Recognition of emotion and complex mental states from facial expressions in adolescents with traumatic brain injury

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Abstract

A number of studies have investigated the impact of a traumatic brain injury (TBI) on affect recognition and theory of mind (ToM). These studies generally look at the effects these potential impairments may have on the social functioning of the individual. No study to date, however, has integrated the ability to recognise affect with the ability to make affective inferences, and looked how they are affected following a TBI. In the current study, TBI adolescents ($N = 5$) were compared to typically developing adolescents ($N = 8$). It was found that neither affect recognition nor the ability to make affective inferences were significantly impaired following a TBI. Both general intellectual functioning and executive functioning were significantly impaired following a TBI. As the effects of interest were not there, further investigation of how much covariance these effects shared with intelligence and executive functioning could not be assessed. The trends for both affect recognition and the ability to make affective inferences, however, were in the expected direction. This suggests that a larger sample size and the resultant increase in power may have produced significant results in both affective abilities. In terms of affect recognition, however, both the TBI and the typically developing adolescents made the most errors because they incorrectly attributed negative emotions to a facial expression.

A traumatic brain injury (TBI) may have many negative consequences for cognition, emotion regulation and social behaviour (Croker & McDonald, 2005; Milders, Fuchs, & Crawford, 2003). A lack of Theory of Mind (ToM), which is the cognitive ability to infer the emotions, thoughts and motivations of others, may explain these deficits in emotion regulation and social behaviour (Henry et al., 2006; McDonald & Flanagan, 2004; Turkstra, Dixon, & Baker, 2004). This theory, however, is not without its rivals. It has been hypothesised that the general decline in intelligence and executive functioning following a TBI may cause these deficits in emotion recognition and social behaviour (Channon, & Crawford, 2000; Fodor, 1992; Lahera et al., 2008; Slaughter, Dennis, & Pritchard, 2002). The study reported here was part of a larger study investigating the effects of a paediatric TBI (pTBI) on ToM. Specifically, it looked at how one aspect of ToM, the ability to infer complex affective mental states in others, was affected following a pTBI. Before affective inferences can be made, however, the more basic and less cognitively challenging recognition of affect needs to take place. This study, therefore, aimed to determine whether, after the effects of IQ and executive functioning were controlled for, 1) those who had sustained pTBIs were more impaired than those who had not when it came to recognising emotion from facial expressions, and 2) those who had sustained pTBIs were more impaired than those who had not when it came to inferring complex mental states from eye expressions. Before this study can be described in detail, however, a traumatic brain injury needs to be adequately defined and discussed.

Traumatic Brain Injury (TBI)

A TBI is defined as a change in brain function that is a consequence of either a blunt or penetrating force to the head (Bruns Jr., & Hauser, 2003). There are, therefore, two forms of TBIs - closed and open. Closed TBIs are a result of one's head being violently hit by an object that does not perforate the skull, but still damages the brain; whereas open TBIs are a result of a foreign object piercing one's skull and penetrating the brain tissue (Tabish, Lone, Afzal, & Salam, 2006).

They are also generally classified in terms of three levels of severity: mild, moderate and severe. Although there is little consensus on the exact criteria for each level of severity, Carroll, Cassidy, Holm, Kraus, and Coronados (2004) reviewed all the literature with high methodological value and recommend the following operational criteria for a mild TBI:

confusion, a loss of consciousness for no longer than 30 minutes, post-traumatic amnesia for no longer than 24 hours, as well as a Glasgow Coma Scale (GCS; Teasdale & Jennet, 1974) score of 13-15 half an hour post-injury and/or other temporary neurological abnormalities such as focal signs. A moderate TBI requires a GCS score of 9-12, with a loss of consciousness for more than 15 minutes; while severe TBIs require a GCS score of below 8 within 48 hours of the injury and a loss of consciousness for more than 6 hours (Tabish et al., 2006; Hawley, Ward, Magnay, & Long, 2002). The level of severity is important as individuals who sustain moderate or severe TBIs may be subject to more long-term physical and cognitive deficits than those who sustain a mild TBI (Ietswaart, Milders, Crawford, Currie, & Scott, 2007; Turkstra, et al., 2004).

Taking a step back, however, the type of TBI also determines the type of brain damage seen. Closed TBIs generally result in diffuse brain damage, while open TBIs generally result in specific damage around the area that was penetrated. Even though closed TBIs result in diffuse brain damage, there are three brain regions that appear to be the most susceptible to injury (Croker & McDonald, 2005). These vulnerable brain regions are the ventrolateral frontal lobes, inferior orbital cortices and temporal lobes. The frontal lobes are vulnerable as they are usually the point of impact, while the orbital cortices are vulnerable as impact to the back of the skull can cause the brain to accelerate forwards and rebound off the anterior and middle fossae. The temporal lobes are vulnerable as the tentorial plates that hold the frontal and temporal lobes in place are uneven, in an almost sandpaper-like way, and can cause injury as the brain is being jostled by the force of impact (Croker & McDonald, 2005). Motor vehicle accidents (MVAs) are usually the cause of this type of diffuse damage, and MVAs and violence are the leading causes of pTBIs in South Africa (Levin, 2004). Despite the high occurrence of these closed TBIs, their effect on adolescents and their ability to make affective inferences have not been adequately explored in the South African context.

As the frontal lobes are particularly vulnerable to injury following a TBI, a TBI during childhood may have a significant negative effect on social cognition (Turkstra, et al., 2004). This is because the frontal lobes take the longest to fully mature, only reaching maturation after puberty, and are integral elements of the neural network that supports social cognition (Bauer & Fritz, 2004; Kagan & Baird, 2004). A TBI during childhood may, therefore, not only disrupt the social skills being acquired, but also those that will be acquired later on in life (Gil, 2003). Children who sustain TBIs before reaching 16 years of age may, therefore, experience significantly greater emotional and social deficits than those who sustain TBIs at an older age. These deficits may become apparent only when the individual reaches adolescence, however. If they do become evident, the social deficits and the potential consequence of loneliness and social isolation may be of greater concern than the cognitive deficits that may result from a TBI (Tonks, Williams, Frampton, Yates, & Slater, 2007; Turkstra, et al., 2004). This however, has not been adequately explored because adults are the preferred participants in studies investigating the affect a TBI had on ToM and the individual's ability to interact in a social setting.

