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Visual Arts Activities Relate to Cortisol and Observed Interest for Preschool Children

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Abstract

This study examined the impact of various visual arts activities on physiological stress response and observed emotion regulation. The first aim of the study was to confirm and expand on results from past investigations showing that visual arts classes relate to lower levels of the stress hormone cortisol and greater observed interest for young children facing economic hardship. This investigation expanded on these findings by examining the effects of individual visual arts activities on cortisol and observed interest in comparison to other preschool activities. Participants were 72 children, ages 3-5 years, who attended a Head Start preschool and were randomly assigned to participate in different schedules of arts and homeroom classes. Children were videorecorded in preschool classes and a well validated observational system was applied to measure observed emotion. Children provided salivary samples at multiple times of day and immunoassays tested levels of the stress hormone cortisol. Results of hierarchical linear modeling indicated that children showed greater interest and lower cortisol in visual arts classes compared to all other classes. Results also showed that child participation in painting and drawing tables was associated with greater interest, as was participation at the teacher art table, with no significant effect for the clay table. Of the four visual arts activities examined in this study, only the teacher art table was associated with lower levels of cortisol. Teacher involvement may be a key factor in the effects of visual art on both stress and interest.

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Visual arts activities hold demonstrated potential for alleviating stress and promoting emotion regulation for both children and adults (Brechet et al., 2020; Drake & Winner, 2013; Kaimal et al., 2016; Toyoshima et al., 2011). This potential may be particularly important for children who face high levels of stress related to poverty and systemic racism (Brown et al., 2019; Miller et al., 2009). However, few studies to date have examined the impact of visual arts activities outside of clinical settings and fewer still have assessed the "active ingredients" responsible for positive effects. The present study examines visual arts classes in the context of a Head Start preschool and seeks to identify particular aspects of these classes that are associated with greater experience of positive emotions, lower incidence of negative emotions, and lower levels of the stress hormone cortisol for young children facing economic adversity, many of whom also are Black, Indigenous, or People of Color (BIPOC).

Impact of Poverty and Racism on Emotion Regulation

Approximately 40% of children under the age of nine years are growing up in families with income levels categorized as poor or low-income (Koball et al., 2021), with children who are Black, Hispanic, or People of Color making up a disproportionate part of this group due to systemic racism (Creamer, 2020). Structural aspects of poverty and racism can also lead to a higher chance of experiencing certain ecological risks that are also linked to emotion regulation difficulties for young children (Evans & Kim, 2013; Izard et al., 2004; Kliewer et al., 2009; McLoyd, 1990; Perzow et al., 2021; Ursache et al., 2012). These ecological risks include family instability, household chaos, neighborhood violence, parent emotional difficulties, and under-resourced schools and daycare (Evans, 2004).

The ecological risks associated with poverty and racism are thought to affect emotion regulation skills in multiple ways. One is by increasing young children's experience of negative emotions (Kliewer et al., 2009; McLoyd, 1990; Perzow et al., 2021) and another is by interfering with the development of emotion regulation skills (Evans & Kim, 2013; Izard et al., 2004; Ursache et al., 2012). One example of how ecological risk can disrupt the development of emotion regulation skills is with verbal skill development which plays a key role in emotion regulation. Numerous studies have shown that verbal skills can be compromised by poverty related risks (Izard, 1989; Trentacosta & Izard, 2007; Ursache et al., 2019), and it is likely that in some cases emotion regulation development is disrupted from a delay in language skills (Reilly & Downer, 2019). Furthermore, chronic exposure to stress related to poverty and racism can affect the development of the hypothalamic-pituitary-adrenal (HPA) axis and levels of the stress hormone cortisol (Karin et al., 2020; McEwen & Gianaros, 2010; McEwen & Morrison, 2013; Raver et al., 2013). The impact of this can be profound, as cortisol influences the development of brain areas such as the prefrontal cortex, which is centrally involved in self-regulation (Blair et al., 2011; McEwen, 2013). An overview of the hypothalamic-pituitary-adrenal axis will be important for understanding the impact of stress and trauma related to poverty and racism and the effect on the development of emotion regulation.

Physiological Stress Response and Cortisol

The hypothalamic-pituitary-adrenal (HPA) axis is a neuroendocrine system that, at baseline, supports daily functions such as metabolism and learning (Charmandari et al., 2005). In addition to supporting daily functions, the HPA is sensitive to mental and physical stressors in the environment and produces a response that helps the body mobilize physiological resources to respond (Charmandari et al., 2005). When activated by stress or challenge, the HPA axis releases

hormones into the bloodstream, the primary of these being cortisol. Cortisol can be measured noninvasively through salivary assay to indicate HPA activity (Gunnar & Adam, 2012).

Basal or resting cortisol has a diurnal rhythm with the peak occurring in the morning followed by a steep decrease until midday, and a gradual decrease throughout the remainder of the day (Eiden et al., 2009; Miller et al. 2007). Morning cortisol can be used as one reliable indicator of basal cortisol functioning (Gunnar & Vazquez, 2001), with atypically high morning cortisol suggesting HPA dysregulation (Eiden et al., 2009). Establishing a baseline for diurnal cortisol functioning is necessary for assessing cortisol reactivity as the elevations of cortisol in response to stress are superimposed on the baseline (Gunnar and Adams, 2012).

Some stress early in life may serve an adaptive function. A mild amount of stress can foster resilience to adverse events and stressors later in life, which is sometimes referred to as stress immunization (Harris et al., 2016; Seery et al., 2010). In a longitudinal study of adults in the United States, Seery et al. (2010) found a U-shaped pattern where a history of some lifetime adversity, relative to both no and high adversity, was associated with lower global distress and higher life satisfaction. People with some lifetime adversity also appeared less negatively affected by recent adverse events (Seery et al., 2010). Whereas elevations in cortisol in response to acute stressors can serve an adaptive function, chronic elevations in stress can lead to long-term dysregulation (McEwen & Gianaros, 2011).

Due to the added stressors for children facing economic hardship, there is concern that the HPA axis may become dysregulated, whether this manifests as hypercortisolism or hypocortisolism (Gunnar & Vazquez, 2001; McEwen, 2013). Hypercortisolism is characterized by elevated basal cortisol and heightened response to acute stress (Lupien et al., 2009; McEwen, 2013). In contrast, hypocortisolism is represented by depressed basal cortisol and diminished

responses to acute stress (Gunnar & Vazquez, 2001). Research to date has suggested that for children facing economic hardship in the United States, hypercortisolism is the more common pattern of dysregulation (McEwen, 2013), though a subset exposed to severe or chronic poverty-related stress may experience hypocortisolism (Gunnar & Vazquez, 2001).

Numerous studies have shown a link between poverty related risks and elevated basal cortisol for young children (Blair et al., 2011; Evans, 2003; Evans & English, 2002; Evans & Kim, 2007, 2012). However, there is less research surrounding hypocortisolism. The attenuation hypothesis suggests that chronic or repeated elevations in cortisol ultimately result in the downregulation of basal cortisol levels, and hypocortisolism (Roisman et al., 2009; Susman, 2006). Badanes et al. (2011) found that serious financial strain related to blunted basal cortisol and attenuated stress reactivity for preschool children. Parental insensitivity and increased time spent in childcare during early childhood also has been associated with lower cortisol levels (Roisman et al., 2009), as has child maltreatment or neglect (Gunnar & Vazquez, 2001). Research by Blair and colleagues (Blair, Granger, et al., 2011; Blair, Raver, et al., 2011; Blair et al., 2013) has examined different effects of family income poverty as well as other poverty related risks on cortisol measured at home in a large sample of preschool-age children. These researchers found that cumulative time in poverty was related to a low and flattened cortisol trajectory across a 90-min period, whereas cumulative household chaos was significantly associated with elevated levels of cortisol (Blair et al., 2013), suggesting that different types of experiences with poverty risks may relate to different patterns of cortisol dysregulation.

HPA Functioning and Child Wellbeing and Development

Both hypo- and hypercortisolism pose problems for children's wellbeing and development, including for their cognitive and social-emotional functioning. Hypocortisolism

can lead to negative consequences for cognitive functioning and behavior problems (Alink et al., 2008; Blair et al., 2005; Haltigan et al., 2011; Miller et al., 2007; Shirtcliff et al., 2005). Chronically elevated basal cortisol levels also have been associated with physical, cognitive, and emotional difficulties (Blair et al., 2011; Fortunato et al., 2008; McEwen, 2013). These include immunosuppression (McEwen, 2013), childhood executive dysfunction (Blair et al., 2011), and early childhood fear/withdrawal (Fortunato et al., 2008). In regards to hypocortisolism, Blair et al. (2005) found that the absence of stress reactivity and up-regulation of cortisol in response to challenge was associated with lower cognitive functioning in children. A growing body of research has also linked chronically low cortisol levels with increased externalizing behavior problems (Alink et al., 2008; Haltigan et al., 2011; Shirtcliff et al., 2005), as well as internalizing problems (Badanes et al., 2011; Miller et al., 2007).

It is possible that emotion regulation also may play a reciprocal role and influence cortisol elevation. Zimmermann and Stansbury (2004) found that children who utilized better emotion regulation strategies were less likely to show elevations in cortisol. Similarly, Kliewer et al. (2009) found that for African American youth facing economic hardship, emotion regulation skills may serve as a protective factor against poverty related risks. Whereas cumulative poverty risk generally predicted depressed cortisol levels, for youth with good emotion regulation skills Kliewer and colleagues found that there were no differences in cortisol across low and high levels of risk. Another study on youth facing economic hardship found that negative emotionality was associated with increased allostatic load or overall tax on physiological stress response systems in adolescence for children with low levels of self-regulation (Dich et al., 2015). This highlights the need to identify strategies for reducing stress and promoting emotion regulation for young children facing poverty and racism.

Before examining specific interventions that relate to changes in the HPA axis, it is important to consider the impact that preschool itself can have on children's cortisol levels. Numerous studies have examined the differences in cortisol levels between home and childcare settings (e.g., Dettling et al., 2000; Gunnar & Cheatham, 2003; Rappolt-Schlichtmann et al., 2009; Tout et al., 1998; Vermeer & van IJzendoorn, 2006; Watamura et al., 2009). In studies on primarily middle-income families, children seem to show higher cortisol levels in daycare or preschool compared to at home, impacting the diurnal pattern with an atypical increase from midmorning to midafternoon (Dettling et al., 2000; Gunnar & Cheatham, 2003; Tout et al., 1998; Vermeer & van IJzendoorn, 2006; Watamura et al., 2009; Watamura et al., 2010). Rappolt-Schlichtmann et al. (2009) did not find this same effect for children from low-income families. Their results indicated that the children's cortisol levels decreased over the course of the morning, though they noted that all the children in the study attended a high-quality child care center which may have acted as a confounding variable (Rappolt-Schlichtmann et al., 2009). The times of day at which cortisol was measured also may have been too limited to capture the slight increase in cortisol across the afternoon in preschool that has been documented in other studies: Rappolt-Schlictmann et al. (2009) measured cortisol only until 1:00 pm.

The pattern of higher afternoon cortisol levels in childcare may be moderated by the quality of care, with higher quality of care acting as a potential buffer for activation of the HPA system (Dettling et al., 2000; Gunnar & Cheatham, 2003). Child age also has been demonstrated to moderate these effects with preschool-age children (i.e., 3- to 5-year-olds) showing a greater likelihood of increasing cortisol across the day compared with infants or school-aged children (Bernard et al., 2015). In a study of adolescence, Roisman et al. (2009) found that time in center-based care may have a long-term cost to HPA functioning, with more time spent in childcare in

the first 3 years of life associated with lower awakening cortisol levels at age 15. Notably, this research team did not find that SES or quality of care moderated the impact of early childcare experience on later HPA functioning.

Notwithstanding the lack of effects for SES in the Roisman et al. (2009) study, some research indicates that poverty related risks may moderate the impact of preschool on cortisol. For example, Berry et al. (2014) found that for 7- to 36-month-old children facing economic hardship, the impact of hours in childcare at 48 months was moderated by cumulative risk. A greater number of hours in childcare predicted higher cortisol for children low on cumulative risk, but lower cortisol for those with high levels of risk (Berry et al., 2014). Also, Brown et al. (2021) examined the effect of poverty related risks on basal cortisol for 3- to 5-year-old children in a Head Start preschool. When accounting for poverty-related instability, family income predicted aspects of child cortisol functioning, with higher levels of poverty associated with larger decreases in cortisol in the morning and larger increases over the rest of the day. In sum, research to date suggests that preschool changes children's cortisol production, and is likely to host an atypical increase in cortisol from mid-morning to midafternoon, but further research is needed to clarify whether and how poverty risks and aspects of childcare quality might moderate the impact of preschool context.

