CHILDREN'S BODY IMAGE ACCURACY AND VISUAL SPATIAL ABILITIES

by

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Masters of Clinical Psychology

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August 2015

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ACKNOWLEDGEMENTS

As my graduate experience comes to an end, I am in awe of all of the support from family and friends that got me to this point. I have grown not only professionally but personally as well. Specifically, I want to thank Dr. Ujcich Ward for her time and dedication to my professional development, Jeff Whitely for his patience and understanding, and Sandy Benson, my mother, for her incredible support both personally and academically. Of course, I am grateful for my amazing cohort at MTSU. All of the late night studying and support phone calls have finally paid off.

ABSTRACT

The purpose of this study was to evaluate children's body image inaccuracy as it relates to visual spatial abilities, BMI, gender, and age. This study was conducted at a local after-school program with children ages 6 to 13. Children rotated through assessment stations that included measures of height and weight, body figures, visuospatial tasks, and demographics. The findings indicate that BMI can significantly predict children's body image overestimations. Also, visual body image accuracy is significantly correlated with visuospatial abilities but verbal body image accuracy was not related to visuospatial skills. Lastly, the higher the child's BMI, the less developed his/her visuospatial skills are. It is essential to continue studying children's perception of their body image and how it relates to their body size to help prevent eating disorders and obesity.

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CHAPTER I

Literature Review

Anorexia Nervosa (AN) is a mental illness with a variety of potential negative effects for individuals. The disorder typically develops during adolescents or young adulthood (American Psychiatric Association, 2013). If identified and treated in its early stages, there may be a better chance at recovery (Morgan, Purgold, & Welbourne, 1983). Therefore, it is essential to identify psychological, environmental, social, and neuropsychological risk factors in children and adolescents to prevent or avoid further development of this debilitating disorder.

Recent research with adults with AN suggests a pattern of neuropsychological functioning, which includes impairment in measures of visuospatial functioning, central coherence, and executive functioning, but enhanced verbal fluency (e.g., Billingsley-Marshall et al., 2013; Castellini et al., 2013; Grunwald et al., 2001; Tenconi et al., 2010). It is unclear, however, if this pattern is a consequence of the disorder or if it existed prior to the onset of the disorder and may have contributed to the development of the eating disorder. Longitudinal research following individuals pre-disorder through the development and experience of AN would provide evidence of the pattern of neuropsychological development, but would be highly resource intensive and difficult due to identifying at risk individuals to follow. Research, however, is needed to clarify the relationship between eating disorder behaviors/factors and neuropsychological

functioning. One option is to assess these constructs in a non-disordered population. Children prior to adolescence such a population, as some may have early risk factors for the development of eating disorders (e.g., body dissatisfaction, inaccurate body perception).

Visuospatial functioning is a particularly interesting area of neuropsychological functioning to assess with these populations due to recent findings with adolescents and adults with AN. Recent neurological studies suggest that those with AN show more poorly developed visuospatial and visual memory abilities compared to healthy controls (e.g., Castellini et al., 2013; Danner et al., 2012; Grunwald et al., 2001; Nico et al., 2010; Stedal, Frampton, Landrø, & Lask, 2012). Only one study assessing visual perception with children with AN has been conducted (Rose, Frampton, & Lask, 2014), but their findings actually show enhanced visual memory compared to controls.

More studies are needed to understand the neuropsychological risks for AN. The purpose of the present thesis is to further explore potential neurological AN risk factors for children and adolescents who already display a psychological risk factor (i.e., body image distortion). By exploring the neuropsychological profile of children who may be in early stages of eating disorder development we may be able aid in early intervention and possibly prevent the development of the disorders.

The following review will further define these constructs and present the empirical findings of research with children specifically. Body image definitions and assessment modalities used to assess body image will be explained for clarification.

Then, empirical research on gender differences and body size as they related to body image accuracy will be described. Finally, a study is presented describing a study to assess body image estimation and visual perception in a sample of children.

Body Image Assessment and Definitions

Body image perception can be conceptualized in two different ways: satisfaction one has with one's own body and how accurately one can identify one's own body shape or size. Both satisfaction and accuracy are related to eating disorder behaviors and both may be related to gender as well as body size. These two constructs have been assessed clinically and in the research literature using both visual and verbal methods.

Body image accuracy and satisfaction have been measured using body figure images (e.g., Abbott, Lee, Stubbs, & Davies, 2010; Collins, 1991). Studies with children validate the use of Collins' body image figures, which are seven gender-matched body figures ranging from underweight to obese (e.g., Collins, 1991; Pallan, Hiam, Duda, & Adab, 2011). The child is asked which body figure looks most like his/her own body today. The perception then is compared with body mass index (BMI) and the amount of discrepancy between the two determines how accurately the individual identified his or her body image. A second question (e.g., "Which body figure would you like your body to look like?") can be asked to determine how satisfied the individual is with his/her current shape and size

Another way body image in children has been measured is verbally. Researchers ask the children to report their height, weight, and/or weight category (e.g., underweight,

about the right weight, and overweight). This report is then compared to their actual category based on BMI, which then determines if individuals are accurately placing themselves in the correct category (e.g., Khambalia, Hardy, & Bauman, 2011).

Gender Differences and Body Image Accuracy

Some gender differences are evident when assessing children's accuracy in describing and identifying their own body shapes and sizes. Compared to the opposite gender, adolescent boys are more likely to underestimate their weight and girls are more likely to overestimate their weight (Abbott et al., 2010; Khambalia et al., 2011; Park, 2011; Sisson, Franco, Carlin, & Michell, 1997). Method of assessment, however, seems to play a role in these findings (e.g., Saxton, Hill, Chadwick, & Wardle, 2009).

An early study from 1997 investigated body image accuracy in 9- to 15-year-old inner-city children. The children rated their weight as too thin, too fat, or just right. They found that girls' tendency was to overestimate their weight, but boys' tendency was to underestimate their weight compared to girls (Sisson et al., 1997). Later studies also found similar results such as a cross sectional study in adolescents in grades 7 through 12 in Australia (Khambalia et al. 2011). Using a verbal measure, they found that girls were more likely to overestimate when they were compared to boys. Another Australian sample of year 10 adolescents yielded similar results when using a verbal measure (Abbott et al., 2010). A different study of 87,418 high school students completed a verbal measure to assess students' height, weight, and weight category. The results indicated that boys were 5 times more likely than girls to underestimate rather than

overestimate their weight while girls were significantly more likely to overestimate their weight (Park, 2011).