Theory of mind (ToM) following a TBI

ToM refers to the ability to cognitively infer the emotions, thoughts and motivations of others. It is, therefore, necessary for the understanding of other individuals' behaviour and peer-appropriate social performance (Henry et al., 2006; McDonald & Flanagan, 2004; Turkstra et al., 2004). There are many different ways to test ToM ability, but only the ability to make inferences will be discussed. There are two forms of inferences that an individual can make that display adequate ToM – affective and epistemic inferences.

Affective inferences are made about the complex emotional states of others. Before an affective inference can be made, however, affect recognition has to take place. Basic affect recognition does not pose much of a cognitive challenge to the individual and is tested by Ekman and Friesen's (1998) Faces test or another test similar in style, such as the NEPSY-II Social Perception domain (Korkman, Kirk, & Kemp, 2007). These tests require the individual to recognize basic emotions that is displayed via the facial expression shown. If an individual cannot successfully recognize the emotion, it is assumed that his or her ability to make higher-level affective inferences will be impaired as well. This is because the ability to make affective inferences imposes a cognitive demand on the individual as it requires the individual to display adequate ToM. This ability can be tested with the use of many different materials, such as vignettes or cartoons for example, but Baron-Cohen, Jolliffe, Mortimore, and Robertson's (1997) "Reading the Mind in the Eyes" test was used in this case. Following a TBI, it has been suggested that affect recognition may only be slightly impaired, or even remain intact, while the ability to make affective inferences may be significantly impaired (Croker, & McDonald, 2005;

Henry, et al., 2006; Tonks, et al., 2007). This, however, has not been explored in children or in the South African context.

Epistemic inferences, on the other hand, are made about what someone else knows or believes. They impose higher cognitive demands on the individual and are generally tested by tasks that make use of the false belief paradigm developed by Wimmer and Perner (1983). The false belief paradigm has two levels of mental state inferences, first-order and second-order. A first-order inference requires only one inference of belief to be made (Baron-Cohen, Leslie, & Frith, 1985). In terms of the Sally-Anne test, this inference can be demonstrated when the individual is asked where Sally will look for the marble when she returns into the room. Sally placed the marble in the basket, so she would look in the basket. She is unaware that while she was not in the room, Anne actually moved the marble to a box. A second-order inference requires two inferences of belief to be made (Mazza, De Risio, Surian, Roncone, & Casacchia, 2001). In terms of the Sally-Anne test, this inference can be made when the individual is asked about where Sally thinks Anne thinks the marble is. The individual is aware that Anne moved the marble and that she knows the marble is actually in the box. This awareness is the crux of this test. If the individual can understand that Sally does not possess this awareness and thinks that Anne thinks the marble is still in the basket, he or she has made a second-order inference. If, however, the individual is not able to separate another's beliefs from the actual state of events, he or she will be unable to make a second-order inference.

After a TBI both affective and epistemic inferences may be significantly impaired (Bibby & McDonald, 2005; Croker & McDonald, 2005; Henry et al., 2006; Martin & McDonald, 2005; McDonald & Flanagan, 2004; Tonks, et al., 2007). Following a TBI, however, children may acquire additional cognitive deficits that impact on concentration, decision-making capability, and complex thinking (Bauer & Fritz, 2004; Turkstra et al., 2004). These additional cognitive deficits may interfere with the individual's performance on the epistemic tasks. This may even result in the incorrect assumption that this individual, who suffered from a TBI, has a ToM deficit. For this reason, affective tasks may be more appropriate for assessing ToM in children with TBIs.

Because these potential additional cognitive deficits are often present, critics do not believe that it is a lack of ToM that causes the social and emotional deficits following a TBI. These critics of the concept of ToM have hypothesized that the general decline in intelligence and executive functioning following a TBI may cause the social and emotional deficits and not a specific ToM deficit (Channon, & Crawford, 2000; Lahera et al., 2008; Slaughter, et al., 2002). Another hypothesis is that the potential decline in intelligence, following the TBI, may make the child less well-liked by his or her peers (Slaughter, et al., 2002). They may, therefore, have social deficits due to the fact that they may interact less with their peers following a TBI.

An adolescent who has not suffered from a TBI spends about one-tenth of his or her time talking, be it on the phone, in person, or even on Skype, and most of this interaction is between friends rather than family (Turkstra, 2000). This increase in friendly interactions is a way for the individual to make auspicious impressions and find his or her social niche (Tonks, et al., 2007). These interactions will also, however, encourage social maturation as they provide many opportunities to learn and practice the individual's developing social skills (Turkstra, 2000). The potential decline in social interactions following a TBI, however, may hinder the affected individual's re-learning of adequate social skills. This may result in further social withdrawal which may blunt the individual's perception of interpersonal cues displayed by another's facial expression (Fraley, Niedenthal, Marks, Brumbaugh, & Vicary, 2006). This may, therefore, be why they have deficits with processing of emotion that has little do with their ToM.

The potential decline in executive functioning following a TBI may be another reason why individuals post-TBI may have trouble with ToM tasks (Carlson, Moses, & Breton, 2002; Carlson, Moses, & Claxton, 2004) This may also have nothing to do with the potential lack of ToM following a TBI. Executive functions include skills such as inhibitory control, self-regulation, attentional flexibility, planning, resistance to interference and error detection and correction (Carlson, Moses, & Breton, 2002). An affected individual may, therefore, be less efficient at controlling their inhibitions, switching their attention away from something more interesting than the ToM tasks, or preventing themselves from getting distracted. In this way, it may not be possible for this individual to pay enough attention to the tasks to actually complete them to the best of their ability. This inability to give the tasks their all may, therefore, be the reason why they appear to lack ToM following a TBI.

The individual, therefore, needs to display significant deficits in the above-mentioned affective tasks, over and above the decline in intelligence and executive functioning, for support of the ToM hypothesis. With this in mind, the recognition of emotion following a TBI will now be discussed.