Promoting Emotional and HPA Regulation

Several early childhood programs have shown promising effects for enhancing emotion regulation. Children in emotion-based prevention programs based on Differential Emotions Theory or DET (Emotion-Based Prevention Program; Izard et al., 2008, Izard et al., 2004) have shown greater increases in emotion regulation and knowledge, as well as a greater decrease in negative emotion expression, as compared to children in comparison Head Starts. Some other

examples of programs that have seen good outcomes are the Preschool Promoting Alternative Thinking Strategies program (PATHS; see Domitrovich et al., 2007), Tools of the Mind (see Bodrova & Leong, 2007, Diamond et al., 2007), and the Chicago School Readiness Project (CSRP; see Raver et al., 2009, Raver et al., 2011). Tools of the Mind also has been associated with increased self-regulatory skills (Solomon et al., 2018). Blair and Raver (2014) studied a kindergarten Tools of the Mind curriculum and found that the program additionally was associated with a significant decrease in salivary cortisol levels for children in high poverty schools.

A few interventions in and out of schools have shown promise for promoting cortisol regulation. One study found that teaching parents helpful ways to respond to their children's emotions was associated with lower systemic cortisol for 1- to 3-year-old children from a heterogenous income group (Havighurst et al., 2022). In a primary school for low-SES families, participation in a behavioral intervention using mindfulness-based practices and activities fostering empathy was related with improvements to diurnal cortisol rhythm and social integration for 7- to 8-year-old children (Carro et al., 2021). Methods have varied greatly between studies conducted thus far, and continued research on interventions to promote cortisol regulation is needed.

Recent studies on strategies for promoting emotion regulation skills in early childhood have found that implicit approaches seem to be more effective than explicit training tasks (Lo et al., 2021; Takacs & Kassai, 2019). Implicit approaches are ones in which the focus is not directly on the information to be learned, but rather enable the learner to develop self-regulation skills as part of an activity or intervention. They are generally more enjoyable, are easier to incorporate into everyday routines, and allow generalization to other adaptive functioning skills (Takacs &

Kassai, 2019). These approaches can include meditation and biofeedback-mediated interventions for relaxing (Lo et al., 2021; Takacs & Kassai, 2019). Lo et al. (2021) found that relaxation training was associated with decreased dysregulated emotions and improved emotion coping strategies for children living in poverty. The evidence for implicit approaches suggests the potential benefits of visual arts for children's emotion regulation and HPA functioning.

Theories on Visual Arts and Emotion Regulation

The ability to express emotions through visual art could aid in emotion regulation in several ways. First, visual arts could promote the experience of positive emotion. From coloring to playing with clay, children show an enjoyment of visual art from a young age (Robb, 2021). Allowing children to make art can create many opportunities for them to experience positive emotions (Dalebroux et al., 2008; De Petrillo and Winner, 2005; Drake et al., 2011; Drake et al., 2016; Smolarski et al., 2015). Success experiences in the arts may also foster positive emotions for children with developmental difficulties (Darby & Catterall, 1994; Schweizer et al., 2020). Visual arts can also provide space for recognizing children's diverse backgrounds and give them the opportunity to bring their lived realities into the classroom, which can foster a sense of belonging, contentment, and pride (Allen & Boykin, 1992; Allison & Rehm, 2007; Griffin & Miller, 2008; Hall, 2007; Macpherson et al., 2015).

Second, visual arts could promote healthy processing of negative emotion. In a review of principles of effective emotion regulation, Izard (2002) emphasized that, in addition to the importance of children's experience of positive emotion, there is value in their expression of limited amounts of negative emotions, particularly in settings where they can learn control. Visual arts programming could provide this opportunity to express or process negative emotions in a safe setting, where children can learn to regulate. De Petrillo and Winner (2005) suggested

that there is a unique element to art-making that can lead to an improved mood, and they particularly looked at drawing for the ability to express feelings through images. In studies examining the impact of drawing to distract or to vent in response to a negative mood for college students, drawing to distract was associated with improvements to positive mood valence (Dalebroux et al., 2008; Drake et al., 2011; Smolarski et al., 2015). This effect may increase over time and promote regulating emotions. Drake et al. (2016) found that for college students drawing to distract over a few days was associated with significantly more improvement to positive and negative affect than drawing after a single day. It is possible that children could also learn to regulate their emotions through using drawing as a way to express or process negative emotions.

Third, and on a related note, visual arts could facilitate improvement in emotion understanding and regulation through emotion training. There are components of emotion training found in programs specifically designed to promote emotion regulation that can also be found in the arts. Izard et al.'s emotions-based prevention (EBP) program, for example, includes activities to help children recognize and label emotions as well as understand, what events may elicit emotions, and ways to regulate these emotions (Izard et al., 2004, Izard et al., 2008). Visual art programming can incorporate elements of emotion training to help children make connections between emotions, thoughts, and actions. For example, viewing different art pieces can elicit different feelings in children and can be used to label and discuss emotions.

Visual Arts, Emotion Regulation, and Stress Reduction

Art making has been associated with lowering anxiety and behaviorally observed or self-reported measures of stress. Several studies have examined the effects on college students. Sandmire et al. (2012) found that participating in a brief art activity including painting, drawing,

collage making, and modeling with clay related to significant reductions in state anxiety. Similarly, van der Vennet and Serice's (2012) found that coloring in a pre-drawn mandala was associated with significant reduction in anxiety. In some studies, artistic activities have also been linked to significantly greater reductions in stress than matched non-artistic activities (Abbot et al., 2013).

Within visual arts, Curl (2008) found that the process of making art was linked to a significant decrease in stress for college students, regardless of focusing on either a personally stressful or positive situation. Curl (2008) interpreted the findings as suggesting that the process of art making may involve a type of emotional catharsis, which could help to facilitate stress reduction. Visual art may also have an impact on the functional interplay of the brain's default mode network, which has been associated with cognitive processes such as introspection, self-monitoring, and comprehension of emotional states. Bolwerk et al. (2014) used fMRI to study the neural effects of visual arts on adults and found that making art was linked with improvement in functional connectivity that related to stress resistance.

Although a substantial body of research has shown that visual arts activities, such as drawing, painting, and coloring, can be used as emotion regulation tools for college students and adults (Abbot et al., 2013; Curl, 2008; De Petrillo & Winner, 2005; Sandmire et al., 2012; van der Vennet & Serice, 2012) studies examining the effect of visual arts on stress reduction and emotion regulation for children have been limited. Most of the research on children has been on art therapy focused on children with medical conditions (e.g., Favara-Scacco et al., 2001; Maheswari & Evency, 2021; Rollins et al., 2020) or with atypical development (e.g., Deboys et al., 2017, Freilich & Shechtman, 2010; Schweizer et al., 2020). These studies have linked art therapy with improved adjustment (Freilich & Shechtman, 2010), mood (Deboys et al., 2017),

and coping strategies (Favara-Scacco et al., 2001), however it is difficult to determine the active elements in these studies as the visual art activity is paired with therapist directed activities such as role-playing and guided discussions.

A few studies outside the healthcare setting have examined the use of drawing as a strategy for emotion regulation for children. Brechet et al. (2020) examined the use of drawing to regulate emotions, by examining effects between age groups (7- and 10-year-olds), stages of emotional comprehension, and factoring in additional measures of perceived competence, drawing duration, appreciation, and graphic skills. Overall, their findings indicated that drawing can be used as an effective emotion regulation technique for children of middle socioeconomic status. Of the additional factors included, the child's perceived competence of their abilities was the only one that statistically related to emotion regulation, with higher perceived competence associated with higher emotion regulation.

Additional research studies have compared effects of free versus prescribed drawing. Drake and Winner (2013) conducted studies that examined the effectiveness of drawing freely versus copying another's drawing as a method of emotion regulation for 6- to 12-year-old children from middle-income families. Drawing freely was found to be more effective than copying for improving mood. Additionally, Carsley et al. (2015) evaluated the effectiveness of coloring in a mandala versus unstructured coloring on test anxiety for fourth to sixth grade children from upper middle-income families. Results showed an overall decrease in anxiety for both conditions. Both male and female children showed a decrease in anxiety in the mandala group, while in free coloring males showed a more significant decrease in anxiety than females. Studies like these give further insight into the complexities within visual art research and the potentially differing effects for different types of engagement with visual arts activities.

Although theory suggests that visual arts activities are highly interesting to children, few studies have examined children's emotion expression in arts classes. A study by Brown and Sax (2013) focused on an arts-integrated Head Start preschool and examined the impact of music, dance, and visual arts classes compared with homeroom for children ages 3 to 5 years from low-income families. The investigation demonstrated that children showed greater incidence of positive emotions like interest, happiness, and pride in the arts classes compared with homeroom. This study further compared children at the arts-integrated Head Start to those attending a matched comparison Head Start that was not fully arts integrated and found that children at the arts-integrated program showed greater positive emotions overall as well as greater growth in emotion regulation skills over the course of the year. The findings for expression of interest in arts classes may be particularly important because a state of interest and calm engagement is most likely to facilitate learning and prosocial engagement (Izard, 2002).

Visual Arts and Cortisol

Although a host of past studies have examined the effects of visual arts on self-reported stress, a more limited number of investigations have focused specifically on the relation to physiological indicators. Drake (2019) examined the effects of drawing to express versus distract on heart rate and respiratory sinus arrhythmia (RSA) for college students. The study found that both drawing conditions were associated with reduced heart rate and increased RSA after a single session, indicating a benefit for physiological regulation. An interesting finding was that drawing to distract increased RSA more over time than drawing to express or the control condition. This study suggests that the benefits of drawing may extend over time and that some results may appear only after repeatedly engaging in the activity. Haiblum-Itskovitch et al. (2018) found that in comparison to pencils and gouache paint, oil-pastels showed the greatest

effect on heart rate variability for adults, particularly in indices of parasympathetic nervous system and sympathetic nervous system activity. The researchers suggested that these findings may be related to the enhanced tactile experience of using oil-pastels as well as the relative fluidity of the art medium, which could benefit physiological stress regulation.

In the available literature on the effects on cortisol, visual art activities have shown a significant relation to reductions in cortisol. Even one time art making interventions have shown promise for reducing stress. Kaimal et al. (2016) found that, for adults, 45 minutes of art making, with the freedom to choose between collage, clay modeling, and drawing with markers, was associated with reductions in cortisol levels. Also, a recent study by Choi et al (2021) found that coloring a mandala was associated with improved cortisol levels for adults with chronic widespread musculoskeletal pain.

Toyoshima et al. (2011) examined the effects of a 30-minute session of piano playing, clay modeling, or calligraphy on cortisol levels and anxiety for college students. Reductions in cortisol and anxiety were observed for all three groups. Further research comparing different art mediums and types of arts engagement could provide information about what kinds of art activities may be the most effective for reducing stress.

Research on the effect of visual arts on cortisol for children has been very limited. One research study focused on the effect of art therapy for hospitalized children ages 3 to 17. Siegal et al. (2016) found a trend of decreased cortisol following a 90-minute session of expressive art therapy where the children worked with a psychotherapist to make a sock creature from medical and craft supplies. Tanaka et al. (2020) examined the impact of participating in a visual art-based participatory art workshop for children with autism spectrum disorder ages 8 to 9 as well as typically developed children ages 8 to 13. The children were provided with a variety of art

materials including paper, fabric, colored tape, soft clay, paint, and colored pens and instructed to make a stop-motion animation with the help of facilitators and supporters as needed. They found no significant difference in cortisol before and after the workshop for either group, though there were some changes in levels of the hormone oxytocin, which generally promotes prosocial interaction and can be linked to reduced stress levels (Tanaka et al., 2020).

In a study of children in an arts integrated Head Start preschool, Brown et al. (2017) compared cortisol levels after arts classes and homeroom and found that visual arts classes related to reduced cortisol levels overall. Further analyses indicated that the effect of visual arts on cortisol was not demonstrated at the start of the preschool year but was apparent at midyear and maintained at the end-of-year timepoint of assessment. This suggests that repeated participation in visual arts over time may be needed to see an effect. Further research on the impact of visual arts on cortisol for children is needed to understand the types of activities and engagement that might be associated with stress reduction and emotion regulation benefits.

