressions, and less intensity to identify negative emotions (Dai & Feng, 2012; Joormann & Gotlib, 2006), and that this bias may have been reduced when patients were in remission (Anderson et al., 2011). Considering the decrease in depressive symptoms in our sample following the *Destress for Success* program, it is not surprising to observe such changes in the ability to recognize facial expression of emotions. Previous research has reported comparable changes in this ability following antidepressant administration (Harmer, Shelley, Cowen, & Goodwin, 2004). In addition, an emotion recognition training program has been recently developed to improve mood among individuals with high levels of depression, and is currently being testing in a randomized control trial (Adams, Penton-Voak, Harmer, Holmes, & Munafo, 2013). As to fearfulness, we did not expect a decrease following the *Destress for Success* program, and this result is difficult to explain. Including a control group with participants without behavioral disorders in a subsequent study would help to disentangle the influence of a diagnosis of conduct disorder from the influence of the *Destress for Success* program on the ability to recognize facial expression of emotion, particularly fearfulness.

In the current pilot study, the number of participants is a clear limitation. Considering the variability observed in physiological data, it is likely that there is a lack of statistical power to detect any effect within the cortisol data. Furthermore, participants differed on numerous variables including medication affecting cortisol levels, individual psychosocial treatment, type of neglect and abuse experienced, and even comorbid conditions associated with conduct disorders. With the number of participants in our study, it was not possible to control for these important elements. Another limitation dealt with the experimental design of the study. Indeed, with a one-group pre-test post-test design, internal validity is threatened by time-related effects, and external validity may be questioned, i.e. it is difficult to assume that observed effects are solely due to the *Destress for Success* program. Although current results suggest a potential effect of the program, future studies should use a randomized, pre-post intervention study design.

Although this pilot study has several limitations, it is important to note that the *Destress for Success* program is a short program of preventive intervention focused on stress, which seems to increase self-esteem and decrease the levels of perceived stress and levels of depressive symptoms.

This pattern of results is consistent with results found in our previous research in a subgroup of a community sample, characterized by a high level of anger. Furthermore, the potential effects observed on participants' ability to detect facial expression is relevant to current research in this emerging field. Although the current study did not detect significant changes in the diurnal rhythm of cortisol, we would like to point out that the HPA axis changes in response to chronic stress might be part of the causal pathway by which environmental stress contributes to the development of anxiety and/or depressive symptomatology. As argued by Adam and colleagues (Adam, Sutton, Doane, & Mineka, 2008), it is imperative to incorporate HPA measures into preventive interventions for children and adolescents. Adolescence may be considered a vulnerable period of development due to brain plasticity, but this developmental plasticity may also make the adolescent brain amenable to interventions to help mitigate early emotional and/or physical trauma (Andersen, 2003). The next step will be to test the program in a more robust experimental design, with a larger number of participants in order to better understand the factors involved in the potential effects of the *Destress for Success* program in children and adolescents living in residential care.

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Author Contributions

N/A

Conflicts of Interest

The authors declare no conflict of interest.

References and Notes

Adam, E. K., Doane, L. D., Zinbarg, R. E., Mineka, S., Craske, M. G., & Griffith, J. W. (2010). Prospective prediction of major depressive disorder from cortisol awakening responses in adolescence. *Psychoneuroendocrinology*, *35*(6), 921-931. doi:10.1016/j.psyneuen.2009.12.007

Adam, E. K., & Kumari, M. (2009). Assessing salivary cortisol in large-scale, epidemiological research. *Psychoneuroendocrinology*, *34*(10), 1423-1436. doi:10.1016/j.psyneuen.2009.06.011

Adam, E. K., Sutton, J. M., Doane, L. D., & Mineka, S. (2008). Incorporating hypothalamic-pituitary-adrenal axis measures into preventive interventions for adolescent depression: are we there yet? *Dev Psychopathol*, *20*(3), 975-1001. doi:10.1017/S0954579408000461

Adam, E. K., Vrshek-Schallhorn, S., Kendall, A. D., Mineka, S., Zinbarg, R. E., & Craske, M. G. (2014). Prospective associations between the cortisol awakening response and first onsets of anxiety disorders over a six-year follow-up--2013 Curt Richter Award Winner. *Psychoneuroendocrinology*, *44*, 47-59. doi:10.1016/j.psyneuen.2014.02.014