Recognition of emotion following TBI

There is still a debate surrounding recognition of emotion and the degree to which it is affected following a TBI (Henry, et al., 2006; Tonks, et al., 2007; Turkstra, McDonald, & DePompei, 2001). Regardless of whether it is slightly impaired, or completely unaffected, there may be another rival explanation as to why affective abilities may be potentially impaired following a TBI. This explanation, however, has nothing to do with the processes themselves being at fault. The suggestion is that the ability to process faces as a whole may be impaired following a TBI, and that this may be why the individual fails to recognise emotions and infer the complex mental states of others. If this is the case, the potential inability to recognise emotion and infer complex mental states may be due to an inability to process the face and not the emotion. Research into this possibility, however, indicates that this does not seem to be the case (Croker & McDonald, 2005; Tonks, et al., 2007). The ability to process whole faces appears to be intact even though the ability to recognise emotions from facial expressions may not be. This implies that the deficits in facial expression processing do not fall under a general face processing deficit and are a result of the inability to recognise emotion.

Despite some potential general impairment in recognition of emotions, individuals with TBI appear to be better at recognising positive than negative emotions from facial expressions, with the least discrimination occurring between fear, sadness and disgust (Croker & McDonald, 2005; Matsumoto, 1992; Milders, et al., 2003). There appear to be two different reasons as to why this may be the case. The first suggestion is that this discrepancy might occur because there are fewer expressions of positive emotions than negative expressions, so positive expressions may be easier to recognize. In addition, negative expressions require more in-depth processing as distinctive features of each negative emotion may overlap, e.g., the jaw widens in both anger and fear and one furrows one's brow in both anger and sadness. The second suggestion, however, is that there may be separate neuronal pathways for recognition of select emotions, with the pathway for recognition of negative emotions being more vulnerable to injury following a TBI (Croker & McDonald, 2005). This theory of separate neuronal pathways has yet to be adequately explored, however.

Regardless of the reasons why the ability to recognise emotion may be impaired following a TBI, if the ability is impaired, it may have a significant impact on the individual's quality of life, as he or she may be unable to function effectively in any social situation (Milders et al., 2003; Tonks, et al., 2007; Turkstra, 2000; Turkstra, et al., 2001; Turkstra, et al., 2004). Social functioning requires emotional stimuli to be processed quickly so that the individual can respond efficiently to the intentions of the other individual(s) involved in the social situation. The emotional stimuli are conveyed by facial and eye expression, and by tone of voice. The intentions of the other individual(s) are determined by integrating these emotional stimuli to determine the complex mental state experienced by the other individual(s), and many individuals with TBI may be unable to do this.

Adolescents appear to gain the most knowledge of how to proceed within the social situation through the perception and integration of all the emotional information (Tonks, et al., 2007; Turkstra, 2000), This is why TBIs occurring during childhood or adolescence tend to result in worse social outcomes than equivalent TBIs occurring during adulthood. In addition, the disruption to the development of ToM that may result from a pTBI will negatively impact on the already-decreased level of social cognition seen due to the disruption of the development of the frontal lobes (Bauer & Fritz, 2004; Kagan & Baird, 2004; Turkstra et al., 2004). This reduction in the ability to "read" social situations correctly, in combination with a lack of knowledge of how to respond appropriately, may lead to separation from peers. This separation will lead to a diminished opportunity for social interaction, isolation and, therefore, may undermine the growth of the adolescent's social competence.

Specific Aims and Hypotheses

Most of the studies that have investigated ToM in children or adolescents who have sustained TBIs, have investigated it in relation to how this affects the individual socially (Slaughter, et al., 2002; Tonks, et al., 2007; Turkstra, et al., 2001; Turkstra, et al., 2004). These studies have either focused on affect recognition, the development of ToM or the level of ToM ability following a TBI. None of these studies have integrated affect recognition in relation to the ability to make affective inferences, following a TBI. They have also not investigated the effect general intelligence and executive functioning may have on both these affective processes. As previously mentioned, the potential social and emotional deficits of an individual who has sustained a TBI may be due to a deficit in ToM or alternatively, may be due to a potential general decline in both intelligence and executive functioning that may also follow. To control for these rival hypotheses, IQ and executive function were assessed to enable statistical control. I additionally hypothesize that recognition of emotion from facial expressions is easier than recognition of complex mental states from eye expression.

The four hypotheses were:

1) Young adolescents who have sustained mild pTBIs will be significantly worse at recognising basic emotions from facial expressions than typically developing adolescents.
2) Young adolescents who have sustained mild pTBIs will be significantly worse at recognising complex mental states from eye expressions than typically developing adolescents.
3) Affect recognition remains more intact than the ability to make affective inferences following a TBI.
4) These differences will remain evident after the effects of IQ and executive functioning have been controlled for.

Method

Design and Setting

This study is part of a larger study currently underway that aims to establish the effects of pTBI on ToM ability in adolescents. The study reported here was cross sectional and aimed to examine the ability to recognize emotion and complex mental states from facial expressions, in adolescents who have sustained a mild TBI, after statistically controlling for IQ and executive functioning. This existing group was then compared to typically developing adolescents. Trends in difficulties with particular types of expression (e.g. positive vs. negative) were also investigated, via descriptive statistics. The participants of this study were obtained by convenience sampling.

Testing took place at the Red Cross Children’s Hospital, Groote Schuur Hospital or at the home of the participant. All participants were tested in a quiet room, free from distractions.

Participants

This study adhered to the Declaration of Helsinki 2000 as well as to the ethical guidelines for research with human subjects outlined by the Health Professions Council of South Africa

(HPCSA). It also adhered to the University of Cape Town (UCT) Codes for Research. The ethical approval for this study was obtained from the Ethics Committee of the Department of Psychology at UCT, and the Faculty of Health Sciences Human Ethics Committee. Ethical approval was also obtained from the Western Cape Education Department to recruit traumatic brain injured children from schools (see *Appendix A*). The letter from the Western Cape Education Department that would have allowed recruitment of typically developing adolescents from schools did not arrive in time. Informed consent and assent was obtained from the parents and participants respectively (see *Appendices B* and *D)*.