Summary of Evidence and Gaps in Knowledge

The preschool age may be a critical time for intervention for young children facing poverty and racism, who can carry with them the negative emotions stimulated by poverty-related stressors at home (Brown & Ackerman, 2011). Children facing poverty and racism also may face opportunity gaps and disproportionate achievement challenges (Ackerman et al., 2004; Duncan and Brooks-Gunn, 2000; Evans, 2004), causing further frustration and negative emotionality (Kliewer et al., 2009; McLoyd, 1990; Perzow et al., 2021). Children from low-income homes may have limited opportunities to develop prerequisite skills for regulating emotions, such as verbal skills (Izard, 1989; Reilly & Downer, 2019; Trentacosta & Izard, 2007; Ursache et al., 2019). This can limit the ability to connect feelings to words, inhibiting emotion

understanding (Izard et al., 2002). Racism and its associated stressors and inequalities can pose further social-emotional challenges within school context (Caughy et al., 2004, Simons et al., 2002). These factors highlight the importance of investigating interventions that might support emotion regulation for young children facing adversity.

Strong evidence suggests the possibility for promoting physiological and emotional regulation through school intervention programs for young children facing adversity (Blair & Raver, 2014; Carro et al., 2021; Solomon et al., 2018). Also, evidence suggests that visual arts activities could be linked to stress reduction and emotion regulation for heterogeneous income samples of adults (e.g., Abbot et al., 2013; Curl, 2008; De Petrillo & Winner, 2005; Kaimal et al., 2016; Sandmire et al., 2012; van der Vennet & Serice, 2012). Some studies also have suggested these benefits could apply to children (e.g., Brechet et al., 2020; Carsley et al., 2015; Drake and Winner, 2013; Siegal et al., 2016). But few studies have focused on young children facing risks related to poverty and racism and much remains to be learned about the specific visual arts activities that might be linked to stress reduction and emotion regulation benefits.

The Present Study

The present study examined the impact of visual art classes on stress levels and emotion regulation within a Head Start preschool program. Head Start is an early childhood education intervention for children facing economic hardship. We chose to focus on this program because early childhood is a critical period for the development of physiological stress regulation and for emotion regulation, and poverty places children at risk in these areas of development. Visual arts classes implanted in a Head Start preschool provide insight into how such classes may enhance this program, which our nation has heavily invested in.

We focused on a Head Start in the large, mid-Atlantic city of Philadelphia, PA, to additionally facilitate the study of large numbers of children who are BIPOC. These children have been underrepresented in arts research and yet are disproportionately affected by poverty-related stress and also face additional stressors due to systemic racism. Research that includes substantial proportion of BIPOC children is important for understanding the potential for arts-based programming to alleviate stress imposed not only by poverty but also by racism. Visual arts programming holds particular interest in this respect because the arts have been used as sources of empowerment and resilience for communities facing racism and related forms of adversity, and may offer strength-based opportunities for promoting child wellbeing.

This investigation seeks to examine the impact of various visual arts activities on physiological stress and observed emotion regulation. Our first aim is confirmatory. We aim to replicate results of prior studies that have demonstrated that visual arts relates to lower cortisol and higher interest. Our second aim is exploratory. This aim is to look at the effects of individual visual arts activities on stress and emotion regulation in comparison to other preschool activities. There is some evidence that different types of visual arts activities may have differing effects on

stress reduction and emotion regulation, but other studies have found similar effects of different arts activities or mediums. Few prior examinations have focused on children facing economic hardship, and particularly those who are BIPOC, or have examined the effects of different types of visual art activities within the same study in comparison to non-artistic activities. In this study, we aim to examine multiple art activities within a preschool visual art class to identify which activities may relate to reduced stress and increased interest.

Experimental components of the study design include random assignment of children to different schedules of visual arts classes and their between-persons comparison, as well as the within-persons comparison of a given child after multiple different visual arts classes. The natural variation of various aspects of visual arts programming and its correlation with outcomes of interest within those classes represents a quasi-experimental component of the study.

We focus on cortisol as an indicator of physiological stress levels. Cortisol is an objective measure that indicates HPA functioning and can be measured noninvasively via children's saliva. Sampling saliva after arts and other classes allows for gauging the impact on stress levels of those classes, as salivary cortisol levels reflect stress levels 20-30 minutes prior to measurement (Gunnar & Adam, 2012). We focus on interest as an indicator of emotion regulation, because a state of interest and calm engagement is thought to be most conducive to learning and prosocial engagement (Izard, 2002) and therefore would be an optimal emotional state for children to experience much of the time within Head Start preschool.

Confirmatory study hypotheses are as follows: (1) We hypothesize that children will show greater interest during visual arts classes compared with homeroom; (2) We hypothesize that children will show lower cortisol levels after visual arts classes compared with homeroom. In terms of the exploratory component of the study, broadly, we hypothesize that certain visual

arts activities will relate to higher interest and lower cortisol compared with other (primarily non-visual arts) activities. We refrain from making specific hypotheses about which visual arts activities might be most potent, given the lack of clear theoretical or empirical rationale for such expectations.

Method

Participants

This study included 72 children who attended Settlement Music School's Kaleidoscope Preschool Arts Enrichment Program, located in the Queen Village neighborhood of Philadelphia, Pennsylvania, USA, in school year 2012-2013, as well as their primary caregivers. Mean age of the children was 4 years, 2 months (*SD* = 6.42 years). Of the children, 42% were female, and 36% were Black or African Heritage, 17% Latino/a/x or Hispanic Heritage, 14% Asian Heritage, and 31% White or European Heritage. Mean family size was two adults (range = 1-4, *SD* = 0.68) and two children (range = 1-7, *SD* = 1.04). Of the primary caregivers, 75% were mothers, 19% were fathers, and 6% were grandmothers. Mean family annual income was $12,583 (range = 0-43,000, *SD* = 13,947). Income to needs ratios were computed by combining income and family size and were compared to federal poverty guidelines for the appropriate years: 80% of the families fell under the threshold for poverty status and 99% fell under the threshold for low-income status.

Procedure

Ethical standards were followed in the conduct of this study, and all procedures were approved by the appropriate institutional review boards. Recruitment took place in September, at the start of the preschool year. Parents or caregivers of children enrolling in the preschool for the first time were provided a description of the study as part of their preschool orientation and were given the opportunity to ask questions of a trained research assistant as well as sign letters of informed consent. Necessary translation was provided for school orientation and research activities. No children participating in the preschool were excluded from the overall study, and

the participation rate was approximately 98%. Three children regularly taking medication known to influence cortisol (e.g., antiseizure medication), were excluded from all cortisol assessments. Additional children were excluded from individual timepoints of cortisol assessment if they had eaten too close to the collection time or were taking medication at that particular time point. Given these criteria, as well as child absences on assessment days, participant numbers for individual assessments of cortisol ranged from 56 to 69.

The first study component involved a demographic interview with parents or caregivers, conducted at the preschool by trained research assistants in September, at the start of the preschool year. Parents were provided with multiple opportunities to complete these interviews, including during preschool orientation and adjacent to school drop-off and pick-up times during the first several weeks of the school year.

The second study component included assessments of child salivary cortisol on 2 days of the week during September, January, and June. On these days, cortisol was sampled in duplicate at five times across the day, resulting in a total of 60 samples per child. Cortisol was sampled at 9 a.m. (after arrival at preschool and before breakfast), 10:30 a.m. (or midmorning), noon (before lunch), 1:30 p.m. (midafternoon), and 3 p.m. (late afternoon, or end of the school day). Although the 9 a.m. assessment time was included to tap baseline cortisol before exposure to preschool classes on a given day, the midmorning, noon, midafternoon, and late afternoon assessments directly followed participation in a 45-min homeroom or arts class and were included to measure the impact of class type and activities on cortisol. Preschool classes were videorecorded and recordings were coded for activity types as well as children’s emotion expression during a 15-minute interval beginning 30 minutes prior to cortisol assessments. The timing of cortisol

assessment was based on current standards, which suggest that salivary cortisol taps stress levels experienced 20-30 minutes prior (Gunnar & Adam, 2012).

Within this arts-integrated Head Start program, children were randomly assigned, by preschool class, to a weekly schedule that included different numbers of music, dance, and visual arts versus homeroom classes and different timing of these classes on different days of the week. No child received more than one class of the same arts modality in 1 day, and the overall exposure to each arts modality was the same: Each child received each type of arts class four times per week. There were five preschool classes, grouped by child age, and each included 12–20 children, with the lowest number in the youngest age class. Within each class, children were randomly assigned to two cortisol assessment days at start, middle, and end of the year. Approximately equal numbers of children in a given preschool class were assigned to a cortisol assessment day on each of the 5-week days, which included different schedules of arts and homeroom classes.

Measures

Demographic Interview

The demographic interview provided information about standard indicators such as child age, sex, race and ethnicity, family size, and family income.

Cortisol

Salivary assays were used to measure child cortisol. Under the direction and supervision of a research assistant, children held two sorbettes (small sponges) under their tongue for approximately 1 min to collect saliva. The research assistant then checked the sorbettes for sufficient saliva volume and repeated the sampling as necessary before placing them in a conical

tube to be frozen (20°C) until shipped on dry ice overnight to Salimetrics, LLC, State College, PA, for analysis. The analysis by Salimetrics, LLC followed standard procedures described by Blair et al. (2005), namely using a 510-k cleared high-sensitive enzyme immunoassay, a biochemical test for the concentration of cortisol in saliva. The test uses 25 ul of saliva (for singlet determinations), has a lower limit of sensitivity of 0.007 ug/dl (micrograms per deciliter), range of sensitivity from 0.007 to 1.8 ug/dl, and average intra- and interassay coefficients of variation < 15% and 10%, respectively. The average of the duplicate tests was used, with a criterion of no more than 7% error in agreement. The design facilitated a possible 4,140 cortisol observations from 69 children. Given missing data due to children who did not contribute saliva samples at individual timepoints of assessment, a total of 2,940 cortisol observations were available for further statistical analyses.

Child observed emotions

Child emotions were coded by independent observers using an adapted version of the Affex system, which is grounded in DET (Izard et al., 1989). Affex was developed to provide a sufficiently reliable and time-efficient affect expression identification system to encourage research that requires the analysis of relatively long periods of facial behavior, and is based on cross-cultural research, and developmental studies of infants and young children (e.g., Ekman et al., 1972; Izard, 1971, 1977, 1978; Tomkins, 1962, 1963). Intersystem reliability for various coding systems for facial expression of emotions (e.g., Affex, Max, FESM) ranges from 74% to 88%, with a mean of 80%, and these systems show predictive validity for emotion classification responses of untrained observers (social consensus) ranging from 56% to 73% (see Izard et al., 1989).

In the present study, children were coded in 1-min intervals as showing one of seven mutually exclusive emotion categories: neutral, interested, happy, proud, sad, angry, or fearful. In pilot testing with this sample, typical Affex categories of contempt, disgust, and pain were rare and difficult to distinguish from anger; thus, these emotions were coded as anger. Children sometimes showed multiple emotions and/or an emotion blend and were coded based on the predominant emotion for that time interval. Graduate research assistants served as observers and were trained by expert coders, first using videos and then, by jointly conducting live observations of children in the classrooms and discussing discrepancies. For video training, intra-rater reliability with Cohen's kappa was .91. Approximately 10% of the sample was double-coded live. For this subset, interrater reliability according to Cohen's kappa was .82. Children were each coded for 15 consecutive minutes (out of a 45 min class period). Results for the focal emotion of interest were based on the number of minutes coded as interest per 15 min block.

Visual Arts and Other Activities

Activity codes for visual arts and other classes were developed via consultation with the program director and teachers, review of standard lesson plans to identify activities typically included in visual arts as well as other classes, and observation of classes both in person and through video recordings to identify additional activities that did not fall clearly within an articulated category. For visual arts classes, children were coded as participating in one of eleven activity categories: library center, teacher table, building blocks, clay table, drawing table, painting table, book/lesson, behavior/discipline lecture, and outside art. Of all activities observed, four activities unique to visual arts classes were chosen as the focus of the present study: teacher table, clay table, drawing table, and painting table. The teacher table included any visual arts activity where the teacher was at the table providing guided instruction to the children.

The activity at the teacher table could include painting, drawing, and/or clay. The distinction between the teacher table and the other tables was the presence of the teacher actively guiding the activity at the table. The four visual arts activities selected were theoretically motivated and matched the present aim of focusing on activities unique to visual arts classes, as opposed to those also present in homeroom or other classes, in order to pinpoint the impact of visual arts activities on child HPA and emotion regulation. All activity categories the child could have engaged in during the focal 15-minute block were coded, with 1 indicating participation in that activity category and 0 indicating no evidence of participation in that activity during that period.

Results

Preliminary Analyses

Table 1 displays descriptive statistics for cortisol and interest at various times of day as well as in visual arts versus other classes. Overall, mean raw cortisol measured in micrograms per deciliter was 0.41 (*SD* = 7.06) and log cortisol was -0.85 (*SD* = 0.30). Mean raw cortisol in visual arts classes was 0.16 (*SD* = 0.30) compared with 0.44 (*SD* = 7.49) in other classes. In accordance with standard procedures (e.g., Blair et al., 2011), the log transformation was applied to correct for positive skew in the cortisol values, and log cortisol was used in subsequent analyses. Results suggested that, overall, children showed interest 95% of the time. In visual arts classes, children showed interest 98% of the time, compared to 95% of the time in other classes. The effect size for this finding was modest with a Cohen's *d* of 0.41.