It has been indicated that girls are more accurate in perceiving their body size than boys (Chung, Perrin, & Skinner, 2013; Pallan et al., 2011; Saxton et al., 2009). Pallan et al. (2011) studied children ages 5 to 7. They used Collin's body figures to assess body image accuracy. BMI percentiles were used to categorize the children into weight categories (i.e., underweight, healthy weight, overweight, or obese). The researchers found that girls' body image accuracy was correlated with weight status but boys' was not. Williamson and Delin (2000) used visual body figures to assess body image accuracy in 195 5-to 10-year-old children, but they did not find any differences between genders.

Both verbal and visual measures yield mixed results for body image accuracy and gender. Chung et al. (2013) found that girl's aged 8 to 15 more accurately identified themselves with the correct weight category according to their BMI than boys. Similarly, Abbott et al. (2010) found that year 10 overweight and obese girls were more accurate in identifying their body size verbally than boys. Saxton et al. (2009) assessed body image accuracy using both visual and verbal measures. When using the verbal measures, they did not find gender differences, potentially because the majority of the individuals placed themselves in the "just right" category.

Visual measures of body image accuracy also have this pattern of inconsistency with gender. Gessell et al. (2010) and Parkinson et al. (1998) found no gender

differences in accuracy of weight perception. Pallan et al. (2011) and Saxton et al (2009), however, found that girls were more accurate than boys. Overall, gender accuracy is mixed, but some research suggests that girls are more accurate at identifying their shape and size both verbally and visually.

It has been suggested that age may be a factor affecting accuracy and body image. Maximova et al. (2008) found age and gender differences among children ages 13 and 16, but not at age 9 using a visual measure of body accuracy. Boys at age 14 were more likely than girls to overestimate their weight status, while not until age 16 were girls more likely to overestimate their weight status (Maximova et al., 2008). In a similarly designed study using a visual measure of body image accuracy, Williamson and Delin (2000), however, reported no age differences in an Australian sample of 5- to 10-year-old children.

Overall, there are gender differences with weight estimation and age (Abbott et al., 2010; Parkinson, Tovee, & Cohen-Tovee, 1998). Methodological issues need to be considered, however, because of the different results for the visual and verbal measures. When using a visual measure, some studies have found that girls are more accurate than boys (Pallan et al., 2011; Saxton et al., 2009). When using a verbal measure, girls are more likely to underestimate their weight, and boys are more likely to overestimate (Abbott et al. 2010; Khambalia et al., 2011; Park, 2011; Sisson et al. 1997). Additionally, weight estimation and age have yielded different results depending on the type of

measure used (Maximova et al., 2008; Sisson et al., 1997). There needs to be more research that uses both visual and verbal measures to clarify the discrepancies.

Body Size and Accuracy

Body image accuracy has been investigated in healthy populations, individuals with obesity, and individuals at risk for or having eating disorders. The obesity literature emphasizes body accuracy misperceptions as a major issue and one that needs to be addressed so that individuals can obtain a healthier weight (Brener, Eaton, Lowry, & McManus, 2004; Khambalia et al. 2011). There are a variety of factors that can affect one's body image accuracy such as if their parents are obese or if the child participates in a weight intervention (e.g., Gesell, Scott, & Barkin, 2010; Maximova et al. 2008).

The amount of exposure a child has to overweight or obese parents or schoolmates may affect his or her body image. Maximova et al. (2008) assessed perceived weight status using a visual measure (i.e., seven varying BMI gender-specific silhouettes) and actual weight status in children ages 9, 13, and 16. They found that children who had parents at home who were overweight or obese or attended a school that had a high average BMI were more likely to underestimate their body size. Consistent with the previous studies, they also found that children who were overweight or obese were more likely to underestimate their body size. From this study, it is possible that the child's environment may affect the way a child perceives his or her body size.

If the environment affects body size, a logical question to ask is if body image perceptions can be transformed if the child's environment changes. Gesell et al. (2010)

investigated this question by recruiting 61 overweight Latino children aged 8 to 11 to participate in an intervention study that included a control group. The children were assessed at baseline, 6 months, and 12 months. At each assessment, body image accuracy was taken using a visual measure, which was compared to his or her BMI. The intervention group participated in an hour exercise skills program once a month. They were taught how to exercise, play a variety of sports, and set goals. The control group was provided with general information about healthy lifestyles at baseline and 6 months. Although the researchers did not find significance between the groups post intervention, there was a trend towards significance with the intervention children being more accurate.

Studies assessing adolescents' body image accuracy often use comparisons of self- reported height and weight (used to calculated BMI) to their standard BMI category (e.g., underweight/too thin, normal weight/about the right weight, or overweight/obese/too fat). Khambalia et al. (2011) found that one third of seventh through twelfth graders did not correctly identify their body size when using a verbal measure. Additionally, individuals in this study who were overweight and obese were more likely to underestimate their body size and individuals who were underweight were more likely to overestimate their body size. A similar verbal measure study with a larger sample size (n = 87,418) of high school students found that more than one fourth of the students inaccurately identified their body size (Park, 2011). Park (2011) reported patterns of inaccuracy such as individuals who were underweight overestimated their

body size, and individuals who were obese underestimated their body size. Saxton et al. (2009) found that most children aged 7 to 9 years slightly underestimated their body size, but children with higher BMIs significantly underestimated his or her body size using a visual measure. Saxton et al. also reported an interaction with gender and body size. Girls with healthy BMIs were more accurate than healthy weight boys, but girls who were obese were less accurate than boys who were obese.

Another study assessed body accuracy of height and weight using a verbal measure (i.e., self-report) and had a researcher weigh and take their height (Brener et al., 2004). The 2,032 high school students were asked, "How do you describe your weight?" and picked from choices: very underweight, underweight, about the right weight, overweight, and very overweight. The researchers found that one fourth of the overweight respondents described themselves as underweight. Twenty percent of students who were underweight (i.e., less than or equal to the fifth percentile) and 15.8% of students at risk for being underweight (i.e., sixth to fifteenth percentile) rated his or her self as about the right weight.