Eight typically developing adolescents participated in this study (see *Table 1*). As the above-mentioned letter regarding ethical approval did not arrive in time, the typically developing adolescents used in this study were not matched controls recruited from low SES schools. After this setback, my initial aim was to try and find any low SES, typically developing adolescents that I could. I found, however, my resources were limited and that most I did find were unwilling to participate. In the end, the adolescents used in this study did not fulfill any specific criteria, other than being willing to participate.

Five adolescents who suffered from a TBI participated in this study (see *Table 1*). The TBI adolescents were recruited from the Red Cross Children's Hospital. The search through the archives produced 63 possible candidates, but only 32 of those candidates had the same contact number as the one they had given to the hospital. Out of those 32, 18 were willing to participate. In the end, only 5 actually showed up for their appointment or were home when I went to test them at their house.

Table 1

Demographic information of the TBI and Typically Developing (TD) adolescents

Demographic Information	**TBI** *(N=5)*	**TD** *(N=8)*
Age Range *(Years: Months)*	11:8-14:11	11:9-14:6
Age *(Years)*	13 (1.41)	12.88 (0.99)
Male: Female	2: 3	6: 2
White: Black: Coloured	0: 5: 0	7: 1: 0
High SES: Low SES	0: 5	7: 1

Note: Means are presented with standard deviations in parentheses.

Inclusion and exclusion criteria

For clinical and typically developing participants, the presence of any developmental disorder, such as mental retardation, autism, cerebral palsy, etc; a history of infantile meningitis; or any neurological condition that affects the central nervous system were cause for exclusion from the study. A history of any serious (premorbid, in the case of the TBI participants) social deficits, such as conduct disorder or oppositional defiant disorder, also led to exclusion from the study. In addition, typically developing adolescents were excluded if they had any history of head injury.

Only mild TBI cases were included in this study because none of the moderate TBI participants attended their testing session. Severe TBI participants were not considered for inclusion in this study because severe TBIs lead to global cognitive and attentional impairments. This would have, therefore, posed a challenge when it came to distinguishing the cause of the deficits in the affect recognition and affective inferences tasks (Anderson & Pentland, 1998; Fontaine, Azouzi, Remy, Bussel & Samson, 1999; Scheibel et al., 2007).

Materials

Cognitive ability

Three tests were used to assess the cognitive ability of participants in this study: the *Weschler Abbrievated Scale of Intelligence* (WASI; Weschler, 1999), the *Weschler Intelligence Scale for Children* (WISC-IV^{UK}; Wechsler, 2004) and the *Delis-Kaplan Executive Function System* (D-KEFS; Delis, Kaplan, & Kramer, 2001).

The WASI (Weschler, 1999) is a brief, but reliable, test that measures the general intellectual ability of any individual between, and including, the ages of 6 and 89. There are two formats of this test: the four- or two-subtest. In this study the four-subtest WASI was administered. This included two tests to obtain a verbal IQ (VIQ) score, the Vocabulary and Similarities subtests; and two tests to obtain a performance IQ (PIQ) score, the Block Design and Matrix Reasoning subtests. The Vocabulary subtest measured the participant's expressive word comprehension and knowledge, and correlates very highly with the full scale IQ (FSIQ) score; while the Similarities subtest measured his or her abstract verbal reasoning. The Block Design subtest measured his or her spatial perception, abstract visual processing, and problem solving; while the Matrix Reasoning subtest measured his or her abstract non-verbal problem solving, spatial and inductive reasoning. The VIQ score combined with the PIQ score resulted in the full scale IQ (FSIQ) score that is an overall measure of general intellectual functioning.

The WISC-IV^{UK} (Weschler, 2004), however, was not used in its entirety as only four subtests were administered to the participants. The Digit Span and Letter-Number Sequencing subtests were administered to get a measure of the participant's working memory, while the Coding and Symbol Search subtests were administered to get a measure of his or her processing speed.

The D-KEFS (Delis et al., 2001) measures key components of executive functions of any individual between, and including, the ages of 8 and 89. In this study, however, only two subtests; the Verbal Fluency and the Colour-Word Interference subtests were administered. The Verbal Fluency subtest is comprised of three conditions: letter fluency, category fluency and category switching. The letter fluency condition measured the participant's speeded production of words; while the category fluency condition measured his or her speeded production of semantic categories. The category switching condition measured the degree to which he or she could automatically access his or her lexicon. The Colour-Word Interference subtest assessed the inhibition and cognitive flexibility of the participant. The inhibition condition assessed his or her ability to inhibit the automatic response of reading the word in order to name the dissonant ink colours instead; while the switching condition required the participant to switch back and forth between reading the conflicting word and naming the dissonant ink colour.

Ability to recognise emotions from facial expressions

The Affect Recognition (AR) subtest from NEPSY-II Social Perception domain was used to assess affect recognition (Korkman, et al., 2007). The AR subtest is designed to assess whether basic affect recognition is intact. This was done by asking the participant to recognize the affect (happy, sad, anger, disgust, fear and neutral) from a photograph of a child's face in four different tasks (Korkman, et al., 2007). In one of the tasks the child was asked whether or not the faces in two photographs depict the same affect. A second task required the participant to choose which two photographs, out of four photographs, showed children with the same facial affect. A third task required the participant to look at the face at the top of the page and select a photograph, from four photographs, that depicted the same facial affect. Finally, in the fourth task the participant was briefly shown a photograph of a face and was then required to pick two photographs that depict the same affect as the face on the photograph he or she had just seen.

The ability to infer complex mental states from eye expressions

The Baron-Cohen, Wheelwright, and Spong's (2001) children's version of the "Reading the Mind in the Eyes" test was used to assess the individual's ability to infer the complex mental states of others. This test required the participant to look at photographs of the eye region, of both young males and females, and make a choice as to which of the four words presented best described what the person in the photograph might be thinking or feeling. If the participant did not understand any of the words presented, I read the definition of the word from the list given. The eye region was used in this test as analysis of the eyes happens at an automatic and unconscious level and, therefore, the ability is unaffected by deficits in working memory or any other executive function (Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001).