Core Analyses

Core analysis relied on Hierarchical Linear Modeling (HLMv7; Raudenbush et al., 2011). This modeling matched the structure of the data in which cortisol samples taken at various times of the day were "nested" within children. In HLM, model fixed effect coefficients and lower level or Level 1 (within-persons) and upper level or Level 2 (between-persons) random effects are estimated. HLM allows for the maximum likelihood of obtaining valid estimates of parameters on outcome variables at particular time points in the presence of missing data. The program does this by making the missing at random (MAR) assumption and using case-wise deletion to handle missing data on predictors at particular time points. MAR specifically refers to the probability that missing a cortisol score at a particular time point may be related to cortisol

scores from previous time points as well as to predictors such as age and sex, but not to the missing cortisol scores at that particular time point (Enders, 2010).

Table 2 presents results of the hierarchical linear model of visual arts classes versus other classes in relation to interest (n = 3510 observations nested within 72 participants). As hypothesized, participation in visual arts classes was associated with greater interest than participation in other classes (B = 0.33, p < .001). Though not a focal predictor, child age was included as a covariate. Younger children particularly showed greater interest in visual arts classes (B = −0.02, p = .039).

Table 3 presents results of the hierarchical linear model of visual arts classes versus other classes in relation to cortisol (n = 2914 observations nested within 69 participants). As predicted, participation in visual arts classes was associated with lower cortisol levels than participation in other classes (B = −0.05, p = 0.003). There was no significant interaction between visual arts classes and cortisol and child age.

Table 4 presents results of the hierarchical linear model of specific visual arts activities compared with all other activity types in relation to interest (n = 3003 observations nested within 72 participants). As hypothesized, the teacher art table was associated with greater interest (B = 0.39, p < 0.001). Age moderated this effect with the teacher art table especially associated with greater interest for younger children (B = −0.03, p = .006). As predicted, the drawing table was also associated with greater interest (B = 0.25, p = .008), as was the painting table (B = 0.49, p < .001). The relation linking the clay table to interest was not statistically significant.

Table 5 presents results of the hierarchical linear model of specific visual arts activities compared with all other activity types in relation to cortisol (n = 2914 observations nested within

69 participants). As predicted, the teacher art table was associated with lower cortisol levels ($B = -0.07$, $p = .007$). Age moderated this effect, with the impact of the teacher art table on cortisol being greater for younger children ($B = 0.01$, $p = .027$). The clay table, drawing table, and painting table did not show any statistically significant associations with cortisol.

Discussion

The present study examined the impact of visual arts classes and activities on stress levels and emotion regulation within a Head Start preschool program. The four visual arts activities were defined as teacher art table, clay table, painting table, and drawing table. Based on past studies by Brown et al. (2017) and Brown and Sax (2013) on the impact of arts classes on cortisol levels and positive emotions, we had two confirmatory hypotheses. First, that children would show greater interest during visual arts classes compared with homeroom and second, that children would show lower cortisol levels after visual arts classes compared with homeroom. For the exploratory component of the study, we hypothesized that certain visual arts activities would relate to higher interest and lower cortisol compared with other (primarily non-visual arts) activities. We refrained from making specific hypotheses about which visual arts activities might be most potent, given the lack of clear theoretical or empirical rationale for such expectations.

We focused on interest as an indicator of emotion regulation, because a state of interest and calm engagement is thought to be most conducive to learning and prosocial engagement (Izard, 2002). Therefore, interest would be an optimal emotional state for children to experience much of the time within Head Start preschool. Although considerable theory suggests children show an enjoyment of visual arts activities (Robb, 2021), we know of only one prior study that included a measure of observed emotions in visual arts, and this study did not isolate interest, specifically, nor did it examine distinct visual arts activities (Brown & Sax, 2013). Our study fills a gap in the literature by examining whether children show greater interest in visual arts classes, as well as associated with specific visual arts activities. As a baseline, our study found that children showed interest 95% of the time when examining all classes together. In visual arts classes, children showed interest 98% of the time, compared to 95% of the time in comparison,

non-visual arts classes. These results suggest that children's predominant emotion in a high quality, arts-integrated, Head Start preschool is one of interest, and that visual arts classes may host even higher than typical levels of interest. The statistical difference between the percent of interest demonstrated in visual arts versus comparison classes was significant and was associated with a moderate effect size. This supports the idea that children tend to be interested in visual arts activities. The difference between interest in visual arts classes and the comparison classes may appear small, but could be meaningful, particularly depending on what emotions were observed during the other 3% of the time. The interpretation could differ, for example, if children tended to be angry when they were not interested versus if they tended to be happy and wellregulated during that time. Whereas the variables we examined in the present study did not give us insight into this, future research could further probe the emotions children were experiencing when they were not demonstrating interest.

In the present study, we focused on cortisol as an indicator of physiological stress levels, as it can be measured noninvasively and serves as an objective measure that indicates HPA functioning. Chronic exposure to stress related to poverty and racism can predict dysregulation of the HPA axis, both in the forms of hypercortisolism and hypocortisolism (Gunnar & Vazquez, 2001; McEwen, 2013). Although there are a limited number of studies that have examined the effects of visual arts on cortisol, few investigations have focused specifically on examining cortisol within preschool context for children facing economic hardship. Whereas there is robust research on the impact of preschool on daily cortisol (e.g., Gunnar & Cheatham, 2003; Vermeer & van IJzendoorn, 2006; Watamura et al., 2010), just a small number of studies have mapped cortisol across the preschool day for children facing economic hardship (Brown et al., 2017; 2021). Our study adds to the literature by providing descriptive statistics on cortisol across the

day for children in a Head Start preschool, as well as by examining the impact of visual arts programming within this context.

The present results build on Brown and Sax's (2013) and Brown et al.'s (2017) studies that examined the effects of visual arts on interest and visual arts on cortisol for children in a Head Start preschool. Brown and Sax (2013) found that participation in arts programming related to higher levels of positive emotions such as interest, happiness, and pride. Brown et al. (2017) compared cortisol levels after arts classes and homeroom and found that visual arts classes related to reduced cortisol levels. Replication of results in behavioral studies provides great value to the literature, particularly within research related to education, as integration and funding of programs often relies on findings from these research studies (Plucker & Makel, 2021). The results from our study replicate the previous findings and expand on them by comparing the visual arts class to not only homeroom but also to all other classes at the school, namely music and dance classes. We found that children showed greater interest in visual arts classes compared to all other classes (homeroom, music, and dance). We also found lower cortisol levels after participation in visual arts classes compared to all other classes. This suggests that there may be unique benefits to visual arts even in comparison to other arts modalities.

Visual arts differ from performing arts, such as music and dance, in ways that could be relevant to their impact on cortisol. With consideration to a classroom context, visual arts activities tend to be more individualized, taking place in smaller group settings. In comparison, performing arts are typically more of a large group activity with the whole class taking part in one activity together. In visual arts, even when children are all given the same task, activities usually involve a child working on their own assignment with minimal awareness needed of how their classmates are doing. Performing arts activities generally require more coordination and a

greater awareness of fellow participants. Whereas performing arts may also include more individualized activities, the act of performing alone in front of others may make some children nervous. These factors could contribute to the differences found between visual arts and performing arts classes, particularly given that the HPA axis tends to be highly sensitive to social challenges.

Various art mediums have been associated with a variety of psychological benefits. Studies have linked drawing to short-term mood repair (Drake et al., 2011), reductions in stress (Abbott et al., 2013; Kaimal et al., 2016), improved mood (Drake et al., 2016; Smolarski et al., 2015), and increased positive affect (Drake et al., 2016). Interventions using modeling clay has been associated with significant reductions in cortisol (Kaimal et al., 2016), mood improvement (Kimport & Robbins, 2012), and reduced anxiety (Sandmire et al., 2012). Painting has also been associated with improved positive mood (Haiblum-Itskovitch et al., 2018) and reduced state-related anxiety (Sandmire et al., 2012). Most past studies, however, have been conducted with adults, so further research has been needed on whether the same effects can be found for children.

The results of our study show that the painting and drawing tables were associated significantly with greater interest. These results are consistent with the previously mentioned studies focusing on adults. They provide evidence that the benefits of arts activities may apply to children as well. In contrast, the clay table was not associated with greater interest. It is possible that the factors of age and setting or other factors not included in this study, such as child sensory issues or special needs, may have influenced the effectiveness of clay as a visual arts tool. Young children in the present study, nearly all of whom faced economic hardship, for example, may have been less likely to have had prior positive experiences with clay making in comparison to

adults included in prior studies of this arts activity. Finally, the teacher art table, which captured any type of art activity conducted at the table with the visual arts teacher, was significantly associated with greater interest. Child age moderated this effect with younger children showing the most interest at the teacher art table. This is a novel finding as we do not know of other published studies that have examined the factor of teacher involvement when studying visual arts activities in relation to emotional regulation. Further studies could explore whether there are aspects of the interaction between teacher involvement and visual arts that uniquely relate to greater interest.

Past research has shown a potential relation between visual art activities and reductions in cortisol. Clay modeling and drawing have both been associated with reductions in cortisol for adults (Choi et al., 2021; Kaimal et al., 2016; Toyoshima et al., 2011). Research on the effect of visual arts on cortisol for children has been very limited and has shown mixed results. Expressive art therapy has been associated with decreased cortisol (Siegal et al., 2016), while a visual arts-based workshop found no significant effect on cortisol (Tanaka et al., 2020). Of the four visual arts activities examined in this study, only the teacher art table was associated with lower levels of cortisol. This is an interesting finding, especially when considering that the teacher art table was also associated with greater interest. Teacher involvement may be a key factor in the effects of visual art on both stress and interest. The finding is novel, as no prior published studies have examined the relationship between teacher involvement in visual arts and cortisol levels. It may be a factor that explains why child art therapy, which typically involves an art therapist working through the activity with the participant, has shown a relation to cortisol when other visual arts activities sometimes have not. Future studies could examine the types and aspects of teacher involvement that may lead to lower cortisol and greater interest within the visual arts.

Limitations

The present study represents an initial effort to identify active elements of visual art programs that may lead to reduced stress levels and improved emotion regulation, and is limited in a number of ways. The focus on young children attending a Head Start preschool in Philadelphia was intentional given that early childhood is a critical period for the development of physiological stress regulation and for emotion regulation, and given risks posed by poverty and systemic racism. However, the focus on young children facing economic hardship in a large mid-Atlantic US city may limit the generalizability of the results. Future studies might include children of other ages, and from other geographic areas. Although the present focus on children facing economic hardship, the majority of whom were non-White, represents a point of strength, the results may be influenced by the factors of poverty and systematic racism that put the children at a higher risk for increased stress. Future studies of visual arts might include heterogenous income groups and might also include samples diverse and large enough to compare results for different socioeconomic as well as racial and ethnic groups.

The present approach to measurement also had both strengths and weaknesses. Child emotions were coded using the well validated Affex observational system, which is based on a strong theoretical model of emotion (Izard et al., 1989). Yet any observational measure can present limitations due to the possibility of error within this type of measurement. Although research assistants were trained on the same material and only allowed to observe once they reached a high level of intra-rater reliability, human observations can include unwanted variability and potential errors in recording data (Popović & Thomas, 2017). Further, in the present application of this observational system, some emotion data may have been lost or obscured: sometimes, for example, children showed multiple emotions or an emotion blend

during a time period which resulted in only the predominant emotion being coded. Future studies might employ multiple methods for measuring children's emotions in visual arts classes, including teacher and self-ratings in addition to observational codes.

The present study contributes to the literature on the effects of visual arts on emotion regulation by examining an emotion that has rarely been explored in its relation to visual arts for children. We chose to focus on interest as an indicator of emotion regulation because a state of interest and calm engagement is thought to be most conducive to learning and prosocial engagement (Izard, 2002). Yet focusing on a singular emotion showed only one aspect of emotion regulation. Future studies might examine interest alongside other emotions to gain a fuller picture of the effects of visual arts activities on children's emotion regulation abilities.