Adams, S., Penton-Voak, I. S., Harmer, C. J., Holmes, E. A., & Munafo, M. R. (2013). Effects of emotion recognition training on mood among individuals with high levels of depressive symptoms: study protocol for a randomised controlled trial. *Trials*, *14*, 161. doi:10.1186/1745-6215-14-161

Andersen, S. L. (2003). Trajectories of brain development: point of vulnerability or window of opportunity? *Neurosci Biobehav Rev*, *27*(1-2), 3-18. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/12732219

Anderson, I. M., Shippen, C., Juhasz, G., Chase, D., Thomas, E., Downey, D., . . . Deakin, J. F. (2011). State-dependent alteration in face emotion recognition in depression. *Br J Psychiatry*, *198*(4), 302-308. doi:10.1192/bjp.bp.110.078139

Angold, A., & Costello, E. J. (1993). Depressive comorbidity in children and adolescents: empirical, theoretical, and methodological issues. *Am J Psychiatry*, *150*(12), 1779-1791. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/8238631

Arredondo, D. E. B., S. F. . (1994). Affective comorbidity in psychiatrically hospitalized adolescents with conduct disorder or oppositional defiant disorder: Should conduct disorder be treated with mood stabilizers? *Journal of Child and Adolescent Psychopharmacology*, *4*(3), 151-158.

Beaupre, M. G., Cheung, N., Hess, U. (2000). The Montreal set of facial displays of emotion [slides]. Montreal, Quebec.

Bottaccioli, F., Carosella, A., Cardone, R., Mambelli, M., Cemin, M., D'Errico, M. M., . . . Minelli, A. (2014). Brief training of psychoneuroendocrinoimmunology-based meditation (PNEIMED) reduces stress symptom ratings and improves control on salivary cortisol secretion under basal and stimulated conditions. *Explore (NY), 10*(3), 170-179. doi:10.1016/j.explore.2014.02.002

Branstrom, R., Kvillemo, P., & Akerstedt, T. (2013). Effects of mindfulness training on levels of cortisol in cancer patients. *Psychosomatics, 54*(2), 158-164. doi:10.1016/j.psym.2012.04.007

Clow, A., Thorn, L., Evans, P., & Hucklebridge, F. (2004). The awakening cortisol response: methodological issues and significance. *Stress, 7*(1), 29-37. doi:10.1080/10253890410001667205

Cohen, S., Kamarck, T., & Mermelstein, R. (1983). A global measure of perceived stress. *J Health Soc Behav, 24*(4), 385-396. Retrieved from http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=6668417

Corey, S. M., Epel, E., Schembri, M., Pawlowsky, S. B., Cole, R. J., Araneta, M. R., . . . Kanaya, A. M. (2014). Effect of restorative yoga vs. stretching on diurnal cortisol dynamics and psychosocial outcomes in individuals with the metabolic syndrome: The PRYSMS randomized controlled trial. *Psychoneuroendocrinology, 49C*, 260-271. doi:10.1016/j.psyneuen.2014.07.012

Dai, Q., & Feng, Z. (2012). More excited for negative facial expressions in depression: evidence from an event-related potential study. *Clin Neurophysiol, 123*(11), 2172-2179. doi:10.1016/j.clinph.2012.04.018

Dickerson, S. S., & Kemeny, M. E. (2004). Acute stressors and cortisol responses: a theoretical integration and synthesis of laboratory research. *Psychol Bull, 130*(3), 355-391. doi:10.1037/0033-2909.130.3.355

Diehl-Schmid, J., Pohl, C., Ruprecht, C., Wagenpfeil, S., Foerstl, H., & Kurz, A. (2007). The Ekman 60 Faces Test as a diagnostic instrument in frontotemporal dementia. *Arch Clin Neuropsychol, 22*(4), 459-464. doi:10.1016/j.acn.2007.01.024