Procedure

Before any of the tests were administered, informed consent was obtained from the participant's parents or guardian (see *Appendix B*). The parents or guardian were also required to complete a general questionnaire (see *Appendix C*). This questionnaire identified any possible exclusion criteria as well as confirmed the participant's SES status and demographic information. Each parent or guardian was interviewed, telephonically, to assess the participant's developmental, medical and social history. Finally, on the day of testing, informed assent was obtained from the participants (see *Appendix D*).

Administration of all these tests, in the participant's preferred language (which was uniformly English for these participant), formed part of a larger study that took place over one session, lasting approximately 3 hours. The child was offered a short break after each hour of testing in which drinks and snacks were provided. For this study the five tests described above were administered in counterbalanced orders to control for fatigue effects. Once the tests were administered, the participants were debriefed and any additional questions they, or their parents, might have had about the process were answered.

Data Analysis

First of all, I looked at performance, and the type of errors made, on affect recognition and affective inferences tasks of both TBI and typically developing adolescents using descriptive statistics. I then used two directional independent *t*-tests to compare the difference in both affect recognition and the ability to make affective inferences following a TBI. Directional independent *t*-tests were then used to compare VIQ, PIQ, working memory and processing speed between the TBI and typically developing adolescents. In this way, I could compare the general cognitive abilities of the two groups. I then conducted a mixed design analysis of variance (ANOVA) with one repeated measure to compare executive functioning between the two groups.

All the statistical analyses were conducted on STATISTICA version 8 (StatSoft, Inc, 2007). The two groups were small and uneven and, therefore, some of the assumptions on homogeneity of variance were not met, but these violations will be individually discussed along with their respective analyses. Inspection of all the normal probability plots revealed that all the data was fairly normally distributed, so this assumption was upheld in every analysis. Non-parametric analyses may have been better given the data set, but these analyses would have reduced the power. It was reasoned that use of these analyses would have been overly conservative, especially given the extremely small sample size and resultant poor power. An alpha level of .05 was used for all statistical tests.

Results

Affect recognition in typically developing adolescents

The ability to recognise affect was obtained using the raw scores as the participants were all in the same age range and the non-scaled scores are more sensitive. The highest score possible was 35. In typically developing adolescents, the highest affect recognition score was 32 while the lowest score was 25 ($M = 27.75$, $SD = 2.25$; see *Table 2*). In terms of the type of errors, the most frequent error was incorrectly attributing disgust to a facial expression, with incorrectly attributing sadness to a facial expression being the second most common error ($M = 3.00$, $SD = 0.76$ vs. $M = 1.75$, $SD = 1.39$ respectively; see *Table 2*).

Table 2.

The ability to recognise affect and the types of errors made by both TBI and typically developing (TD) adolescents

Group	**N**	**Affective Recognition** *(SD)*	**Mean Number of Errors** *(SD)*					
			Happy	Sad	Neutral	Fear	Anger	Disgust
TBI	5	25.80 (1.30)	1.00 (1.00)	3.00 (1.58)	1.20 (0.84)	0.80 (0.45)	3.20 (1.64)	2.40 (0.89)
TD	8	27.75 (2.25)	0.00 (0.00)	1.75 (1.39)	1.50 (1.39)	1.00 (0.53)	1.63 (1.51)	3.00 (0.76)

Note: Means are presented with standard deviations in parentheses.

Affect Recognition in TBI adolescents

In TBI adolescents, the highest affect recognition score was 27 while the lowest score was 24 (M = 25.80, SD = 1.30; see *Table 2*). In terms of errors, the most frequent errors involved incorrectly attributing anger, sadness and disgust to facial expressions (M = 3.20, SD = 1.64 vs. M = 3.00, SD = 1.58 vs. M = 2.40, SD = 0.89 respectively; see *Table 2*).

Table 3.

The ability to recognise affect in both TBI and typically developing (TD) adolescents

Group	**N**	**Affective Recognition**	**Group Difference**		**Effect size**
		(SD)	$t_{(11)}$	p	d
TBI	5	25.80 (1.30)	-1.74	.05	1.06
TD	8	27.75 (2.25)			

Note: Means are presented with standard deviations in parentheses.

Although the mean score for affect recognition in the TBI group was somewhat lower than that of the TD group, this difference did not turn out to be statistically significant (M = 25.80, SD = 1.30 vs. M = 27.75, SD = 2.25, $t_{(11)}$ = -1.74, p = .05, d =1.06; see *Table 3*). This may be because the effect size is small, and the extremely small sample provides very little statistical power.

The ability to make affective inferences in typically developing adolescents

To measure the individual's ability to make affective inferences, pictures of eyes were shown and the individual had to choose the complex mental state shown by the eyes. There were 28 pictures and a raw score was obtained by adding all the individual's correct responses. In the same way as it was for affect recognition, the more sensitive raw scores were used in the analyses. In typically developing adolescents, their ability to make affective inferences was reasonably high (M = 20.38, SD = 3.34) with the highest score being 24 and the lowest being 15 (see *Table 4*).

Table 4.

The ability to make affective inferences in both TBI and typically developing (TD) adolescents

	Affective Inferences	**Group Difference**		**Effect size**
	(N=5)	$t_{(5.01)}$	p	d
TBI	17.20 (7.50)	-0.89	.21	-0.80
TD	20.38 (3.34)			

Note: Means are presented with standard deviations in parentheses.

The ability to make affective inferences in TBI adolescents

In the TBI adolescents, their ability to make affective inferences was slightly worse than the typically developing adolescents (M = 17.20, SD = 7.50 vs. M = 20.38, SD = 3.34; see *Table 4*). The range of scores were more widespread though, with the highest score being 23 and the lowest score being 6.

In this analysis of the difference in the ability to make affective inferences in the TBI and typically developing adolescents violated the assumption of homogeneity of variance. An independent *t*-test using separate variance estimates was conducted. Following this analysis, the difference between the means did not turn out to be statistically significant (*M* = 17.20, *SD* = 7.50 vs. *M* = 20.38, *SD* = 3.34 for the TBI and typically developing adolescents respectively; $t_{(5.01)} = -0.89$, $p = .21$, $d = -0.80$; see *Table 4*).