Although the self-reported BMI measures are commonly utilized in body image studies, there are concerns about their accuracy. Williamson and Delin (2000) discovered a discrepancy between actual BMI and reported BMI. When the researchers took their height and weight, more students were overweight or at risk for being overweight when compared to the child's self-report.

One issue in body size accuracy is that age and methodology may be a determinate for body image accuracy. A study done in Australia suggests that children aged 5 to 10 can accurately identify their body size when using visual measures regardless of BMI (Williamson & Delin, 2000). To the contrary, Chung et al. (2013) found that 12 to 15 year old adolescents more accurately identified if they were overweight or obese than 8 to 11 year old children when using a verbal measure. The differences in accuracy and age could be that Chung et al. used verbal measures instead of visual measures for the younger children.

Another issue in the literature is that the extremes (i.e., obese or underweight) may be skewing the data. Parkinson, Tovee, and Cohen-Tovee (1998) investigated body image accuracy in a healthy population of fourth to fifth grade children. They excluded children who's BMI was significantly different from the norm, and they found that the visual body image score was correlated with weight status. Because this study did not include overweight and underweight children, it is possible that healthy weight children are more accurate than children at higher or lower weights.

Collectively, these studies suggest that the two extremes (i.e. underweight or obese) do not accurately perceive their weight, but children in the healthy range can accurately identify their body size (Khambalia et al., 2011; Park, 2011; Parkinson et al., 1998). Children who are younger (e.g., 4^{th} to 5^{th} grade) are accurate in perceiving their body size when using a visual measure (Parkinson et al.1998). Further research is needed, however, to investigate the difference in visual and verbal measures in younger

children with a variety of body shapes and sizes to clarify the relationship between accuracy in body image perception, age, and body size.

Visuospatial Functioning and Body Image in Children

Little is known about the neuropsychological profile in children with eating disorders or at risk. Two studies have investigated the neuropsychological functioning in children with or at risk for having an eating disorder (i.e., Kothari, Solmi, Treasure, & Micali, 2013; Rose et al., 2014). One study focused on children who had a diagnosis of AN. The researchers compared children with AN to children who did not have a diagnosis of AN (Rose et al., 2014). The second study recruited moms who had an eating disorder (i.e., AN or Bulimia Nervosa (BN), and assessed the neuropsychological functioning of their children, who were considered an at risk group for developing an eating disorder due to their mothers' eating disorder (Kothari et al. 2013).

Rose et al. (2014) studied 156 children aged 10 to 18. Half of the children had a diagnosis of AN; the other half served as healthy controls. The children were asked to engage in a visual memory task that required the children to copy the Rey Complex Figure Task onto a blank page. The researchers then asked the children to recreate the figure after 3 minutes passed and again after 30 minutes passed. After the long-term memory task, the children were presented with a series of figures and were asked if the images were in the model or not. The children with AN were more accurate in their drawings but took longer to copy the figure than the healthy controls. Additionally, children were administered the Wechsler Abbreviated Scale of Intelligence (WASI). The

researchers found that children with AN scored significantly higher on the IQ test than the healthy controls.

Kothari et al. (2013) followed healthy children and children with moms that had an eating disorder from ages 8 to 10. At age 8, the children were administered the Wechsler Intelligence Scale for Children- Third Edition (WISC-III). The researchers found that children who were at risk for having an eating disorder had higher Full Scale IQ and Performance IQ scores than did children who were not at risk. Individual subtest scores also had differences not only between the children at risk and not at risk, but also between moms with AN verses moms with BN. Children whose mothers had BN scored lower on a visuospatial subtest (i.e., object assembly), and children whose mothers had AN scored higher on a sequential reasoning visual task (i.e., picture arrangement). Finally, children who had moms with AN scored significantly higher on the Perceptual Organization Index than the children who were not at risk. These data suggest that children who are at risk for having an eating disorder may show differences in neurological functioning and that the pattern may be different for different disorders.

Taken together, these two studies suggest that there may be cognitive differences in children with or at risk for eating disorders (Kothari et al., 2013; Rose et al., 2014), with some emphasis on visual-perceptual abilities. Rose et al. (2014) primarily focused on visual memory in adolescence not visuospatial abilities. Kothari et al. (2013) found preliminary support for visual perceptual increases among at risk children. These findings suggest a need for further studies to clarify these potential patterns and to

determine at what age the differences may occur and if these cognitive differences may be risk factors to developing AN or Bulimia.

Summary and Purpose of the Current Study

If AN manifests into adulthood, the recovery process is more difficult and the right parietal lobe may be dysfunctional (e.g., Castellini et al., 2013; Grunwald et al., 2001). Previous research has established that adults with eating disorders do not accurately perceive their own body size (Cash & Deagle, 1997). It is difficult to determine if this dysfunction is a consequence of the disorder or if the abnormality develops before the onset of the disorder. Few studies have been done with children with AN. One study indicated that adolescents with AN have better visual memory than the healthy control group (Rose et al., 2014). Another study found that children who were at risk for developing AN scored higher on perceptual organizational tasks than children who were not at risk (Kothari et al., 2013). Both of these studies, however, focus on a clinical or specific at-risk populations of children. Thus, the need to investigate children with inaccurate body perception (i.e., a risk factor for eating disorders) but without a clinical disorder is necessary to begin to address this question. This thesis explored the relationship between body image perception of children and their visuospatial abilities.

Studies with nonclinical samples of children regarding body image perception suggest gender and body size relationships. Gender differences are evident in body image accuracy (e.g., Abbott et al., 2010; Khambalia et al., 2011). These differences most commonly present as girls overestimating their body size and boys underestimating

their body size (e.g., Brener et al., 2004; Sission et al., 1997). Children who are underweight, overweight, and obese are less accurate than children who are a healthy weight at estimating their body size (e.g., Brener et al., 2004; Khambalia et al., 2011).

The current study was designed to examine the relationship between body image inaccuracy and visuospatial abilities among school age children with a variety of body sizes. Because of the relationship between body image inaccuracy and AN, this study focused on the connection between body image accuracy and visuospatial abilities as it may provide insight into measurable potential risk factors. Two primary goals of this project were to (1) assess the potential relationship between visuospatial skills and body image estimation, and (2) compare the visual and verbal methods of body image estimation and how these methods are each related to body size (i.e., BMI) in children.