Doane, L. D., Mineka, S., Zinbarg, R. E., Craske, M., Griffith, J. W., & Adam, E. K. (2013). Are flatter diurnal cortisol rhythms associated with major depression and anxiety disorders in late adolescence? The role of life stress and daily negative emotion. *Dev Psychopathol, 25*(3), 629-642. doi:10.1017/S0954579413000060

Elfenbein, H. A., & Ambady, N. (2002). On the universality and cultural specificity of emotion recognition: a meta-analysis. *Psychol Bull, 128*(2), 203-235. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/11931516

Fairchild, G., Van Goozen, S. H., Calder, A. J., Stollery, S. J., & Goodyer, I. M. (2009). Deficits in facial expression recognition in male adolescents with early-onset or adolescence-onset conduct disorder. *J Child Psychol Psychiatry, 50*(5), 627-636. doi:10.1111/j.1469-7610.2008.02020.x

Feeney, J., Gaffney, P., & O'Mara, S. M. (2012). Age and cortisol levels modulate judgment of positive and negative facial expressions. *Psychoneuroendocrinology, 37*(6), 827-835. doi:10.1016/j.psyneuen.2011.09.015

Freitag, C. M., Hanig, S., Palmason, H., Meyer, J., Wust, S., & Seitz, C. (2009). Cortisol awakening response in healthy children and children with ADHD: impact of comorbid disorders and psychosocial risk factors. *Psychoneuroendocrinology, 34*(7), 1019-1028. doi:10.1016/j.psyneuen.2009.01.018

Fries, E., Hesse, J., Hellhammer, J., & Hellhammer, D. H. (2005). A new view on hypocortisolism. *Psychoneuroendocrinology, 30*(10), 1010-1016. doi:10.1016/j.psyneuen.2005.04.006

Garber, J. (2006). Depression in children and adolescents: linking risk research and prevention. *Am J Prev Med, 31*(6 Suppl 1), S104-125. doi:10.1016/j.amepre.2006.07.007

Gruenewald, T. L., Kemeny, M. E., Aziz, N., & Fahey, J. L. (2004). Acute threat to the social self: shame, social self-esteem, and cortisol activity. *Psychosom Med, 66*(6), 915-924. doi:10.1097/01.psy.0000143639.61693.ef

Guillon, M. S., Crocq, M. A., & Bailey, P. E. (2003). The relationship between self-esteem and psychiatric disorders in adolescents. *Eur Psychiatry, 18*(2), 59-62. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/12711400

Gunlicks-Stoessel, M., Mufson, L., Cullen, K. R., & Klimes-Dougan, B. (2013). A pilot study of depressed adolescents' cortisol patterns during parent-adolescent conflict and response to interpersonal psychotherapy (IPT-A). *J Affect Disord, 150*(3), 1125-1128. doi:10.1016/j.jad.2013.05.037

Harmer, C. J., Shelley, N. C., Cowen, P. J., & Goodwin, G. M. (2004). Increased positive versus negative affective perception and memory in healthy volunteers following selective serotonin and norepinephrine reuptake inhibition. *Am J Psychiatry, 161*(7), 1256-1263. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/15229059

Hibel, L. C., Granger, D. A., Cicchetti, D., & Rogosch, F. (2007). Salivary biomarker levels and diurnal variation: associations with medications prescribed to control children's problem behavior. *Child Dev, 78*(3), 927-937. doi:10.1111/j.1467-8624.2007.01041.x

Hsiao, F. H., Lai, Y. M., Chen, Y. T., Yang, T. T., Liao, S. C., Ho, R. T., . . . Jow, G. M. (2014). Efficacy of psychotherapy on diurnal cortisol patterns and suicidal ideation in adjustment disorder with depressed mood. *Gen Hosp Psychiatry, 36*(2), 214-219. doi:10.1016/j.genhosppsych.2013.10.019

Imeraj, L., Antrop, I., Roeyers, H., Swanson, J., Deschepper, E., Bal, S., & Deboutte, D. (2012). Time-of-day effects in arousal: disrupted diurnal cortisol profiles in children with ADHD. *J Child Psychol Psychiatry, 53*(7), 782-789. doi:10.1111/j.1469-7610.2012.02526.x