Power analysis

A post hoc power analysis was conducted on the affect recognition and affective inferences data and it yielded a power estimate of 0.09. This means that there was only a 9% chance, in this study, of finding a significant small effect, at $\alpha = 0.05$, between the TBI and typically developing adolescents on both affect recognition and the ability to make affective inferences. This is clearly highly problematic, but difficulties in recruiting participants resulted in the extremely small sample obtained.

General Intellectual Ability

Performance by the TBI participants on the verbal tasks was significantly worse than that of the typically developing adolescents (*M* = 70.40, *SD* = 19.19 vs. *M* = 110.88, *SD* = 5.67 respectively; $t_{(11)} = -5.71$, $p = .00005$, $d = -2.86$; see *Table 5*).

The same was true for the performance tasks. In this analysis, however, the assumption of homogeneity of variance was violated, so an independent *t*-test using separate variance estimates was conducted. Following this analysis, it was shown that the TBI participants were significantly worse on the performance tasks than the typically developing adolescents (*M* = 81.60, *SD* = 17.63 vs. *M* = 103.75, *SD* = 6.32 respectively; $t_{(4.65)} = -2.70$, $p = .02$, $d = -1.67$; see *Table 2*).

The analysis for full scale IQ also violated the assumption of homogeneity of variance, so an independent *t*-test using separate variance estimates was conducted. Following this analysis, TBI participants had significantly lower full scale IQ scores than the typically developing adolescents (*M* = 73.20, *SD* = 15.30 vs. *M* = 108.50, *SD* = 4.07 respectively; $t_{(4,36)} = -5.05$, $p = .00003$, $d = -3.15$; see *Table 5*).

Table 5.

IQ, working memory, and processing speed means and differences between the TBI and Typically Developing (TD) adolescents

	TBI	TD	Group Differences		Effect Size
	(*N*=5)	(*N*=8)	$t_{(11)}^{*}$	*p*	*d*
WASI					
Verbal IQ *(SD)*	70.40 (19.19)	110.88 (5.67)	-5.71	0.00005	-2.86
Performance IQ *(SD)*	81.60 (17.63)	103.75 (6.32)	-2.7	0.02	-1.67
Full Scale IQ *(SD)*	73.20 (15.30)	108.50 (4.07)	-5.05	0.00003	-3.15
WISC-IV					
Working Memory *(SD)*	86.00 (19.61)	109.50 (6.74)	-2.59	0.03	-1.6
Processing Speed *(SD)*	82.60 (11.37)	101.13 (6.40)	-3.8	0.001	-2.01

* For PIQ and working memory, the degrees of freedom for the *t* statistics are 4.36 and -4.60 respectively

Note: Means are presented with standard deviations in parentheses.

Working Memory and Processing Speed

For the analysis of working memory, the assumption of homogeneity of variance was violated, so an independent *t*-test using separate variance estimates was conducted. Following this analysis, it was shown that working memory in the TBI participants was significantly impaired when compared to the typically developing adolescents (*M* = 86.00, *SD* = 19.61 vs. *M* = 109.50, *SD* = 6.74 respectively; $t_{(-4.60)} = -2.59$, $p = .03$, $d = -1.60$; see *Table 5*).

Following the analysis on speed of processing, it was shown that the TBI participants' were significantly slower than the typically developing adolescents (*M* = 82.60, *SD* = 11.37 vs. *M* = 101.13, *SD* = 6.40 respectively; $t_{(11)} = -3.80$, $p = .001$, $d = -2.01$; see *Table 5*).

Executive Functioning

In the analysis of executive functioning following a TBI, the raw scores were used as the participants were all in the same small age range and raw scores are more sensitive. The assumption of homogeneity of variance was violated, and as the groups were uneven, these results should be interpreted with caution. A mixed design analysis of variance (ANOVA) with repeated measures was conducted. There was a significant effect for the interaction between group and their executive functioning, $F_{(1,6)} = 11.48$, $p = .0000001$, $\eta^2 = .51$ (see *Table 6*). There was also a significant main effect for the type of task, $F_{(1,6)} = 63.79$, $p = .0000001$, $\eta^2 = .85$ (see *Table 6*). A significant effect in the type of task means that all the participants did more poorly on certain tasks, but the interaction between group and type of EF task is of greater interest.

Table 6.

Results of the mixed design ANOVA on differences in executive functioning (EF) between TBI and the typically developing adolescents

	SS	***df***	**MS**	***F***	***p***	**Partial eta-squared**
Group	793.0	1	793.0	2.02	.09	.15
Error	4328.0	11	393.5			
EF	83587.6	6	13931.3	63.70	.0000001	.85
EF*Group	15067.7	6	2511.3	11.48	.0000001	.51
Error	14435.1	66	218.7			

Note: Means are presented with standard deviations in parentheses.

Inspection of the cell mean plot for the interaction between the TBI and typically developing adolescents and their executive functioning indicated that there are potential significant differences between the TBI and typically developing adolescents on the number of correct verbal responses given (*M* = 58.60, *SD* = 21.35 vs. *M* = 88.50, *SD* = 10.21 respectively), the Inhibition task (*M* = 94.20, *SD* = 41.05 vs. *M* = 53.50, *SD* =7.65 respectively), and the

Inhibition/Switching task (*M* = 108.80, *SD* = 41.12 vs. *M* = 61.13, *SD* = 9.30 respectively). These three potential significant effects were then looked at further.

Table7.

Performance on the D-KEFS Verbal Fluency and Colour-Word Interference tasks by TBI and typically developing (TD) adolescents

Measure	**TBI** (*N*=5)	**TD** (*N*=8)	**Tukey's HSD** *p*	**Effect Size** η^2
D-KEFS Verbal Fluency				
Letter Fluency *(SD)*	23.80 (10.80)	34.88 (6.33)	.99	0.34
Category Fluency *(SD)*	26.80 (12.72)	40.00 (4.69)	.97	0.40
Total Correct Responses *(SD)*	58.60 (21.35)	88.50 (10.21)	.07	0.52
D-KEFS Colour-Word Interference				
Inhibition *(SD)*	94.20 (41.05)	53.50 (7.65)*	.002	0.42
Inhibition /Switching *(SD)*	108.80 (41.12)	61.13 (9.30)*	.0002	0.49
Total Errors: Inhibition *(SD)*	6.20 (2.59)	2.38 (2.56)	1.00	0.38
Total Errors: Inhibition /Switching *(SD)*	8.20 (3.70)	3.75 (1.58)	1.00	0.46

* In the Inhibition and Inhibition/Switching tasks, a smaller mean equals a better performance on the task.