Three specific predictions were proposed in this study. First, body image estimation was expected to be predicted by a combination of age, gender, body size, and visuospatial abilities. Second, it was predicted that body image estimation would be negatively correlated with visuospatial abilities due to clinical populations showing the more distorted the body image perception, the better the visual perceptual skills (e.g., Kothari et al., 2013). Third, it was hypothesized that BMI would be negatively correlated with body dissatisfaction and body image estimation (verbal and visual).

CHAPTER II

Method

Participants

Thirty-eight children were recruited from a local children's agency. Children participating were ages 6 to 13 years (M = 9.05, SD = 1.87). All ethnic groups, genders, and BMI groups were eligible to participate. No underweight children participated in the study, thus the sample consisted of healthy, overweight and obese children. Table 1 summarizes the demographic information.

Materials

Demographics. All children were asked questions regarding their age, ethnicity, and grade in school (see Appendix A) using a brief interview format.

Anthropometrics. Body weight was assessed for each child using a digital scale. Height was obtained by having the child stand without shoes with his/her back against a premeasured wall strip (measured to the nearest half inch). BMI then was calculated using age and gender charts (Centers for Disease Control and Prevention, 2014). BMI was coded into three categories based on these age/gender data: overweight/obese ($\geq 85^{th}$ percentile), underweight ($< 5^{th}$ percentile), and healthy weight ($\geq 5^{th}$ to $< 85^{th}$ percentile).

Table 1

Demographic Summary for the Full Sample (N = 38)

Variable	*N*	Percent
Gender		
Boy	14	36.8
Girl	24	63.2
Grade		
1st	5	13.2
2nd	8	21.1
3rd	4	10.5
4th	10	26.3
5th	7	18.4
6th	3	7.9
7th	1	2.6
Ethnicity		
African American	12	31.6
Caucasian	18	47.4
Hispanic	2	5.3
Native American	2	5.3
Other	4	10.5
BMI Category		
Healthy	18	47.4
Overweight	9	23.7
Obese	11	28.9
Self-Described Body Size		
Fat	1	2.6
Skinny	15	29.5
In-between	20	52.6

Body Image: Visual. The Body Figure Task (BFT; Collins, 1991) was used to assess both body dissatisfaction and body image estimation. The child was presented with 7 gender-specific body figures of various sizes in random order (see Appendix B) and was asked, "Which of these figures looks most like your body today?" The images were numbered 1-7 from smallest to largest, but the child did not see the numbers. The child's body estimation score was calculated by subtracting the child's actual body size (as determined by his/her BMI) from the selected body size. For example, someone who selected the body figure #7 as his/her current size, but based on BMI he/she was actually more similar to body figure #2, received a body image estimation score of 5. Positive scores indicated that the child overestimated, and negative scores indicated that the child underestimated. Following the first question, the researcher picked up the figures, shuffled them, and laid them back down in random order. Then, the child was asked, "Which of these figures would you most like your body to look like?" The amount of discrepancy between the first question and the second was defined as subjective body dissatisfaction (SBD). For example, a child who selected a "7" as his/her current body size but wanted to be a "3" received a subjective body image dissatisfaction score of 4. For this study, positive scores indicated the child wanted to be smaller than their current size, while negative scores indicated that the child wanted to be larger than they were. Objective body dissatisfaction (OBD) was calculated by subtracting the child's preferred body size from his/her actual body figure based on BMI.

Body Image: Verbal. Body image estimation also was assessed verbally using a multiple choice question. The researcher stated, "I think I am…" and the child was asked to select response option: fat, skinny, or in-between. Verbal body image estimation was determined by what category the children place themselves in compared to their actual BMI category (i.e., "Fat" = overweight or obese, "Skinny" = underweight, "in-between" = healthy weight). For example, if a child said he/she was fat, but the BMI is $\geq 5^{th}$ and $< 85^{th}$ percentile (i.e., healthy weight), he/she had an inaccurate body image accuracy score for the verbal measure.

Visuospatial Ability. Visuospatial ability was assessed by two subtests from the Developmental NEuroPSYchological Assessment: Second Edition (NEPSY-II; Korkman, Kirk, & Kemp, 2007), a standardized neuropsychological tool for children. One of the subtests was Arrows, which involved having the child assess the direction and orientation of lines without the use of motor skills. Reliability of the Arrows subtest ranges from .64 to .84 for children aged 7 to 12 (Korkman et al., 2007). The other subtest administered was Geometric Puzzles. This also is a nonmotor subtest that required the child to mentally rotate geometric designs and select the correct item from an array of designs. Reliability coefficients for the Geometric Puzzle subtest ranges from .67 to .82 (Korkman et al., 2007). Age-corrected scaled scores for each subtest were calculated for both subtests. Possible scaled scores range from 1 to 19, with $M = 10$, $SD = 3$.

Procedure

Middle Tennessee State University's Institutional Review Board approved this study, as it was part of a larger project of children's body image and neuropsychological functioning (see Appendix C). Data collection was conducted at the participating agency. Parent consent was obtained by sending home the consent form with each child along with a description of the study (See Appendices D and E). Signed consent forms were returned and collected in a box at the agency. Children with signed consents then were assessed individually following their agreement using an assent script (see Appendix F).

Once consent and assent were obtained, each child rotated through three stations where demographic information, body image, anthropometric data, and visuospatial abilities were assessed one child at a time. One station included demographics and anthropometrics, one included the BFT and the verbal body image assessment, and one included the two subtests from the NEPSY: II. The order of progression through the three stations was counterbalanced to control for potential order effects. The entire assessment lasted about 30 minutes. Participants carried their assessment packet to each station to prevent the need for identifying information to be collected. After the child completed the study, he or she selected a small toy from a "treasure box" for participating.

CHAPTER III

Results

Descriptive statistics for all analyses are presented in Table 2. On average, this sample is overweight, with the average BMI being 20.41 (i.e., approximately at the 85%ile for gender and height). Generally, the children are satisfied with body shape and size, but on average they would like to be one body size smaller. Their ideal body size is within a healthy range. On average their visuospatial abilities are within the average range of functioning.