In the present study, salivary cortisol was used as the means of measuring stress. Whereas it represents an objective measure (Gunnar & Adam, 2012), salivary cortisol is only a singular bioindicator of stress and may not provide the whole picture of HPA functioning. Further, although it was a strength to measure cortisol across the preschool day, the study was limited in failing to capture cortisol at home. Utilizing research assistants to sample cortisol increased our ability to verify the collection method and decreased potential issues with compliance from relying on collection by parents at home. However, this does present limitations to the comparison of stress levels due to missing the cortisol awakening response or CAR typically apparent just after morning wakeup, which is an important indicator of overall HPA functioning. Future research might assess cortisol over the whole day to gain a fuller picture of the effects of visual arts activities on stress. Additionally, measuring salivary cortisol was helpful in that this indicates stress approximately 20-30 minutes prior (Gunnar & Adam, 2012), and allowed us to link cortisol to activities completed within the class period, but limited in distinguishing between

particular portions of those activities that may have been linked to more or less stress. The transition to an arts activity, for example, might be associated with stress, and the imprecision in the cortisol measurement might make it difficult to know whether we were capturing the impact of that transition or just the impact of the activity itself. Future studies might consider methods to support such distinctions.

We chose to focus on visual arts classes as there is evidence that visual arts classes relate to greater interest and lower cortisol for children in Head Start preschools (Brown et al., 2017; Brown & Sax, 2013). Confirming the results of these past studies provides greater confidence in the effects of visual arts classes on cortisol and interest. However, focusing broadly on a visual arts class rather than on a certain educational program or pedagogical model limits generalizability as curricula for classes can widely differ between schools. Further, although multiple stages of consultation and investigation guided the decision to focus on the four visual arts activities represented in the present study (teacher art table, clay table, drawing table, and painting table) these were broadly construed categories that could be further broken down for further study (e.g., free drawing versus copying shapes), and do not represent the full spectrum of visual arts activities which includes many other activities such as photography, collage, mural painting, calligraphy, and other things simply not demonstrated within this particular Head Start program during the period of study. Additionally, although there were advantages to studying these activities in a naturalistic setting of the classroom with as little disruption by observers as possible, there are limitations of this approach, including the “noise” created by variation within activities and possible disruption from other students, which was not accounted for. Future studies might examine these activities in a more controlled environment.

Implications for Policy and Practice

Notwithstanding limitations, the present study contributes valuable findings that have implications for policy and practice. Over the last decade there has been a decrease in funding for arts education in the United States (Mullaney-Loss & Rhee, 2021), making research on the importance of the arts critical for funding to continue and increase to match rising inflation. Although the arts should be viewed as valuable for the arts sake (Eisner, 1998), the additional benefits of the arts to social and emotional functioning are becoming an increasingly vital part of policy decisions related to the arts (Dwyer, 2011; Wan et al., 2018). The present study adds to evidence showing the value of the arts for child social-emotional functioning and specifically demonstrates the potential value of visual arts classes and activities for stress and emotion regulation for children facing economic hardship.

In terms of practice, the results of the present study suggest the importance of teacher involvement in visual arts classes and activities. The teacher art table was the only activity specifically associated with both lower cortisol and greater interest. This suggests that schools should not simply rely on visual arts workshops focused on independent work and instead should focus on incorporating small group settings with individual teacher instruction. Teacher involvement may help to explain why art therapy has been associated with decreased cortisol (Siegal et al., 2016), improved adjustment (Freilich & Shechtman, 2010), mood (Deboys et al., 2017), and coping strategies (Favara-Scacco et al., 2001). Often in these studies, the art therapist plays an active role guiding the children through the visual arts activities. Future studies should continue to investigate the role of teacher guidance in the effects of visual arts of stress and emotion regulation. If teacher involvement does play a key role in the effects of visual arts, then it is critical that it is highlighted as such in the practice of visual arts in education.

Summary and Conclusion

The present study confirms and expands on results from past investigations showing that visual arts classes relate to lower cortisol and greater interest. Replication provides great value to the literature and offers evidence for future funding of arts programs. The results from our study replicate the previous findings and expand on them by comparing visual arts classes to not only homeroom but to all other classes at the school, including music and dance classes, suggesting that there may be unique benefits to visual arts even in comparison to other arts modalities.

This research also makes novel contributions to understanding the effects of visual arts activities on cortisol and interest for young children facing economic hardship. Of the four visual arts activities examined in this study, the teacher art table was uniquely associated with both lower levels of cortisol and greater interest. Teacher involvement may play a key role in the effects of visual arts on both stress and interest and be a factor as to why art therapy can show greater benefits than other arts interventions. These results may guide future research to further explore the active elements of visual arts that lead to lower cortisol and greater interest for children. Such research could be particularly important for understanding how to maximize the potential for the arts to support positive social-emotional functioning for children facing stress related to poverty and systemic racism.

References

Abbott, K. A., Shanahan, M. J., & Neufeld, R. W. J. (2013). Artistic tasks outperform nonartistic tasks for stress reduction. *Art Therapy: Journal of the American Art Therapy Association*, *30*(2), 71–78. https://doi.org/10.1080/07421656.2013.787214

Abe, J. A. A., & Izard, C. E. (1999a). The developmental functions of emotions: An analysis in terms of differential emotions theory. *Cognition & Emotion*, *13*(5), 523-549. https://doi.org/10.1080/026999399379177

Abe, J. A. A., & Izard, C. E. (1999b). A longitudinal study of emotion expression and personality relations in early development. *Journal of personality and social psychology*, *77*(3), 566. https://doi.org/10.1037/0022-3514.77.3.566

Ackerman, B. P., Abe, J. A. A., & Izard, C. E. (1998). Differential emotions theory and emotional development: Mindful of modularity. In M. F. Mascolo & S. Griffin (Eds.), *What develops in emotional development?* (pp. 85–106). Plenum Press. https://doi.org/10.1007/978-1-4899-1939-7_4

Ackerman, B. P., Brown, E. D., & Izard, C. E. (2004). The relations between contextual risk, earned income, and the school adjustment of children from economically disadvantaged families. *Developmental Psychology*, *40*(2), 204–216. https://doi.org/10.1037/0012-1649.40.2.204

Alink, L. R. A., van Ijzendoorn, M. H., Bakermans-Kranenburg, M. J., Mesman, J., Juffer, F., & Koot, H. M. (2008). Cortisol and externalizing behavior in children and adolescents: Mixed meta-analytic evidence for the inverse relation of basal cortisol and cortisol reactivity with externalizing behavior. *Developmental Psychobiology*, *50*(5), 427–450. https://doi.org/10.1002/dev.20300

Allen, B. A., & Boykin, A. W. (1992). African-American children and the educational process: Alleviating cultural discontinuity through prescriptive pedagogy. *School Psychology Review*, *21*(4), 586.

Allison, B. N., & Rehm, M. L. (2007). Effective teaching strategies for middle school learners in multicultural, multilingual classrooms. *Middle School Journal*, *39*(2), 12–18. https://doi.org/10.1080/00940771.2007.11461619

Badanes, L. S., Watamura, S. E., & Hankin, B. L. (2011). Hypocortisolism as a potential marker of allostatic load in children: Associations with family risk and internalizing disorders. *Development and Psychopathology 23*(3), 881–896 https://doi.org/10.1017/S095457941100037X

Berhenke, A., Miller, A. L., Brown, E., Seifer, R., & Dickstein, S. (2011). Observed emotional and behavioral indicators of motivation predict school readiness in Head Start graduates. *Early childhood research quarterly*, *26*(4), 430-441. https://doi.org/10.1016/j.ecresq.2011.04.001

Bernard, K., Laurenceau, J.-P., Peloso, E., Zhang, Z., & Dozier, M. (2015). Examining change in cortisol patterns during the 10-week transition to a new child-care setting. *Child Development*, *86*(2), 456–471.

Berry, D., Blair, C., Ursache, A., Willoughby, M., Garrett-Peters, P., Vernon-Feagans, L., Bratsch-Hines, M., Mills-Koonce, W. R., & Granger, D. A. (2014). Child care and cortisol across early childhood: context matters. *Developmental Psychology*, *50*(2), 514–525. https://doi.org/10.1037/a0033379

Blair, C., Berry, D., Mills-Koonce, R., & Granger, D. (2013). Cumulative effects of early poverty on cortisol in young children: Moderation by autonomic nervous system

activity. *Psychoneuroendocrinology*, *38*(11), 2666–2675. https://doi.org/10.1016/j.psyneuen.2013.06.025

Blair, C., Granger, D., & Razza, R. P. (2005). Cortisol reactivity is positively related to executive function in preschool children attending Head Start. *Child Development*, *76*(3), 554–567. https://doi.org/10.1111/j.1467-8624.2005.00863.x

Blair, C., Granger, D. A., Willoughby, M., Mills-Koonce, R., Cox, M., Greenberg, M. T., Kivlighan, K. T., & Fortunato, C. K. (2011). Salivary cortisol mediates effects of poverty and parenting on executive functions in early childhood. *Child Development, 82*(6),1970–1984. https://doi.org/10.1111/j.1467-8624.2011.01643.x

Blair, C., Raver, C. C., Granger, D., Mills-Koonce, R., & Hibel, L. (2011). Allostasis and allostatic load in the context of poverty in early childhood. *Development and Psychopathology*, *23*(3), 845–857. https://doi.org/10.1017/S0954579411000344

Blair, C., & Raver, C. C. (2014). Closing the achievement gap through modification of neurocognitive and neuroendocrine function: Results from a cluster randomized controlled trial of an innovative approach to the education of children in kindergarten. *PLoS ONE*, *9*(11), 1–13. https://doi.org/10.1371/journal.pone.0112393

Bodrova, E., & Leong, D. J. (2007). Play and early literacy: A Vygotskian approach. In K. A. Roskos & J. F. Christie (Eds.), *Play and literacy in early childhood: Research from multiple perspectives* (2nd ed., pp. 185–200). Lawrence Erlbaum Associates Publishers.

Bolwerk, A., Mack-Andrick, J., Lang, F. R., Dörfler, A., & Maihöfner, C. (2014). How art changes your brain: Differential effects of visual art production and cognitive art evaluation on functional brain connectivity. *PLoS ONE*, *9*(7), 1–8. https://doi.org/10.1371/journal.pone.0101035

Brechet, C., D'Audigier, L., & Audras-Torrent, L. (2020). The use of drawing as an emotion regulation technique with children. *Psychology of Aesthetics, Creativity, and the Arts*. https://doi.org/10.1037/aca0000314

Brooks-Gunn, J., & Greg J. Duncan. (1997). The effects of poverty on children. *The Future of Children*, *7*(2), 55–71. https://doi.org/10.2307/1602387

Brown, E. D., & Ackerman, B. P. (2011). Contextual risk, maternal negative emotionality, and the negative emotion dysregulation of preschool children from economically disadvantaged families. *Early Education & Development*, *22*(6), 931-944. https://doi.org/10.1080/10409289.2010.508033

Brown, E. D., Anderson, K. E., Garnett, M. L., & Hill, E. M. (2019). Economic instability and household chaos relate to cortisol for children in poverty. *Journal of Family Psychology*, *33*(6), 629–639. https://doi.org/10.1037/fam0000545

Brown, E. D., Garnett, M. L., Anderson, K. E., & Laurenceau, J.-P. (2017). Can the arts get under the skin? Arts and cortisol for economically disadvantaged children. *Child Development*, *88*(4), 1368–1381. http://doi.org/10.1111/cdev.12652

Brown, E. D., & Sax, K. L. (2013). Arts enrichment and preschool emotions for low-income children at risk. *Early Childhood Research Quarterly*, *28*(2), 337–346. https://doi.org/10.1016/j.ecresq.2012.08.002

Cadima, J., Doumen, S., Verschueren, K., & Buyse, E. (2015). Child engagement in the transition to school: Contributions of self-regulation, teacher–child relationships and classroom climate. *Early Childhood Research Quarterly*, *32*, 1–12. https://doi.org/10.1016/j.ecresq.2015.01.008

Carro, N., D'Adamo, P., & Lozada, M. (2021). A school intervention helps decrease daily stress while enhancing social integration in children. *Behavioral Medicine, 47*(3), 251–258. https://doi.org/10.1080/08964289.2020.1738319

Carsley, D., Heath, N. L., & Fajnerova, S. (2015). Effectiveness of a classroom mindfulness coloring activity for test anxiety in children. *Journal of Applied School Psychology, 31*(3), 239–255. http://doi.org/10.1080/15377903.2015.1056925

Caughy, M. O. B., O'Campo, P. J., & Muntaner, C. (2004). Experiences of racism among African American parents and the mental health of their preschool-aged children. *American Journal of Public Health, 94*(12), 2118-2124. https://doi.org/10.2105/AJPH.94.12.2118

Charmandari, E., Tsigos, C., & Chrousos, G. (2005). Endocrinology of the stress response. *Annual Review of Physiology, 67*, 259–284. https://doi.org/10.1146/annurev.physiol.67.040403.120816

Choi, H., Hahm, S. C., Jeon, Y. H., Han, J. W., Kim, S. Y., & Woo, J. M. (2021). The effects of mindfulness-based mandala coloring, made in nature, on chronic widespread musculoskeletal pain: Randomized trial. *Healthcare, 9*(6), 642. https://doi.org/10.3390/healthcare9060642

Clow, A. & Fredhoi, C. (2006). Normalisation of salivary cortisol levels and self-report stress by a brief lunchtime visit to an art gallery by London City workers. *Journal of Holistic Healthcare, 3*(2), 29- 32.