Note: Means are presented with standard deviations in parentheses.

Tukey's HSD post-hoc test revealed that TBI adolescents do not give significantly less correct verbal responses than the typically developing adolescents (p = .07, η^2 = .52; see *Table 7*). It did, however, reveal that TBI adolescents take significantly longer on the Inhibition task and the Inhibition/Switching tasks than the typically developing adolescents (p = .002, η^2 = .42 vs. p = .0002, η^2 = .49 respectively; see *Table 7*).

Discussion

In this study, general IQ, executive functioning, working memory and processing speed were all significantly impaired following a TBI. The effects of interest, the ability to recognise affect and make affective inferences, however, were not shown to be significantly impaired following a TBI.

Affect Recognition

While the TBI individuals did slightly worse than the typically developing adolescents in recognising affect, this difference was not statistically significant. This result may be due to a problem with power as a small effect seems to be present (M = 25.80, SD = 1.30 vs. M = 27.75, SD = 2.25, for TBI and typically developing adolescents respectively; d = 1.06). It is, therefore, possible that the ability to recognise affect may have been found to be significantly impaired, following a TBI, had the sample size been larger. This trend, however, is not what is generally reported in the literature (Croker, & McDonald, 2005; Henry, et al., 2006; Tonks, et al., 2007). The literature suggests that affect recognition may not be significantly impaired following a TBI, even if the ability to make affective inferences is impaired. This is usually explained by suggesting that affect recognition and the ability to make affective inferences may be two distinctly different processes and that the pathway for affect recognition may be less impaired following a TBI. Before this theory can be further explored, the ability to make affective inferences needs to be analysed. First, however, the types of recognition errors made will be discussed.

In both TBI and typically developing adolescents the main errors were mistakenly attributing negative emotions to facial expressions. In accordance with the literature, there may be one of two reasons for the errors seen. The first reason is that fear, sadness, anger and disgust share distinctive features and require more in-depth processing than the adolescents gave to the task (Croker & McDonald, 2005; Matsumoto, 1992; Milders, et al., 2003). The other reason is that the pathway for recognition of negative emotions may be more vulnerable to injury than the pathway for recognition of positive emotions (Croker & McDonald, 2005). While the sample size is small in this study, it seems more feasible to attribute the errors to the fact that negative emotions share distinctive features. This is because both injured and non-injured adolescents made the same type of errors and the TBI individuals did incorrectly attribute positive emotions to some facial expressions.

The ability to make affective inferences

In general, the TBI participants did slightly worse than the typically developing adolescents with respect to the ability to infer the complex mental states of others (M = 17.20, SD = 7.50 vs. M = 20.38, SD = 3.34; d = -0.80). This difference, however, was not statistically significant. As a small effect seems to be present, this may be due to a problem with power. This suggests that it is likely that the ability to make affective inferences may have been found to be significantly impaired, following a TBI, had the desired number of participants been recruited.

This effect, although not as small, is consistent with the effect found in other literature. The ability to make affective inferences is generally seen to be affected by a TBI (Bibby & McDonald, 2005; Croker & McDonald, 2005; Henry et al., 2006; Martin & McDonald, 2005; McDonald & Flanagan, 2004; Tonks, et al., 2007).

Given the extreme constraints imposed by the very small sample size, this study cannot confirm or disconfirm the idea that affect recognition and the ability to make affective inferences may result from two distinctly different processes. The descriptive statistics indicate a trend in which both affect recognition and complex mental state inference are reduced in the TBI group. While the trends seem to be heading towards disconfirming this idea, the effect size for both processes is small. Investigation using far larger samples is required before this idea can be taken any further within the South African population.

The potential covariates of the affective abilities

IQ, executive functioning, working memory and processing speed were all tested in this study because they have all been put forward as rival hypotheses to the ToM account – viz that a ToM specific deficit causes the emotional and social impairments following a TBI. The general decline observed here in the above-mentioned processes following a TBI is, therefore, in accordance with all the literature (Bauer & Fritz, 2004; Carlson, Moses, & Breton, 2002; Carlson, Moses, & Claxton, 2004; Channon, & Crawford, 2000; Lahera et al., 2008; Slaughter, et al., 2002; Turkstra et al., 2004). It is interesting to note that the IQs of the TBI adolescents were not just significantly worse than the typically developing adolescents. They actually fell outside of the normal range of IQ scores (*M* = 81.60, *SD* = 17.63 vs. *M* = 100, *SD* = 15 for TBI participants and the normal range respectively).

In general, the TBI adolescents were more impaired than the typically developing adolescents on executive functioning tasks. Specifically, the TBI individuals in this study were more impaired on the Colour-Word Interference tasks. If the analyses on the ability to recognise affect and make affective inferences had produced significant results, the general decline in IQ and executive functioning seen following a TBI would have necessitated the need for further analyses. These analyses would have looked at both IQ and executive functioning as possible covariates impacting on recognition of emotion and the ability to make affective inferences. In this way, a detailed investigation could have occurred which would have either supported the ToM hypothesis or the rival hypotheses, which argue that a general decline in IQ or executive functioning can account for the social and emotional deficits seen following a TBI.

Limitations and directions for future studies

This study was part of a larger study, currently underway, and due to time constraints and the inability to recruit participants from schools, the sample size was small, uneven, and had very little power statistically. The uneven sample size also meant that, some of the within subjects factors of the mixed design ANOVA violated the statistical assumption of homogeneity of variances. This may have threatened the validity of those results. This limitation, however, will not be a problem for the larger study as far more time will be available to source both clinical and typically developing participants.