Isaksson, J., Hogmark, A., Nilsson, K. W., & Lindblad, F. (2013). Effects of stimulants and atomoxetine on cortisol levels in children with ADHD. *Psychiatry Res, 209*(3), 740-741. doi:10.1016/j.psychres.2013.06.011

Isaksson, J., Nilsson, K. W., Nyberg, F., Hogmark, A., & Lindblad, F. (2012). Cortisol levels in children with attention-deficit/hyperactivity disorder. *J Psychiatr Res, 46*(11), 1398-1405. doi:10.1016/j.jpsychires.2012.08.021

Joormann, J., & Gotlib, I. H. (2006). Is this happiness I see? Biases in the identification of emotional facial expressions in depression and social phobia. *J Abnorm Psychol, 115*(4), 705-714. doi:10.1037/0021-843X.115.4.705

Kashani, J. H., Vaidya, A. F., Soltys, S. M., Dandoy, A. C., & Reid, J. C. (1990). Life events and major depression in a sample of inpatient children. *Compr Psychiatry, 31*(3), 266-274. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/2340721

King, J. A., Mandansky, D., King, S., Fletcher, K. E., & Brewer, J. (2001). Early sexual abuse and low cortisol. *Psychiatry Clin Neurosci, 55*(1), 71-74. doi:10.1046/j.1440-1819.2001.00787.x

Klein, L. C., Kim, K., Almeida, D. M., Femia, E. E., Rovine, M. J., & Zarit, S. H. (2014). Anticipating an Easier Day: Effects of Adult Day Services on Daily Cortisol and Stress. *Gerontologist*. doi:10.1093/geront/gnu060

Kovacs, M. (1981). Rating scales to assess depression in school-aged children. *Acta Paedopsychiatr, 46*(5-6), 305-315. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/7025571

Kovacs, M. (1985). The Children's Depression, Inventory (CDI). *Psychopharmacol Bull, 21*(4), 995-998. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/4089116

Leist, T., & Dadds, M. R. (2009). Adolescents' ability to read different emotional faces relates to their history of maltreatment and type of psychopathology. *Clin Child Psychol Psychiatry, 14*(2), 237-250. doi:10.1177/1359104508100887

Lupien, S. J., King, S., Meaney, M. J., & McEwen, B. S. (2001). Can poverty get under your skin? basal cortisol levels and cognitive function in children from low and high socioeconomic status. *Dev Psychopathol, 13*(3), 653-676. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/11523853

Lupien, S. J., Ouellet-Morin, I., Trepanier, L., Juster, R. P., Marin, M. F., Francois, N., . . . Plusquellec, P. (2013). The DeStress for Success Program: effects of a stress education program on cortisol levels and depressive symptomatology in adolescents making the transition to high school. *Neuroscience, 249*, 74-87. doi:10.1016/j.neuroscience.2013.01.057

Ma, L., Chen, Y. H., Chen, H., Liu, Y. Y., & Wang, Y. X. (2011). The function of hypothalamus-pituitary-adrenal axis in children with ADHD. *Brain Res, 1368*, 159-162. doi:10.1016/j.brainres.2010.10.045

Marsh, A. A., & Blair, R. J. (2008). Deficits in facial affect recognition among antisocial populations: a meta-analysis. *Neurosci Biobehav Rev, 32*(3), 454-465. doi:10.1016/j.neubiorev.2007.08.003

Mason, J. W. (1968). A review of psychoendocrine research on the pituitary-adrenal cortical system. *Psychosom Med, 30*(5), Suppl:576-607. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/4303377

Miller, S., Malone, P. S., Dodge, K. A., & Conduct Problems Prevention Research, G. (2010). Developmental trajectories of boys' and girls' delinquency: sex differences and links to later adolescent outcomes. *J Abnorm Child Psychol, 38*(7), 1021-1032. doi:10.1007/s10802-010-9430-1

Murray, J., & Farrington, D. P. (2010). Risk factors for conduct disorder and delinquency: key findings from longitudinal studies. *Can J Psychiatry, 55*(10), 633-642. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/20964942