Table 2

Descriptive Statistics for All Dependent Measures

Variable	*M*	*SD*	*n*
BMI	20.41	4.06	38
BMI Percentile	77.79	19.19	38
Body Current	3.84	1.17	38
Body Ideal	3.00	0.93	38
Body Dissatisfaction	0.84	1.37	38
Geometric Puzzles	8.86	2.67	37
Arrows	9.51	3.39	37

Note. Body Current and Body Ideal are on a scale of 1-7. Body Dissatisfaction is on a scale of 0 – 6. Arrows and Geometric Puzzles are age-corrected scaled scores with $M = 10$ and $SD = 3$.

It was expected that a combination of BMI, age, gender, and visuospatial (i.e., Arrows and Geometric Designs) would predict body image estimation visual scores; a

specific prediction model was not proposed. Linear regression with forward selection was used to find the best predictors of visual body image estimation. An alpha of .05 was used when selecting the predictors. BMI, age, gender, Arrows, and Geometric Puzzles were considered as possible predictors for visual body image estimation (see Table 3 for prediction model). BMI was the only variable selected as a significant predictor for visual body image estimation, F (1, 34) = 39.66, MSE = 49.70, $p < .001$, $Adj.\ R^2 = .53$.

Table 3

Linear Regression Model for Predicting Visual Body Image Estimation

Predictor	Model 1	
	B	*t*
Constant	7.24	7.34*
BMI	-0.30	-6.30*
R^2	0.54	
F	39.66*	

* $p < .001$

Additionally, it was predicted that both verbal and visual body image estimation scores would be negatively correlated with visuospatial abilities. Pearson's r (for visual body image estimation) and Spearman's Rho (for verbal body image estimation) correlations were calculated.

Table 4 presents the Pearson correlations among the dependent measures. Visual body image estimation (visual BI estimation) was positively correlated with Arrows, $r(37) = .44$, $p = .007$, indicating that the higher the scores on the Arrows subtest the more

the children overestimated their body sizes. Although Geometric Puzzles and Arrows were correlated with one another, $r(36) = .47$, p = .004, Geometric Puzzles was not significantly correlated with visual BI estimation, $r(37) = .18$, $p = .30$.

Table 4

Pearson Correlations among Dependent Measures

Variable	GP	AR	BMI	Age	SBD	OBD
Visual BI Estimation	0.18	0.44**	-0.76***	-0.29	-0.70	-0.78
Geometric Puzzles (GP)		0.47**	-0.16	0.01	-0.14	-0.17
Arrows (AR)			-0.53**	-0.39*	-0.38*	-0.55***
BMI				0.53**	0.53**	0.98***
Age					0.23	0.51**
SBD						0.54***

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

Verbal body image estimation was not significantly correlated with Geometric Puzzles, $r(35) = -.08$ $p = .67$, or Arrows, $r(35) = .16$, $p = .37$. As predicted, visual body image estimation had a stronger correlation than verbal body image estimation with visuospatial abilities. Because verbal body image estimation was not significantly correlated with either Geometric Puzzles or Arrows, no z-test was conducted.

It was predicted that BMI would be positively correlated with body dissatisfaction (subjective and objective) and body image estimation (visual). Visual body image dissatisfaction and estimation were assessed using the BFT. To test this hypothesis, Pearson Product Moment correlation coefficients were calculated (see Table 4). We

found a positive correlation between subjective body dissatisfaction and BMI, $r(38) = .53$, $p = .001$ and objective body dissatisfaction, $r(38) = .89$, $p < .001$. This indicates the higher their BMI the smaller the children desired to be. Age was significantly correlated with objective body dissatisfaction, $r(38) = .51$, $p = .001$, but not subjective body dissatisfaction, $r(38) = .23$, $p = .174$. This indicates the older the child the more he/she wanted to be a smaller size. Lastly, BMI was significantly negatively related to body image estimation, $r(38) = .76$, $p < .001$, indicating that the higher the child's BMI, the more the child underestimated his/her body size.

It was expected that verbal body image estimation would be negatively related to BMI. In this sample, only 7 of the 38 participants described their BMI category accurately. A chi-square analysis was conducted to test the hypothesis that those who had healthy BMIs would be more likely to accurately categorize themselves compared to the obese and overweight children. Chi-square analysis supports this hypothesis, $X^2(4) = .57$, $p = .02$. These data indicate that those in the healthy BMI category were more likely to be verbally accurate than those in either the overweight or obese categories at estimating their body size category.

Table 5
Chi Square Analysis of BMI Category and Verbal Body Image Estimation

		Inaccurate by 2 categories	Inaccurate by 1 category	Accurate
BMI	Healthy	0	11	6
	Overweight	3	5	0
	Obese	1	9	1
Total		4	25	7

Finally, it was predicted that higher BMI would be negatively correlated with visuospatial skills. BMI was significantly negatively correlated with Arrows, $r(37) = -.53$, $p = .001$, indicating that the higher the BMI the lower the visuospatial performance on Arrows. Geometric puzzles was not significantly correlated with BMI, $r(37) = -.16$, $p = .342$.

CHAPTER IV

Discussion

This project assessed the relationship between body image estimation and visuospatial abilities in healthy, overweight, and obese elementary school aged children. Recent literature has suggested that the right parietal is negatively affected in adults with AN (e.g., Castellini et al., 2013; Grunwald et al., 2001). It is difficult to determine if this is a consequence of the disorder or if the dysfunction exists prior to the development of the disorder. Thus, the need to study healthy children is evident. Only two studies have investigated children with eating disorders and visual perceptual functioning. It has been found that adolescents with AN scored higher on a visual memory task than the healthy control group (Rose et al., 2014), and children who were at risk for the development of AN (based on material AN) scored higher on perceptual organizational tasks than children who were not at risk (Kothari et al., 2013).

In the current study, it was hypothesized that BMI, age, gender, and visuospatial abilities would predict visual body image estimation scores. Consistent with previous literature (e.g., Maximova et al., 2008; Saxton et al., 2009), BMI was selected as a significant predictor, which indicates that BMI is useful when predicting visual body image estimation. Age was not selected as a useful predictor of visual body image estimation, which is consistent with Williamson and Delin (2000), who found that despite BMI, children aged 5 to 10 could accurately identify their body sizes. Maximova et al.

(2008), however, found that there were differences in age for predicting body image estimation. Their sample consisted of 9, 14, and 16- year-old children. The age differences in samples between the current study and Maximova et al. (2008) could explain these inconsistent findings.