Creamer, J. (2020, September 15). *Inequalities persist despite decline in poverty for all major race and Hispanic origin groups.* United States Census Bureau.

https://www.census.gov/library/stories/2020/09/poverty-rates-for-blacks-and-hispanics-reached-historic-lows-in-2019.html

Curl, K. (2008). Assessing stress reduction as a function of artistic creation and cognitive focus. *Art Therapy: Journal of the American Art Therapy Association*, *25*(4), 164–169.

Dalebroux, A., Goldstein, T. R., & Winner, E. (2008). Short-term mood repair through art-making: Positive emotion is more effective than venting. *Motivation and Emotion*, *32*(4), 288–295. https://doi.org/10.1007/s11031-008-9105-1

Darby, J. T., & Catterall, J. S. (1994). The fourth R: The arts and learning. *Teachers College Record*, *96*(2), 299–328.

Deboys, R., Holttum, S., & Wright, K. (2017). Processes of change in school-based art therapy with children: A systematic qualitative study. *International Journal of Art Therapy: Inscape*, *22*(3), 118–131. https://doi.org/10.1080/17454832.2016.1262882

De Petrillo, L., & Winner, E. (2005). Does art improve mood? A test of a key assumption underlying art therapy. *Art Therapy: Journal of the American Art Therapy Association*, *22*(4), 205–212.

Dettling, A., Parker, S., Lane, S., Sebanc, A., & Gunnar, M. (2000). Quality of care and temperament determine changes in cortisol concentrations over the day for young children in childcare. *Psychoneuroendocrinology*, *25*(8), 819–836. https://doi.org/10.1016/S0306-4530(00)00028-7

Diamond, A., Barnett, W. S., Thomas, J., & Munro, S. (2007). Preschool program improves cognitive control. *Science*, *318*(5855), 1387–1388. https://doi.org/10.1126/science.1151148

Dich, N., Doan, S. N., & Evans, G. W. (2015). Children's emotionality moderates the association between maternal responsiveness and allostatic load: Investigation into differential susceptibility. *Child Development*, *86*(3), 936–944. https://doi.org/10.1111/cdev.12346

Domínguez, X., Vitiello, V. E., Maier, M. F., & Greenfield, D. B. (2010). A longitudinal examination of young children's learning behavior: Child-level and classroom-level predictors of change throughout the preschool year. *School Psychology Review*, *39*(1), 29–47. https://doi.org/10.1080/02796015.2010.12087788

Domitrovich, C. E., Cortes, R. C., & Greenberg, M. T. (2007). Improving young children's social and emotional competence: A randomized trial of the preschool 'PATHS' curriculum. *The Journal of Primary Prevention*, *28*(2), 67–91. https://doi.org/10.1007/s10935-007-0081-0

Drake, J. E. (2019). Examining the psychological and psychophysiological benefits of drawing over one month. *Psychology of Aesthetics, Creativity, and the Arts*, *13*(3), 338–347. https://doi.org/10.1037/aca0000179

Drake, J., Coleman, K., & Winner, E. (2011). Short-term mood repair through art: Effects of medium and strategy. *Art Therapy: Journal of the American Art Therapy Association*, *28*(1), 26–30. https://doi.org/10.1080/07421656.2011.557032

Drake, J. E., Hastedt, I., & James, C. (2016). Drawing to distract: Examining the psychological benefits of drawing over time. *Psychology of Aesthetics, Creativity & the Arts*, *10*(3), 325–331. https://doi.org/10.1037/aca0000064

Drake, J., & Winner, E. (2013). How children use drawing to regulate their emotions. *Cognition & Emotion*, *27*(3), 512–520. https://doi.org/10.1080/02699931.2012.720567

Duncan, G. J., & Brooks-Gunn, J. (2000). Family poverty, welfare reform, and child development. *Child development*, *71*(1), 188-196. https://doi.org/10.1111/1467-8624.00133

Dwyer, M. C. (2011). *Reinvesting in arts education: Winning America's future through creative schools.* President's Committee on the Arts and the Humanities. https://www.arts.gov/sites/default/files/ReinvestinginArtsEducation.pdf

Eiden, R. D., Veira, Y., & Granger, D. A. (2009). Prenatal cocaine exposure and infant cortisol reactivity. *Child Development, 80*(2), 528–543 https://doi.org/10.1111/j.1467-8624.2009.01277.x

Eisner, E. W. (1998). Does experience in the arts boost academic achievement? *Arts Education Policy Review, 100*(1), 32–40. https://doi.org/10.1080/10632919809599448

Ekman, P., Friesen, W. V., & Ellsworth, P. (1972). *Emotion in the human face: Guidelines for research and an integration of findings.* Pergamon Press.

Evans, G. W. (2003). A multimethodological analysis of cumulative risk and allostatic load among rural children. *Developmental Psychology*, *39*(5), 924–933.

Evans, G. W. (2004). The environment of childhood poverty. *American Psychologist*, *59*(2), 77–92. https://doi.org/10.1037/0003-066X.59.2.77

Evans, G. W., & English, K. (2002). The environment of poverty: Multiple stressor exposure, psychophysiological stress, and socioemotional adjustment. *Child Development*, *73*(4), 1238–1248. https://doi.org/10.1111/1467-8624.00469

Evans, G. W., & Kim, P. (2007). Childhood poverty and health: Cumulative risk exposure and stress dysregulation. *Psychological Science*, *18*(11), 953–957. https://doi.org/10.1111/j.1467-9280.2007.02008.x

Evans, G. W., & Kim, P. (2012). Childhood poverty and young adults' allostatic load: The mediating role of childhood cumulative risk exposure. *Psychological Science*, *23*(9), 979–983. https://doi.org/10.1177/0956797612441218

Evans, G. W., & Kim, P. (2013). Childhood poverty, chronic stress, self-regulation, and coping. *Child Development Perspectives*, *7*(1), 43–48. https://doi.org/10.1111/cdep.12013

Favara-Scacco, C., Smirne, G., Schilirò, G., & Di Cataldo, A. (2001). Art therapy as support for children with leukemia during painful procedures. *Medical and Pediatric Oncology*, *36*(4), 474–480. https://doi.org/10.1002/mpo.1112

Fisher, P. A., Stoolmiller, M., Gunnar, M. R., & Burraston, B. O. (2007). Effects of a therapeutic intervention for foster preschoolers on diurnal cortisol activity. *Psychoneuroendocrinology*, *32*(8), 892–905. https://doi.org/10.1016/j.psyneuen.2007.06.008

Fortunato, C. K., Dribin, A. E., Granger, D. A., & Buss, K. A. (2008). Salivary alpha-amylase and cortisol in toddlers: Differential relations to affective behavior. *Developmental Psychobiology*, *50*(8), 807–818. https://doi.org/10.1002/dev.20326

Freilich, R., & Shechtman, Z. (2010). The contribution of art therapy to the social, emotional, and academic adjustment of children with learning disabilities. *The Arts in Psychotherapy*, *37*(2), 97–105. https://doi.org/10.1016/j.aip.2010.02.003

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

Graziano, P. A., Reavis, R. D., Keane, S. P., & Calkins, S. D. (2007). The role of emotion regulation in children's early academic success. *Journal of school psychology*, *45*(1), 3-19. https://doi.org/10.1016/j.jsp.2006.09.002

Griffin, J. P., Jr., & Miller, E. (2007). A research practitioner's perspective on culturally relevant prevention: Scientific and practical considerations for community-based programs. *Counseling Psychologist*, *35*(6), 850–859. http://doi.org/10.1177/0011000007307999

Gunnar, M. R., & Adam, E. K. (2012). Physiological measures of emotion from a developmental perspective: State of the science: The hypothalamic–pituitary–adrenocortical system and emotion: Current wisdom and future directions. *Monographs of the Society for Research in Child Development*, *77*(2), 109–119. https://doi.org/10.1111/j.1540-5834.2011.00669.x

Gunnar, M. R., & Cheatham, C. L. (2003). Brain and behavior interfaces: Stress and the developing brain. *Infant Mental Health Journal*, *24*(3), 195–211. https://doi.org/10.1002/imhj.10052

Gunnar, M. R., Vazquez, D. M. (2001). Low cortisol and a flattening of expected daytime rhythm: Potential indices of risk in human development. *Developmental and Psychopathology*, *13*(3), 515–38. https://doi.org/10.1017/s0954579401003066

Haiblum-Itskovitch, S., Czamanski-Cohen, J., & Galili, G. (2018). Emotional response and changes in heart rate variability following art-making with three different art materials. *Frontiers in Psychology*, *9*, 968. https://doi.org/10.3389/fpsyg.2018.00968

Hall, H. R. (2007). Poetic expressions: Students of color express resiliency through metaphors and similes. *Journal of Advanced Academics*, *18*(2), 216–244. https://doi.org/10.4219/jaa-2007-355

Haltigan, J. D., Roisman, G. I., Susman, E. J., Barnett-Walker, K., & Monahan, K. C. (2011). Elevated trajectories of externalizing problems are associated with lower awakening cortisol levels in midadolescence. *Developmental Psychology*, *47*(2), 472–478. https://doi.org/10.1037/a0021911

Harms, T., Clifford, R., & Cryer, D. (2015). *Early childhood environment rating scale* (3rd ed.). Teachers College Press.

Harris, M. A., Brett, C. E., Starr, J. M., Deary, I. J., & McIntosh, A. M. (2016). Early-life predictors of resilience and related outcomes up to 66 years later in the 6-day sample of the 1947 Scottish mental survey. *Social Psychiatry and Psychiatric Epidemiology: The International Journal for Research in Social and Genetic Epidemiology and Mental Health Services*, *51*(5), 659–668. https://doi.org/10.1007/s00127-016-1189-4

Havighurst, S. S., Kehoe, C. E., Harley, A. E., Radovini, A., & Thomas, R. (2022). A randomized controlled trial of an emotion socialization parenting program and its impact on parenting, children's behavior and parent and child stress cortisol: Tuning in to Toddlers. *Behaviour Research and Therapy, 149*. https://doi.org/10.1016/j.brat.2021.104016

Hughes, F. P. (2010). *Children, play, and development* (4th ed.). SAGE publications.

Izard, C. E. (1971). *The face of emotion*. Appleton-Century-Crofts.

Izard, C. E. (1977). *Human emotions*. Plenum Press.

Izard, C. E. (1978). Emotions as motivators: An evolutionary-developmental perspective. In R. A. Dienstbier (Ed.), *Nebraska symposium on motivation.* (Vol. 26, pp. 163–200). University of Nebraska Press.

Izard, C. E. (1989). The structure and functions of emotions: Implications for cognition, motivation, and personality. In I. S. Cohen (Ed.), *The G. Stanley Hall lecture series.* (Vol. 9, pp. 39–73). American Psychological Association. https://doi.org/10.1037/10090-002

Izard, C. E. (1992). Basic emotions, relations among emotions, and emotion–cognition relations. *Psychological Review*, *99*(3), 561–565. https://doi.org/10.1037/0033-295X.99.3.561

Izard, C. E. (1993). *Organizational and motivational functions of discrete emotions.* Guilford Press.

Izard, C. E. (2002). Translating emotion theory and research into preventive interventions. *Psychological Bulletin*, *128*(5), 796–824. https://doi.org/10.1037/0033-2909.128.5.796

Izard, C. E., Ackerman, B. P., Schoff, K. M., & Fine, S. E. (2000). Self-organization of discrete emotions, emotion patterns, and emotion–cognition relations. In M. D. Lewis & I. Granic (Eds.), *Emotion, development, and self-organization: Dynamic systems approaches to emotional development.* (pp. 15–36). Cambridge University Press. https://doi.org/10.1017/CBO9780511527883.003

Izard, C. E., Fine, S., Mostow, A., Trentacosta, C., & Campbell, J. A. N. (2002). Emotion processes in normal and abnormal development and preventive intervention. *Development and Psychopathology*, *14*(4), 761-787. https://doi.org/10.1017/S0954579402004066

Izard, C. E., King, K. A., Trentacosta, C. J., Morgan, J. K., Laurenceau, J., Krauthamer-Ewing, E. S., & Finlon, K. J. (2008). Accelerating the development of emotion competence in Head Start children: Effects on adaptive and maladaptive behavior. *Development and Psychopathology, 20*(1), 369–397. https://doi.org/10.1017/S0954579408000175

Izard, C. E., Dougherty, L., & Hembree, E. (1989). *A system for identifying affect expressions by holistic judgments (Affex)* (rev. ed.). University of Delaware Media Sources

Izard, C. E., Trentacosta, C. J., King, K. A., & Mostow, A. J. (2004). An emotion-based prevention program for Head Start children. *Early Education and Development*, *15*(4), 407–422.