Muscatell, K. A., Slavich, G. M., Monroe, S. M., & Gotlib, I. H. (2009). Stressful life events, chronic difficulties, and the symptoms of clinical depression. *J Nerv Ment Dis, 197*(3), 154-160. doi:10.1097/NMD.0b013e318199f77b

Nigg, J. T. (2006). Temperament and developmental psychopathology. *J Child Psychol Psychiatry, 47*(3-4), 395-422. doi:10.1111/j.1469-7610.2006.01612.x

Oosterlaan, J., Geurts, H. M., Knol, D. L., & Sergeant, J. A. (2005). Low basal salivary cortisol is associated with teacher-reported symptoms of conduct disorder. *Psychiatry Res, 134*(1), 1-10. doi:10.1016/j.psychres.2004.12.005

Orth, U., Robins, R. W., & Roberts, B. W. (2008). Low self-esteem prospectively predicts depression in adolescence and young adulthood. *J Pers Soc Psychol, 95*(3), 695-708. doi:10.1037/0022-3514.95.3.695

Pajer, K., Leininger, L., & Gardner, W. (2010). Recognition of facial affect in girls with conduct disorder. *Psychiatry Res, 175*(3), 244-251. doi:10.1016/j.psychres.2009.06.003

Popma, A., Doreleijers, T. A., Jansen, L. M., Van Goozen, S. H., Van Engeland, H., & Vermeiren, R. (2007). The diurnal cortisol cycle in delinquent male adolescents and normal controls. *Neuropsychopharmacology, 32*(7), 1622-1628. doi:10.1038/sj.npp.1301289

Power, C., Thomas, C., Li, L., & Hertzman, C. (2012). Childhood psychosocial adversity and adult cortisol patterns. *Br J Psychiatry, 201*(3), 199-206. doi:10.1192/bjp.bp.111.096032

Pruessner, J. C., Kirschbaum, C., Meinlschmid, G., & Hellhammer, D. H. (2003). Two formulas for computation of the area under the curve represent measures of total hormone concentration versus time-dependent change. *Psychoneuroendocrinology, 28*(7), 916-931. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/12892658

Rondo, P. H., Souza, M. R., Moraes, F., & Nogueira, F. (2004). Relationship between nutritional and psychological status of pregnant adolescents and non-adolescents in Brazil. *J Health Popul Nutr, 22*(1), 34-45. Retrieved from http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=15190810

Rosenberg, M. (1965). *Society and the adolescent self-image.* Princeton, NJ: Princeton University Press.

Rosenthal, R., Hall, J., DiMatteo, M.R., Rogers, P., Archer, D. (1979). *Sensitivity to nonverbal communication.* Baltimore.

Shoal, G. D., Giancola, P. R., & Kirillova, G. P. (2003). Salivary cortisol, personality, and aggressive behavior in adolescent boys: a 5-year longitudinal study. *J Am Acad Child Adolesc Psychiatry, 42*(9), 1101-1107. doi:10.1097/01.CHI.0000070246.24125.6D

Sibinga, E. M., Perry-Parrish, C., Chung, S. E., Johnson, S. B., Smith, M., & Ellen, J. M. (2013). School-based mindfulness instruction for urban male youth: a small randomized controlled trial. *Prev Med, 57*(6), 799-801. doi:10.1016/j.ypmed.2013.08.027

Siqueira, L., Diab, M., Bodian, C., & Rolnitzky, L. (2000). Adolescents becoming smokers: the roles of stress and coping methods. *J Adolesc Health, 27*(6), 399-408. doi:S1054139X00001671 [pii]

Sprott, J. B. D., A.N. (2000). Bad, sad, and rejected: the lives of aggressive children. . *Can J Ciminol, 42*, 123-133.

St-Laurent, L. (1999). *Adaptation française du Children's Depression Inventory de Maria Kovacs.* . Ontario.