Consistent with previous research (e.g., Williamson and Delin, 2000) gender was not related to visual body image estimation. Previous research has been inconsistent for gender as it relates to body image estimations. When measured visually, Parkinson et al. (1998) and Gessell et al. (2010) found body image accuracy is similar between boys and girls, but Pallan et al. (2011), Maximova et al. (2008), and Saxton (2009) found that girls were more accurate than boys. When assessed verbally, girls more often overestimate but boys more often underestimate body size (e.g., Khambalia, et al., 2012; Park 2011). The current study did not analyze the strength of the correlation between gender and body image estimation, but only if it added to predicting body image estimation scores. Thus, there may be differences in gender, but in this study gender did not add to the predictive model.

This exploratory study was the first to look at visuospatial abilities as a predictor of body image estimation in a nonclinical sample of young children. Although visuospatial ability was not a significant predictor of body image estimation, visual body image estimation was positively correlated with Arrows (i.e., a measure of visuospatial ability), suggesting that the higher the visuospatial abilities, the more the children overestimated their body sizes. Because overestimating one's body size is considered a

risk factor for the development of an eating disorder, this finding is consistent with Kothari et al (2013), who found that children who had mothers with AN (an eating disorder risk) scored significantly higher on perceptual organizational task than children who did not have mothers with AN.

Although the Arrows subtest was correlated with body image estimation, Geometric Puzzles was not. There are several potential reasons for this discrepancy. Arrows is a right parietal lobe task, which is associated with visuospatial abilities. This task involves estimation of the direction and orientation of lines. Geometric Puzzles involves visuospatial processing as well as mental rotation. Because of the addition of mental rotation, this task becomes more integrative and involves brain areas in addition to right parietal lobe functioning.

Additional analysis of the Arrows subtest and body size showed that the larger the child's size (i.e., higher BMI), the worse the performance on this visuospatial task. Why body size was related to visuospatial performance is unclear, but may be related to activation in specific brain areas and the effects of that activation. For example, Tucker (1981) proposed that when the one hemisphere of the brain is activated, the opposing side is deactivated. For example, researchers have found that when one hand is engaged in activity, stimulating activation in a structure in one hemisphere, it also resulted in deactivation in the opposite hemisphere (Allison, Meader, Loring, Figueroa, & Wright, 1981). This theory could explain why the higher the BMI the lower the children scored on the Arrows subtest. The left parietal lobe may be activated in those with higher BMI

because of the extra body mass to process in the left somatosensory cortex, which could results in deactivation in the right parietal lobe, which controls visuospatial abilities.

In our study we also found that the higher the BMI the smaller the child desired to be. This is consistent with previous literature, which has found the higher the BMI the more dissatisfied the children were with their body size (e.g., Pallan et al., 2011). Although children with higher BMIs do not identify their body sizes accurately (e.g., Maximova et al., 2008), they do report dissatisfaction with their current sizes (e.g., Pallan et al., 2011).

In the current study, only 18% of the children correctly classified themselves in the correct BMI category. A chi-square analysis revealed that children in the healthy weight BMI categories were more accurate at identifying their body size verbally than children who were overweight or obese. This is important because children in the higher weight categories are not perceiving themselves as overweight or obese. If children do not perceive themselves as overweight, they may not engage in appropriate weight loss behaviors (Khambalia et al, 2011). Consistent with Saxton et al. (2014), when children verbally rated themselves as fat, skinny, or in-between, the majority of the children placed themselves in the middle category (i.e., "in-between"). In fact, only one child in the current study identified himself or herself as "fat" even though 11 children were actually obese. To this end, assessing body image estimation visually rather than verbally seems to be a better assessment modality.

Limitations and Future Directions

The current study had methodological limitations. First, the sample size was small and consisted primarily of children from low income families (based on the agency from where the children were recruited). Also, this sample did not include any underweight children; all children were healthy, overweight, or obese. Thus, the generalizability of the findings to a broad population of young children is limited.

Additionally, the verbal and visual measures of body image estimation were limited. We only provided children with 3 possible verbal categories from which to choose (i.e., fat, skinny, or in-between). Providing more options, at least 4 to match the BMI categories, may have provided more useful data. Additionally, no description of the terms were provided; children's interpretations of "fat", "skinny" and "in-between" may be very different, thus affect the utility of their responses. Future studies may benefit from providing behavioral definitions of each of the verbal options. Verbal measures of body image inaccuracy have not been reliable in younger ages (e.g., Maximova et al. 2008), but if they are included having more categories may be helpful.

A second measurement issue involves the visual body image estimation method. Although the children could have scored between -6 and 6 for visual body image estimation, our sample only ranged between -3 and 3. This restricted range could have limited the findings. Thus, a larger, more diverse (in body size) sample would be beneficial for future studies.

Finally, future studies should include a wider range of neuropsychological assessments including visuospatial as well as other neuropsychological functionalities. This more comprehensive neuropsychological assessment will help to determine the possible relationship between broad ranges of cognitive functioning (e.g., verbal fluency, executive functioning) with body image risk factors in children. Identifying such relationships may help with early detection of and potential prevention of eating disorders in children and early adolescents.

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APPENDICES

APPENDIX A
Demographics

Ask the child to tell you:

How old are you?

What grade are you in at school?(circle one):

1st 2nd 3rd 4th 5th 6th

What is your Ethnicity?: (circle one)

African-American Asian/Asian-American Caucasian

Hispanic Native American Other____

_____

Weigh and measure the child.

Height: _____ Weight: _____ BMI:_____

APPENDIX B
Body Figures

Body Size Drawings:

Lay out the 7 body drawing cards (of the child's gender) in random order in two rows with 4 on the top row and 3 on the bottom row facing the child.