Johnson, S. B., Riis, J. L., & Noble, K. G. (2016). State of the art review: Poverty and the developing brain. *Pediatrics, 137*(4), 1–16.

Kaimal, G., Ray, K., & Muniz, J. (2016). Reduction of cortisol levels and participants' responses following art making. *Art therapy: Journal of the American Art Therapy Association*, *33*(2), 74–80. https://doi.org/10.1080/07421656.2016.1166832

Karin, O., Raz, M., Tendler, A., Bar, A., Korem Kohanim, Y., Milo, T., and Alon, U. (2020). A new model for the HPA axis explains dysregulation of stress hormones on the timescale of weeks. *Molecular Systems Biology*, *16*(7), e9510. https://doi.org/10.15252/msb.20209510

Kimport, E. R., & Robbins, S. J. (2012). Efficacy of creative clay work for reducing negative mood: A randomized controlled trial. *Art Therapy: Journal of the American Art Therapy Association*, *29*(2), 74–79. https://doi.org/10.1080/07421656.2012.680048

Kliewer W, Reid-Quiñones K, Shields BJ, & Foutz L. (2009). Multiple risks, emotion regulation skill, and cortisol in low-income African American youth: a prospective study. *Journal of Black Psychology*, *35*(1), 24–43. https://doi.org/10.1177/0095798408323355

Koball, H., Moore, A, & Hernandez, J. (2021, April). *Basic facts about low-income children: Children under 9 years, 2019.* New York: National Center for Children in Poverty, Bank

Street College of Education. https://www.nccp.org/wp-content/uploads/2021/03/NCCP_FactSheets_Under-9-Years_FINAL-5.pdf

Law, M., Minissale, G., Lambert, A., Nater, U. M., Skoluda, N., Ryckman, N., Tahara-Eckl, L., Bandzo, M., & Broadbent, E. (2020). Viewing landscapes is more stimulating than scrambled images after a stressor: A cross-disciplinary approach. *Frontiers in Psychology, 10*. https://doi.org/10.3389/fpsyg.2019.03092

Lo, S. L., Gearhardt, A. N., Fredericks, E. M., Katz, B., Sturza, J., Kaciroti, N., Gonzalez, R., Hunter, C. M., Sonneville, K., Chaudhry, K., Lumeng, J. C., & Miller, A. L. (2021). Targeted self-regulation interventions in low-income children: Clinical trial results and implications for health behavior change. *Journal of Experimental Child Psychology, 208*. https://doi.org/10.1016/j.jecp.2021.105157

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. *Development and psychopathology, 13*(3), 653–676. https://doi.org/10.1017/s0954579401003133

Lupien, S. J., McEwen, B. S., Gunnar, M. R., & Heim, C. (2009). Effects of stress throughout the lifespan on the brain, behaviour and cognition. *Nature Reviews. Neuroscience*, *10*(6), 434–445. https://doi.org/10.1038/nrn2639

Macpherson, H., Hart, A., & Heaver, B. (2016). Building resilience through group visual arts activities: Findings from a scoping study with young people who experience mental health complexities and/or learning difficulties. *Journal of Social Work, 16*(5), 541–560. https://doi.org/10.1177/1468017315581772

Maheswari, M., & Evency, A. R. (2021). Effectiveness of art therapy on level of anxiety among hospitalized school age children in a selected hospital at Kanyakumari district. *International Journal of Nursing Education, 13*(4), 30–33. https://doi.org/10.37506/ijone.v13i4.16584

McEwen, B. S. (2013). The brain on stress: Toward an integrative approach to brain, body, and behavior. *Perspectives on Psychological Science, 8*(6), 673–675. https://doi.org/10.1177%2F1745691613506907

McEwen, B. S., & Gianaros, P. J. (2010). Central role of the brain in stress and adaptation: Links to socioeconomic status, health, and disease. *Annals of the New York Academy of Sciences, 1186*(1), 190–222. https://doi.org/10.1111/j.1749-6632.2009.05331.x

McEwen, B.S., & Morrison, J.H. (2013). The brain on stress: Vulnerability and plasticity of the prefrontal cortex over the life course. *Neuron, 79*(1), 16-29. https://doi.org/10.1016/j.neuron.2013.06.028

McLoyd, V. C. (1990). The impact of economic hardship on Black families and children: Psychological distress, parenting, and socioemotional development. *Child Development, 61*(2), 311–346. https://doi.org/10.2307/1131096

McLoyd, V. C. (1998). Socioeconomic disadvantage and child development. *American psychologist, 53*(2), 185. https://doi.org/10.1037/0003-066X.53.2.185

Miller, A. L., Fine, S. E., Kiely Gouley, K., Seifer, R., Dickstein, S., & Shields, A. (2006). Showing and telling about emotions: Interrelations between facets of emotional competence and associations with classroom adjustment in Head Start preschoolers. *Cognition and Emotion, 20*(8), 1170-1192. https://doi.org/10.1080/02699930500405691

Miller, G. E., Chen, E., Fok, A. K., Walker, H., Lim, A., Nicholls, E. F., Cole, S., & Kobor, M. S. (2009). Low early-life social class leaves a biological residue manifested by decreased glucocorticoid and increased proinflammatory signaling. *Proceedings of the National Academy of Sciences of the United States of America*, *106*(34), 14716–14721. https://doi.org/10.1073/pnas.0902971106

Miller, G. E., Chen, E., & Zhou, E. S. (2007). If it goes up, must it come down? chronic stress and the hypothalamic-pituitary-adrenocortical axis in humans. *Psychological Bulletin*, *133*(1), 25–45. https://doi.org/10.1037/0033-2909.133.1.25

Mullaney-Loss, P., & Rhee, N. (2021). *State Arts Agency Revenues, Fiscal Year 2021*. National Assembly of State Arts Agencies. https://nasaa-arts.org/wp-content/uploads/2021/02/NASAA-FY2021-State-Arts-Agency-Revenues-Report.pdf

Neitzel, J. (2018). What measures of program quality tell us about the importance of executive function: implications for teacher education and preparation. *Journal of Early Childhood Teacher Education*, *39*(3), 181–192. https://doi.org/10.1080/10901027.2018.1457580

Pagliaccio, D., Luby, J. L., Bogdan, R., Agrawal, A., Gaffrey, M. S., Belden, A. C., Botteron, K. N., Harms, M. P., & Barch, D. M. (2015). Amygdala functional connectivity, HPA axis genetic variation, and life stress in children and relations to anxiety and emotion regulation. *Journal of Abnormal Psychology*, *124*(4), 817–833. https://doi.org/10.1037/abn0000094

Perzow, S. E. D., Bray, B. C., Wadsworth, M. E., Young, J. F., & Hankin, B. L. (2021). Individual differences in adolescent coping: Comparing a community sample and a low SES sample to understand coping in context. *Journal of Youth & Adolescence*, *50*(4), 693–710. https://doi.org/10.1007/s10964-021-01398-z

Pianta, R., Downer, J., & Hamre, B. (2016). Quality in early education classrooms: Definitions, gaps, and systems. *Future of Children, 26*(2), 119–137.

Pianta, R. C., La Paro, K. M., & Hamre, B. K. (2008). *Classroom assessment scoring system, pre-k (CLASS-PreK).* Brookes Pub. Co.

Plucker, J. A., & Makel, M. C. (2021). Replication is important for educational psychology: Recent developments and key issues. *Educational Psychologist, 56*(2), 90–100. https://doi.org/10.1080/00461520.2021.1895796

Popović, Z. B., & Thomas, J. D. (2017). Assessing observer variability: a user's guide. *Cardiovascular Diagnosis and Therapy*, *7*(3), 317–324. https://doi.org/10.21037/cdt.2017.03.12

Raver, C. C., Blair, C., & Willoughby, M. (2013). Poverty as a predictor of 4-year-olds' executive function: New perspectives on models of differential susceptibility. *Developmental Psychology*, *49*(2), 292–304.

Raver, C. C., Garner, P. W., & Smith-Donald, R. (2007). The roles of emotion regulation and emotion knowledge for children's academic readiness: Are the links causal? In R. C. Pianta, M. J. Cox, & K. L. Snow (Eds.), *School readiness and the transition to kindergarten in the era of accountability.* (pp. 121–147). Paul H Brookes Publishing.

Raver, C. C., Jones, S. M., Li-Grining, C., Zhai, F., Bub, K., & Pressler, E. (2011). CSRP's impact on low-income preschoolers' preacademic skills: self-regulation as a mediating mechanism. *Child Development*, *82*(1), 362–378. https://doi.org/10.1111/j.1467-8624.2010.01561.x

Raver, C. C., Li-Grining, C., Metzger, M. W., Jones, S. M., Zhai, F. & Solomon, B. (2009). Targeting children's behavior problems in preschool classrooms: A cluster-randomized

controlled trial. *Journal of Consulting & Clinical Psychology*, *77*(2), 302–316. https://doi.org/10.1037/a0015302

Reilly, S. E., & Downer, J. T. (2019). Roles of executive functioning and language in developing low-income preschoolers' behavior and emotion regulation. *Early childhood research quarterly*, *49*, 229-240. https://doi.org/10.1016/j.ecresq.2019.07.006

Robb, A. (2021). Children talking about their experiences of visual art in and out of the classroom: a systematic literature review. *International Journal of Student Voice, 6*(2).

Roisman, G. I., Susman, E., Barnett-Walker, K., Booth-LaForce, C., Owen, M. T., Belsky, J., Bradley, R. H., Houts, R., & Steinberg, L. (2009). Early family and child-care antecedents of awakening cortisol levels in adolescence. *Child Development*, *80*(3), 907–920. https://doi.org/10.1111/j.1467-8624.2009.01305.x

Rollins, J., Rollins, C., Boocks, L. A., & Sitz, T. (2020). Supporting children living with chronic medical conditions through empathetic art. *Journal of Child & Family Studies*, *29*(8), 2218–2233. https://doi.org/10.1007/s10826-020-01738-w

Rappolt-Schlichtmann, G., Willett, J. B., Ayoub, C. C., Lindsley, R., Hulette, A. C., & Fischer, K. W. (2009). Poverty, relationship conflict, and the regulation of cortisol in small and large group contexts at child care. *Mind, Brain & Education*, *3*(3), 131–142. https://doi.org/10.1111/j.1751-228X.2009.01063.x

Sajaniemi, N., Suhonen, E., Hotulainen, R., Tormanen, M., Alijoki, A., Nislin, M., & Kontu, E. (2014). Demographic factors, temperament and the quality of the preschool environment as predictors of daily cortisol changes among Finnish six-year-old children. *European Early Childhood Education Research Journal*, *22*(2), 286–306. https://doi.org/10.1080/1350293X.2013.783303

Sajaniemi, N., Suhonen, E., Kontu, E., Rantanen, P., Lindholm, H., Hyttinen, S., & Hirvonen, A. (2011). Children's cortisol patterns and the quality of the early learning environment. *European Early Childhood Education Research Journal*, *19*(1), 45–62. https://doi.org/10.1080/1350293X.2011.548938

Sandmire, D. A., Gorham, S. R., Rankin, N. E., & Grimm, D. R. (2012). The influence of art making on anxiety: A pilot study. *Art Therapy: Journal of the American Art Therapy Association*, *29*(2), 68–73. https://doi.org/10.1080/07421656.2012.683748

Schweizer, C., Knorth, E. J., van Yperen, T. A., & Spreen, M. (2020). Evaluation of 'Images of Self,' an art therapy program for children diagnosed with autism spectrum disorders (ASD). *Children and Youth Services Review*, *116*. https://doi.org/10.1016/j.childyouth.2020.105207

Seery, M. D., Holman, E. A., & Silver, R. C. (2010). Whatever does not kill us: cumulative lifetime adversity, vulnerability, and resilience. *Journal of personality and social psychology*, *99*(6), 1025–1041. https://doi.org/10.1037/a0021344

Sergerie, K., Chochol, C., & Armony, J. L. (2008). The role of the amygdala in emotional processing: A quantitative meta-analysis of functional neuroimaging studies. *Neuroscience & Biobehavioral Reviews*, *32*(4), 811–830. https://doi.org/10.1016/j.neubiorev.2007.12.002