Turner, R. J., & Lloyd, D. A. (2004). Stress burden and the lifetime incidence of psychiatric disorder in young adults: racial and ethnic contrasts. *Arch Gen Psychiatry, 61*(5), 481-488. doi:10.1001/archpsyc.61.5.481

van de Wiel, N. M., van Goozen, S. H., Matthys, W., Snoek, H., & van Engeland, H. (2004). Cortisol and treatment effect in children with disruptive behavior disorders: a preliminary study. *J Am Acad Child Adolesc Psychiatry, 43*(8), 1011-1018. doi:10.1097/01.chi.0000126976.56955.43

van Goozen, S. H., Matthys, W., Cohen-Kettenis, P. T., Thijssen, J. H., & van Engeland, H. (1998). Adrenal androgens and aggression in conduct disorder prepubertal boys and normal controls. *Biol Psychiatry, 43*(2), 156-158. doi:10.1016/S0006-3223(98)00360-6

Yarcheski, A., & Mahon, N. E. (2000). A causal model of depression in early adolescents. *West J Nurs Res, 22*(8), 879-894. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/11109406

Zorrilla, E. P., DeRubeis, R. J., & Redei, E. (1995). High self-esteem, hardiness and affective stability are associated with higher basal pituitary-adrenal hormone levels. *Psychoneuroendocrinology, 20*(6), 591-601. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/8584600

Table 1. Descriptive statistics for participants

	Mean	SD
Age	13.51	.82
Age of first placement	10	5.71
Motives of the placement(%)[a]		
emotional neglect	16.13	
physical neglect	32.26	
educational neglect	19.35	
physical abuse	22.58	
sexual abuse	19.35	
at least one neglect or abuse	74.19	
serious behavioral disorders	41.94	
Duration of residential care (days)	600.1	812.41
Diagnosis of conduct disorder (%)	71.43	
Diagnosis of attention deficit and Hyperactivity disorder (%)	47.05	
Diagnosis of oppositional and defiant disorder (%)	26.47	
Other diagnosis (Tourette, attachment disorder…) %	23.52	
Medication(%)[b]	57.14	
Type of family		
single parent family	42.86	
nuclear family	14.29	
grandparent family	28.57	
host family	14.29	
Educational age (%)		
primary grade 6	16.67	
secondary grade 1	50.00	
secondary grade 2	33.33	
Psychosocial intervention followed		
none	47.05	
individual psychotherapy	20.59	
anger management	8.82	
EQIP (Ensuring Qualification and Independence Program)	16.67	

[a] most of the participants have more than one motive of placement

[b] mainly psychostimulant, such as methylphenidate (Concerta©, Ritalin©, Atomoxetine etc…)

Table 2: Summary of the DeStress for Success Program

Session 1: Recognizing Stress : NUTS	- What is stress? - Elements of stress - N.U.T.S. Model of Stress (Novelty, Unpredictability, Threat to Ego, Sense of low control)
Session 2: Application of the NUTS Model of Stress	- Application of the N.U.T.S. model to identify and deal with daily stressors - Individual interpretation of stressful events
Session 3: The Body's Response to Stress	- Recognition of body's response to stress - Energy mobilization - Physical signs of stress - Ways the body gets rid of built up energy - Strategies to cope with stress (Emotion-focused coping)
Session 4: Dealing with Stress: Don't go NUTS!	- Coping Strategies (Problem-focused coping) - Utilize N.U.T.S . Model to deconstruct real-life stressors
Session 5: The importance of others: Social Support versus Social Pressure	- The Trier Social Stress Test is used with students to demonstrate the concept of social support - Line Experiment – to demonstrate social support *versus* social pressure as coping strategies to stress

Table 3. Comparisons of physiological and psychological variables between pre- and post-intervention.

Variables	Pre-Intervention		Post-Intervention		F	p value
	Mean	SD	Mean	SD		
Rosenberg Self-Esteem score	31.19	4.88	32.77	5.40	8.223	.008**
Perceived stress scale	27.50	7.98	23.06	8.86	9.580	.005**
Child depression inventory (total score)	12.32	7.06	10.39	7.31	5.068	.033*
Facial affect recognition						
rate of correct answer per emotion (%)						
happy	82.21	8.92	82.79	9.61	.424	.521[a]
angry	61.83	16.65	60.32	19.23	.198	.660
disgusted	59.18	22.80	60.50	24.46	.146	.705
sad	69.25	24.25	66.67	25.87	.260	.614
ashamed	69.35	15.56	71.33	20.13	.167	.686
fearful	63.56	19.54	55.22	24.66	6.965	.014*
rate of correct answer per low intensity emotion (%)						
happy	61.01	18.57	68.45	12.90	4.985	.035[a*]
angry	37.20	26.40	36.61	24.04	.073	.790[a]
disgusted	44.05	15.85	41.07	16.96	.594	.448
sad	62.20	26.69	55.65	34.85	.863	.361
ashamed	45.54	26.40	52.68	22.91	1.479	.234
fearful	46.13	22.16	35.12	22.83	7.249	.012*
Diurnal salivary cortisol						
cortisol awakening response (%)	13.96	91.88	24.57	88.90	.138	.713
Area under the curve	136.31	85.75	145.24	88.29	.229	.637