Then say to the child:

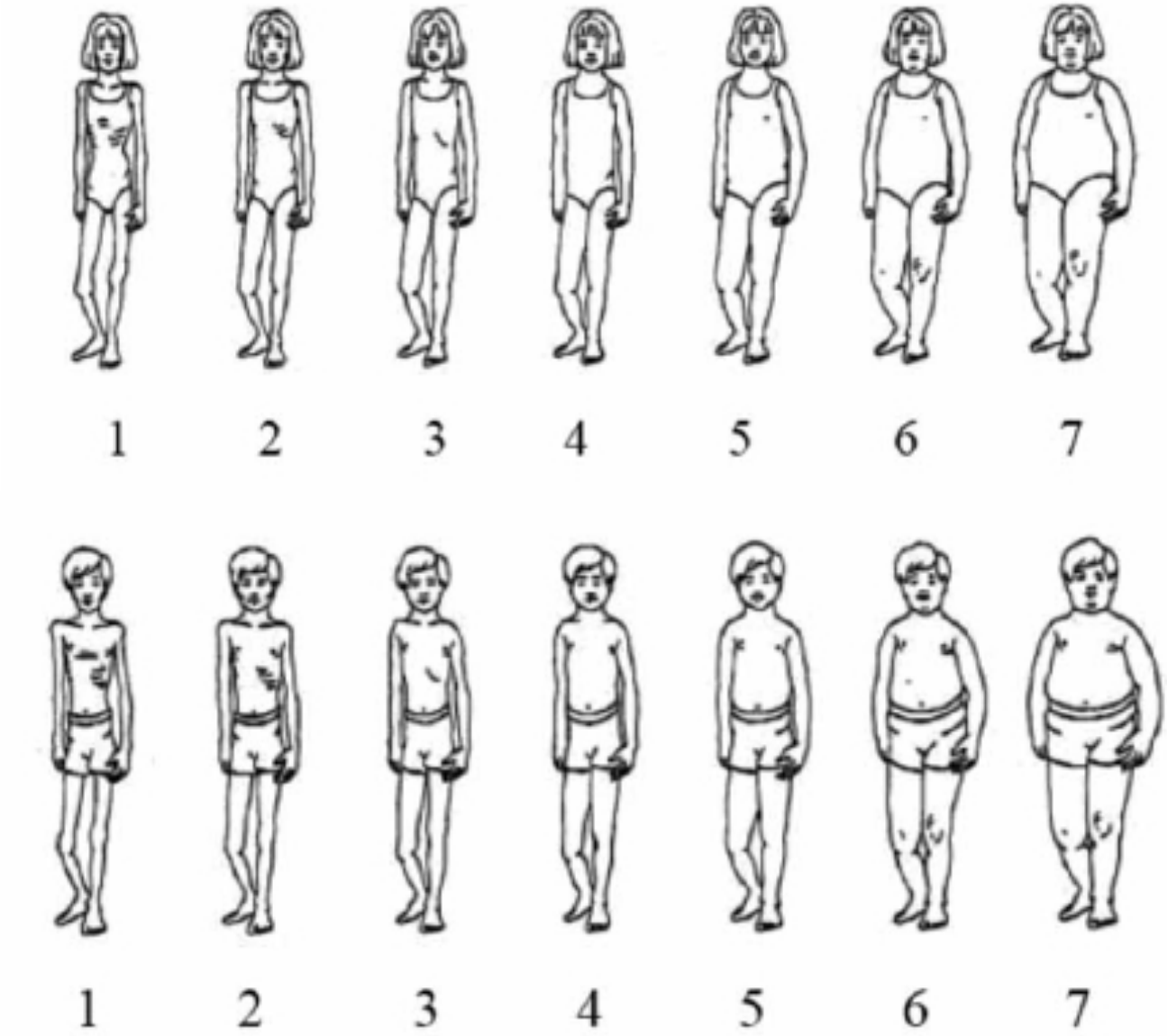
Look at these drawings of children whose bodies are different shapes and sizes.
Pick the one that has a body shape and size that looks the most like your body looks today. Point to it or tell me which one. #_____

Shuffle the cards and lay them out again using the same format as above. Then say,

Now look at them again. This time, pick the one with the body shape and size that you wish your body would look like. #_____

Pick up the cards and put them away.

(Body Figures on the Cards):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APPENDIX C
IRB Approval

5/2/2014
Investigator(s): Kim Ujcich Ward, Sheryl Kate Benson, Lauren Qualls
Department: Psychology
Investigator(s) Email: kimberly.ward@mtsu.edu
Protocol Title: "Children's Body Image, Physical Activity, and Visual Perceptual Functioning "
Protocol Number: 14-347
Dear Investigator(s),
The MTSU Institutional Review Board, or a representative of the IRB, has reviewed the research proposal identified above. The MTSU IRB or its representative has determined that the study poses minimal risk to participants and qualifies for an expedited review under 45 CFR 46.110 and 21 CFR 56.110, and you have satisfactorily addressed all of the points brought up during the review.
Approval is granted for one (1) year from the date of this letter for 150 participants.
Please note that any unanticipated harms to participants or adverse events must be reported to the Office of Compliance at (615) 494-8918. Any change to the protocol must be submitted to the IRB before implementing this change.
You will need to submit an end-of-project form to the Office of Compliance upon completion of your research located on the IRB website. Complete research means that you have finished collecting and analyzing data. Should you not finish your research within the one (1) year period, you must submit a Progress Report and request a continuation prior to the expiration date. Please allow time for review and requested revisions. Failure to submit a Progress Report and request for continuation will automatically result in cancellation of your research study. Therefore, you will not be able to use any data and/or collect any data. Your study expires 5/2/2015.
According to MTSU Policy, a researcher is defined as anyone who works with data or has contact with participants. Anyone meeting this definition needs to be listed on the protocol and needs to complete the required training. If you add researchers to an approved project, please forward an updated list of researchers to the Office of Compliance before they begin to work on the project.
All research materials must be retained by the PI or faculty advisor (if the PI is a student) for at least three (3) years after study completion and then destroyed in a manner that maintains confidentiality and anonymity.
Sincerely,
Kellie Hilker
Compliance Officer/ MTSU Institutional Review Board Member

APPENDIX D
Parental Consent

Principal Investigator: Kim Ujcich Ward, Ph.D., BCBA-D
Study Title: Children's Body Image, Physical Activity and Visual Perceptual Development
Institution: Middle Tennessee State University

Name of child: _____ Age: _____

The following information is provided to inform you about the research project and your child's participation in it. Please read this form carefully and feel free to ask any questions you may have about this study and the information given below. You will be given an opportunity to ask questions, and your questions will be answered. Also, you will be given a copy of this consent form.