Shirtcliff, E. A., Granger, D. A., Booth, A., & Johnson, D. (2005). Low salivary cortisol levels and externalizing behavior problems in youth. *Development and Psychopathology*, *17*(1), 167–184. https://doi.org/10.1017/S0954579405050091

Siegel, J., Iida, H., Rachlin, K., & Yount, G. (2016). Expressive arts therapy with hospitalized children: A pilot study of co-creating healing sock creatures. *Journal of Pediatric Nursing*, *31*(1), 92–98. https://doi.org/10.1016/j.pedn.2015.08.006

Simons, R. L., Murry, V., McLoyd, V., Lin, K. H., Cutrona, C., & Conger, R. D. (2002). Discrimination, crime, ethnic identity, and parenting as correlates of depressive symptoms among African American children: A multilevel analysis. *Development and psychopathology*, *14*(2), 371-393. https://doi.org/10.1017/S0954579402002109

Sims, M., Guilfoyle, A., & Parry, T. S. (2006). Children's cortisol levels and quality of child care provision. *Child: Care, Health & Development*, *32*(4), 453–466. https://doi.org/10.1111/j.1365-2214.2006.00632.x

Smolarski, K., Leone, K., & Robbins, S. J. (2015). Reducing negative mood through drawing: Comparing venting, positive expression, and tracing. *Art Therapy: Journal of the American Art Therapy Association*, *32*(4), 197–201. https://doi.org/10.1080/07421656.2015.1092697

Solomon, T., Plamondon, A., O'Hara, A., Finch, H., Goco, G., Chaban, P., Huggins, L., Ferguson, B., & Tannock, R. (2018). A cluster randomized-controlled trial of the impact of the Tools of the Mind curriculum on self-regulation in Canadian preschoolers. *Frontiers in psychology*, *8*, 2366. https://doi.org/10.3389/fpsyg.2017.02366

Takacs, Z. K., & Kassai, R. (2019). The efficacy of different interventions to foster children's executive function skills: A series of meta-analyses. *Psychological Bulletin*, *145*(7), 653–697. https://doi.org/10.1037/bul0000195

Tanaka, S., Komagome, A., Iguchi-Sherry, A., Nagasaka, A., Yuhi, T., Higashida, H., Rooksby, M., Kikuchi, M., Arai, O., Minami, K., Tsuji, T., & Tsuji, C. (2020). Participatory art

activities increase salivary oxytocin secretion of ASD children. *Brain sciences*, *10*(10), 680. https://doi.org/10.3390/brainsci10100680

Tomkins, S. S. (1962). *Affect, imagery, consciousness. Vol I: The positive affects.* Springer. https://doi.org/10.1037/14351-000

Tomkins, S. S. (1963). *Affect, imagery, consciousness. Vol II: The negative affects*. Springer.

Tout, K., de Haan, M., Campbell, E. K., & Gunnar, M. R. (1998). Social behavior correlates of cortisol activity in child care: Gender differences and time-of-day effects. *Child Development*, *69*(5), 1247–1262. https://doi.org/10.2307/1132263

Toyoshima, K., Fukui, H., & Kuda, K. (2011). Piano playing reduces stress more than other creative art activities. *International Journal of Music Education*, *29*(3), 257–263. http://doi.org/10.1177/0255761411408505

Trentacosta, C. J., & Izard, C. E. (2007). Kindergarten children's emotion competence as a predictor of their academic competence in first grade. *Emotion*, *7*(1), 77–88. https://doi.org/10.1037/1528-3542.7.1.77

Ursache, A., Blair, C., & Raver, C. C. (2012). The promotion of self-regulation as a means of enhancing school readiness and early achievement in children at risk for school failure. *Child Development Perspectives*, *6*(2), 122–128. https://doi.org/10.1111/j.1750-8606.2011.00209.x

Ursache, A., Dawson-McClure, S., Siegel, J., & Brotman, L. M. (2019). Predicting early emotion knowledge development among children of colour living in historically disinvested neighbourhoods: consideration of child pre-academic abilities, self-regulation, peer relations and parental education. *Cognition & Emotion*, *33*(8), 1562–1576. https://doi.org/10.1080/02699931.2019.1587388

van der Vennet, R., & Serice, S. (2012). Can coloring mandalas reduce anxiety? A replication study. *Art Therapy: Journal of the American Art Therapy Association*, *29*(2), 87–92. https://doi.org/10.1080/07421656.2012.680047

Vermeer, H. J., & van IJzendoorn, M. H. (2006). Children's elevated cortisol levels at daycare: A review and meta-analysis. *Early Childhood Research Quarterly*, *21*(3), 390–401. https://doi.org/10.1016/j.ecresq.2006.07.004

Wan, Y., Ludwig, M. J., & Boyle, A. (2018). *Review of evidence: Arts education through the lens of ESSA.* American Institutes for Research. https://files.eric.ed.gov/fulltext/ED591872.pdf

Watamura, S. E., Coe, C. L., Laudenslager, M. L., & Robertson, S. S. (2010). Child care setting affects salivary cortisol and antibody secretion in young children. *Psychoneuroendocrinology*, *35*(8), 1156–1166. https://doi.org/10.1016/j.psyneuen.2010.02.001

Watamura, S. E., Kryzer, E. M., & Robertson, S. S. (2009). Cortisol patterns at home and child care: Afternoon differences and evening recovery in children attending very high quality full-day center-based child care. *Journal of Applied Developmental Psychology*, *30*(4), 475–485. https://doi.org/10.1016/j.appdev.2008.12.027

Zimmermann, L. K., & Stansbury, K. (2004). The influence of emotion regulation, level of shyness, and habituation on the neuroendocrine response of three-year-old children. *Psychoneuroendocrinology*, *29*(8), 973–982. https://doi.org/10.1016/j.psyneuen.2003.09.003

Appendix A

IRB Approval Document

WCU
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Office of Research and Sponsored Programs | West Chester University | Wayne Hall
West Chester, PA 19383 | 610-436-3557 | www.wcupa.edu

TO: Eleanor Brown
FROM: Nicole M. Cattano, Ph.D.
Co-Chair, WCU Institutional Review Board (IRB)
DATE: 7/14/2021

Protocol ID # 20140914-R7

Project Title: Children's Learning and Emotions in an Arts Enriched Preschool
Date of Approval for Revision: 7/14/2021**

☒**Expedited Approval**

This protocol has been approved under the new updated 45 CFR 46 common rule that went in to effect January 21, 2019. As a result, this project will not require continuing review. Any revisions to this protocol that are needed will require approval by the WCU IRB. Upon completion of the project, you are expected to submit appropriate closure documentation. Please see www.wcupa.edu/research/irb.aspx for more information.

Any adverse reaction by a research subject is to be reported immediately through the Office of Research and Sponsored Programs via email at irb@wcupa.edu.

Signature:

Co-Chair of WCU IRB

WCU Institutional Review Board (IRB)
IORG#: IORG0004242
IRB#: IRB00005030
FWA#: FWA00014155

Appendix B: Tables

Table 1

Means and Standard Deviations for Cortisol Samples and Interest

	Cortisol (*n = 69*)			Interest (*N = 72*)		
	Obs.	Raw	Log	Obs.	*M (SD)*	*%*
Visual Arts	355	0.16 (0.30)	-0.91 (0.25)	377	14.67 (0.75)	98
Comparison	2584	0.44 (7.49)	-0.84 (0.31)	1850	14.21 (1.39)	95
All Classes						
9:00 a.m.	600	1.00 (13.93)	-0.66 (0.33)			
10:30 a.m.	575	0.48 (7.02)	-0.93 (0.31)	576	14.23 (1.27)	95
12:00 p.m.	588	0.16 (0.39)	-0.94 (0.25)	595	14.07 (1.54)	94
1:30 p.m.	590	0.20 (0.46)	-0.84 (0.28)	577	14.36 (1.33)	96
3:00 p.m.	587	0.18 (0.32)	-0.88 (0.25)	479	14.52 (0.97)	97

Note. Obs. = number of observations nested within participants. Cortisol was measured in *µg/dl*. *%* shows the average percentage of time in minutes that children showed interest as their predominant emotion during 15-minute observations.

Table 2

Hierarchical Linear Model of Visual Arts Classes in Relation to Interest (n = 3510 Observations Nested within 72 participants).

Fixed Effect	*B*	*SE*	*t*	*~d.f.*	*p*
For intercept 1, β_0					
Intercept 2, γ_{00}	13.98	.08	183.38	73	< .001***
Child age, γ_{01}	-0.04	.01	-3.68	73	< .001***
For time-of-day slope, β_1					
Intercept 2, γ_{10}	0.00	.00	4.09	2127	< .001***
Child age, γ_{11}	0.00	.00	2.90	2127	.004**
For visual arts class slope, β_2					
Intercept 2, γ_{20}	0.33	.06	5.60	2127	< .001***
Child age, γ_{21}	-0.02	.01	-2.07	2127	.039*

Note. Age was measured in months. Random effects were estimated.

*p < .05. **p < .01. ***p < .001

Table 3

Hierarchical Linear Model of Visual Arts Classes in Relation to Cortisol (n = 2914 Observations Nested within 69 participants).

Fixed Effect	*B*	*SE*	*t*	*~d.f.*	*p*
For intercept 1, β_0					
Intercept 2, γ_{00}	-0.78	.02	-45.50	72	< .001***
Child age, γ_{01}	-0.01	.00	-3.70	72	< .001***
For time-of-day slope, β_1					
Intercept 2, γ_{10}	0.00	.00	-8.32	2806	< .001***
Child age, γ_{11}	0.00	.00	1.16	2806	.247
For visual arts class slope, β_2					
Intercept 2, γ_{20}	-0.05	.02	-2.99	2806	.003**
Child age, γ_{21}	0.00	.00	1.28	2806	.200

Note. Age was measured in months. Log cortisol was measured in *ul/dl*. Random effects were estimated.

*p < .05. **p < .01. ***p < .001

Table 4

Hierarchical Linear Model of Visual Arts Activities in Relation to Interest (n = 3003 Observations Nested within 72 participants)

Fixed Effect	*B*	*SE*	*t*	~*d.f.*	*p*
For intercept 1, β_0					
Intercept 2, γ_{00}	13.99	.07	189.28	71	< .001***
Child age, γ_{01}	-0.05	.01	-4.03	71	< .001***
For time-of-day slope, β_1					
Intercept 2, γ_{10}	0.00	.00	4.34	2014	< .001***
Child age, γ_{11}	0.00	.00	3.19	2014	.001**
For teacher arts table slope, β_2					
Intercept 2, γ_{20}	0.39	.07	5.71	2014	< .001***
Child age, γ_{21}	-0.03	.01	-2.75	2014	.006**
For clay table slope, β_3					
Intercept 2, γ_{30}	0.08	.15	0.55	2014	.585
Child age, γ_{31}	-0.02	.02	-0.99	2014	.320
For drawing table slope, β_4					
Intercept 2, γ_{40}	0.25	.10	2.64	2014	.008**
Child age, γ_{41}	-0.02	.02	-1.04	2014	.297
For painting table slope, β_5					
Intercept 2, γ_{50}	0.49	.10	4.71	2014	< .001***
Child age, γ_{51}	0.00	.01	0.00	2014	.999

Note. Age was measured in months. Random effects were estimated.

*p < .05. **p < .01. ***p < .001

Table 5

Hierarchical Linear Model of Visual Arts Activities in Relation to Cortisol (n = 2914 Observations Nested within 69 participants)

Fixed Effect	*B*	*SE*	*t*	~*d.f.*	*p*
For intercept 1, β_0					
Intercept 2, γ_{00}	-0.78	.02	-40.25	72	< .001***
Child age, γ_{01}	-0.01	.00	-2.66	72	.010*
For time-of-day slope, β_1					
Intercept 2, γ_{10}	0.00	.00	-6.44	2796	< .001***
Child age, γ_{11}	0.00	.00	0.66	2796	.512
For teacher arts table slope, β_2					
Intercept 2, γ_{20}	-0.07	.02	-2.69	2796	.007**
Child age, γ_{21}	0.01	.00	2.22	2796	.027*
For clay table slope, β_3					
Intercept 2, γ_{30}	-0.04	.04	-1.06	2796	.290
Child age, γ_{31}	0.01	.01	1.25	2796	.210
For drawing table slope, β_4					
Intercept 2, γ_{40}	-0.04	.02	-1.51	2796	.131
Child age, γ_{41}	0.00	.00	-0.78	2796	.434
For painting table slope, β_5					
Intercept 2, γ_{50}	0.01	.02	0.48	2796	.628
Child age, γ_{51}	0.01	.00	1.81	2796	.071

Note. Age was measured in months. Log cortisol was measured in *ul/dl*. Random effects were estimated.

*$p < .05$. **$p < .01$. ***$p < .001$