Note. [a]In the ANOVA, we introduced Units as a between-subject factor. No interaction was found. We thus present only the main-effect of the within-subject factor.
*Significant change from pre- to post-intervention, $p < .05$. ** $p < .01$.

Figure 1. Scores on the affect recognition task, split by emotion, before and after the Destress for Success program.

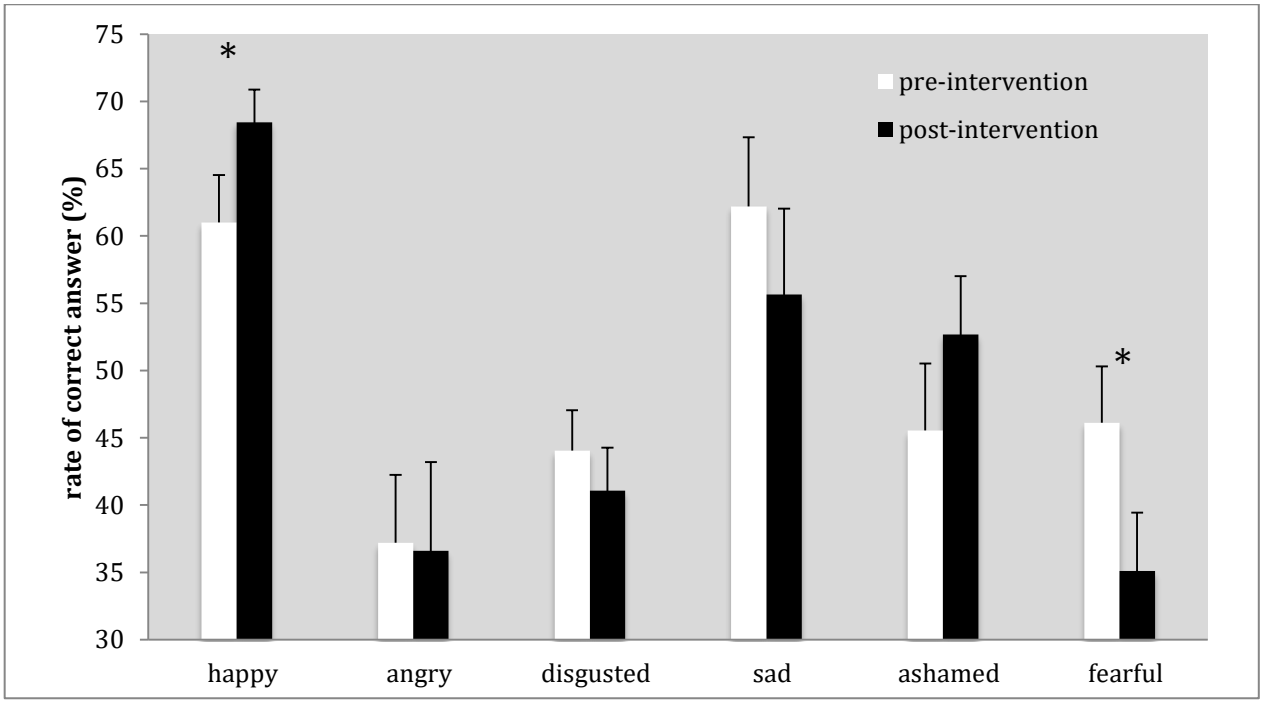

Figure 2. Diurnal salivary cortisol levels before and after the Destress for Success program.