Your child's participation in this research study is voluntary. He or she is also free to withdraw from this study at any time. In the event new information becomes available that may affect the risks or benefits associated with this research study or your willingness to participate in it, you will be notified so that you can make an informed decision whether or not to continue your participation in this study.

For additional information about giving consent or your rights as a participant in this study, please feel free to contact the MTSU Office of Compliance at (615) 494-8918.

1. **Purpose of the study:**
   Your child is being asked to participate in a research study because we are interested in learning about how children's understanding of their body shape and size may be related to how they see things and understand what they see.

2. **Description of procedures to be followed and approximate duration of the study:** The study we are doing will take your child about 30 minutes to participate. During that time, he/she will measure their height and weight. We also will ask them questions about foods they like and don't like, how they feel about their bodies, and some things they might be thinking about their bodies and health. We also will have them look at some pictures of different body shapes and sizes and have them tell us what they think of them. Finally, they will be asked to do some visual puzzles. We will be doing these things individually with each child who participates. The study will be conducted during normal ESP hours.

3. **Expected costs:** There are no costs to you or your child for him/her to participate**.**

4. **Description of the discomforts, inconveniences, and/or possible risks that can be reasonably expected as a result of participation in this study:** The risk for your child to participate in this study is minimal. Some children may be uncomfortable answering questions or talking about their thoughts and feelings about their body shape and size. If your child does not want to answer a question or do an activity that is part of the study, he/she can skip that question or that part. There will be no negative consequences if they skip something or want to stop at any point. Each child will be told this before we start the study, and will be reminded that it is ok to say you don't want to say or do something during the project.

5. **Compensation in case of study-related injury: N/A**

6. **Anticipated benefits from this study: The anticipated b**enefits from this study include a better understanding of how body image perception and satisfaction occur across different ages of young children and how these factors may be related to a child's understanding of what they see and how they interpret what they see. This kind of information may be helpful to identify early risk factors for intervention that could prevent the development of eating disorders in children.

7. **Alternative treatments available: N/A**

8. **Compensation for participation:** Each child who participates in the study will be given a small trinket/toy as a thank you for participating.

9. **Circumstances under which the Principal Investigator may withdraw you from study participation:**
   If at any time during the project your child seems distressed, as may be indicated by crying, yelling, or becoming very withdrawn, we will stop the study and talk with your child to help calm them. We will then return them to their ESP class. We do not expect the children to become distressed because of the study, but if they do, we will stop their participation.

10. **What happens if you choose to withdraw from study participation:** If your child chooses to stop participating at any point during the study, he/she will still receive the small thank you trinket/toy. There will be no negative consequences to your child for choosing not to participate fully.

11. **Contact Information.** If you should have any questions about this research study or possibly injury, please feel free to contact Kim Ujcich Ward at 615-898-2188 or email Kimberly.ward@Mtsu.edu**.**

12. **Confidentiality.** All efforts, within reason, will be made to keep the personal information in your child's research record private but total privacy cannot be promised. Your information may be shared with MTSU or the government, such as the Middle Tennessee State University Institutional Review Board, Federal Government Office for Human Research Protections, *if* you or someone else is in danger or if we are required to do so by law. If during the study your child shares any information that would lead us to believe he/she is in danger or causing harm to him/herself, we will discuss our concerns with your child and will contact you (his/her parent/guardian) with that information. Please put a contact number on the bottom of this form so we can contact you if we need to do so.

14. **STATEMENT BY PERSON AGREEING TO PARTICIPATE IN THIS STUDY**

I have read this informed consent document and the material contained in it has been explained to me verbally. I understand each part of the document, all my questions have been answered, and I give permission for my child to participate in the study.

Date

Signature of patient/volunteer

Phone number or contact information for parent/guardian

Consent obtained by:

Date

Signature

Printed Name and Title

APPENDIX E
Parent Letter

April 23, 2014

Dear ESP Parents,

I am Kim Ujcich Ward, Ph.D., a psychology professor at MTSU. One of the areas I work in is child clinical psychology with a special interest in body image. I have conducted several research studies about body image in children and young adults. I will be working on a research study with children at your child's school during ESP and want to ask your permission to allow your child to participate. We will be doing the study during ESP with the children one at a time. They will be asked to do a variety of things, including telling us about foods they like and don't like, telling us about their exercising and activities, and telling us what they think about their bodies and how they look. We also will be doing some visual puzzles and will see how much they weight and how tall they are. It will take about 30 minutes for each child to participate. We are doing this study to better understand what children think about their bodies and health, and how that might be related to how they think and understand what they see. I have attached a consent form to this letter that explains the study in more detail. Please read that form, and if you are willing to let your child participate in this project, sign that form and return it to ESP. There is a box beside the ESP check-out desk where you can put the signed consent forms. If you have any questions about the project, please call me at 615.898.2188 or email me at Kimberly.ward@mtsu.edu.

Thank you for considering allowing your child to help us with this research project.

Sincerely,

Kim Ujcich Ward, Ph.D., BCBA-D
MTSU Department of Psychology
Kimberly.ward@mtsu.edu
615.898.2188

APPENDIX F
Child Assent

Assent Script for Body Image and Neuropsychological Functioning in Children Study

Read the following to the child:

Thank you for coming to meet with us today. We are doing a project to help us learn more about how children think about their bodies and their health. What we are doing today will be lots of different things. We will be seeing how much you weigh and how tall you are. We also will show you some pictures and drawings and ask you to tell us or show us something about them. We are going to do some puzzles and activities, too. Finally, we also will ask you some questions about things you might eat, exercise you might do, and things you might think about. These questions aren't like a test you have in school; they are more like questions about you and your ideas. If we ask you something that you don't understand, you can just say that – like, "I don't know what you are talking about!" or "I don't understand that one", and we will try to explain it to you. If we ask you something that you don't want to answer, you don't have to – just say something like, "I don't want to answer that one", or "can we please do the next one" and we will go on. You won't be in any trouble or anything if you don't answer something or if you don't want to do any of the things we ask you to do. We aren't going to tell anybody what your answers are or what you do with us today, so don't worry about if someone will find out. There is one situation when we might tell somebody, and that would be if you tell us something that shows you are harming yourself or that someone else is harming you. Then we would have to tell so that someone can help you not to be harmed.

Your parents have already said it was ok for you to help us with this project today if you want to.

Would you like to participate?