Another limitation may have been due to the testing process and the participants tested. The TBI adolescents all chose to participate in this study because they were interested in the effect their traumatic brain injury had on recognition of emotion and complex mental states and wished to be of help to me. They were, therefore, much more attentive and really gave their all on every task. They were also all tested at Groote Schuur Hospital in a small room completely free of distractions. The typically developing adolescents were all recruited as friends of friends and were tested in their homes. While I did test each of the typically developing adolescents in a quiet room, it was generally their bedroom and they did not maintain the same level of attention that the TBI participants did. As the ability to make affective inferences is an aspect of ToM one's level of concentration is a potential confounding variable. This should be addressed in the larger study as it is an area of concern.

Lastly, only mild TBI participants were used in this study. This was because none of the moderate TBI participants actually attended their scheduled testing session or were home when we had arranged to test them there. The inclusion of data from moderate TBI participants, however, would have impacted on the interpretation of the results. It could have been determined whether the severity of the TBI had any effect on the ability to recognise emotion or the ability to make affective inferences. In the larger study, however, ToM will be determined in both mild and moderate TBI participants and will, therefore, lead to a greater understanding of ToM following a TBI in the South African adolescent population.

Conclusion

The ability to make affective inferences is a critical ToM competency, and requires the ability to be able to recognise affect to be present. In typically developing adolescents both the ability to recognise affect and make affective inferences is present in the individual. Following a TBI, however, it has been suggested that both these processes may be impaired, with the ability to make affective inferences being significantly more impaired. In this study, however, neither affect recognition nor the ability to make affective inferences were shown to be significantly impaired following a TBI, despite obvious declines in general intellect and executive function. Both these affective abilities, however, were slightly reduced relative to the healthy controls, and it was perhaps the absence of statistical power that led to the non-significant results. A larger, more representative sample is needed for adequate, statistically sound analyses to take place, and this will be achieved in ongoing research.

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Appendix B

Consent Form

University of Cape Town
Department of Psychology

Theory of mind following paediatric traumatic brain injury: A comparative study of South African children

Principal Researcher:

Susan Malcolm-Smith
Lecturer
Department of Psychology
University of Cape Town
021-650-4605

You are invited to take part in a research study looking at theory of mind development in children with traumatic brain injury and typically developing children. Theory of mind is the ability to understand what other people want, feel and believe, and being able to predict people's actions using this knowledge. Thus, theory of mind is very important for everyday social interactions. We know that people with traumatic brain injury may have impaired and delayed theory of mind abilities, as well as impaired social and communication skills.

This study will look at the differences in theory of mind ability between children with mild and moderate traumatic brain injury and typically developing children, aged 12 to 15 years. Approximately 60 children will participate in the study.

Theory of mind has not been studied in South African children. This study will aid in the understanding of theory of mind development by seeing whether South African children develop these abilities at the same age as previously studied children from other countries. It will also increase our understanding of how theory of mind ability differs in children with traumatic brain injury compared to typically developing children.

If you consent to your child participating in this study, your child will be involved in two cognitive assessment sessions (each about 90 minutes long), where abilities like memory, language and social perception will be assessed. These abilities are assessed by completing several straightforward pencil and paper tasks. You, or another caregiver, may be present at the testing session. There are no risks involved in participating in this study. If at any time during the experiment you or your child finds any of the procedures uncomfortable, you are also free to discontinue participation without penalty. At the end of the study, both you and your child's school will receive feedback about what we found.

We will take strict precautions throughout the study to keep your personal information safe and confidential. Your information will be kept without your name or other personal identifiers, only a code, in a locked file cabinet or on a password-protected, secure computer. The data gathered from this research may be published, but your child's contribution will remain anonymous.

Should you have any questions or queries about the research or your participation, please do not hesitate to contact Nadine Kilchenmann: (cell)076 216 1266, (email) Nadine.Kilchenmann@uct.ac.za

Consent Form

The study has been explained to me, and my questions have been answered.

I understand that participation in this study is voluntary, and that I may withdraw my child at any point.

I understand that my child will not be identified except by an initial, and that this anonymity will be maintained throughout the study and when the research is published.

I consent to allow my child to participate in this study.

Child's name ______________________________________
Signature of parent/guardian **_________________________**
Date ____

I have explained the study to the participant, and in my opinion s/he understands that participation is voluntary and is able to give informed consent.

Researcher _______________________________________
Signature **____**
Date ____

Use of Samples/Data for Future Research

With your permission, we would like to store the unused parts of your child's tests for use in future research. This is your choice entirely and you are free to say no and your child will still be able to take part in the study. Please check the boxes that apply to your choice:

I do <u>not</u> want my child's samples to be used for any future research. ___

You may use my child's samples for any future research about spatial navigation. ___

Please indicate below if you would like to be notified of future research projects conducted by our research group:

______________ (initial) Yes, I would like to be added to your research participation pool and be notified of research projects in which I or my child might participate in the future.

Method of contact:

Phone number: ______________________________

Cell phone number: ______________________________

E-mail address: ______________________________

Mailing address: ______________________________

____

____

Appendix C

General Questionnaire

Participant no.: _______ Date: _______________

A. Child's Information:

1. Name: _____________________
2. Age: ______
3. Date of Birth (dd/mm/yy): ___________
4. Sex (circle one): Male Female
5. Ethnicity: White Black Indian Coloured
   Asian Other If other please specify:
   ____
6. Home Language: ___________
7. Handedness (circle one): Left Right Ambidextrous
8. Number of siblings: ___________
9. Has your child ever experienced a head injury? (e.g., being hit on the head with an object and losing consciousness as a result) YES
   NO
   If yes, please give details:
   ____
   ____
   ____
   ____
10. Has your child ever experienced any of the following medical conditions:
    a. Neurological problems YES NO
       If yes, please specify:
       ____
    b. Depression YES NO
       If yes, please specify:
       ____
    c. Memory problems YES NO

If yes, please specify:

____

d. Problems with your vision YES NO

If yes, please specify:

____

e. Problems with your hearing YES NO

If yes, please specify:

____

f. Is he/she currently taking any prescription medication? YES NO

If yes, what medication(s)?

____

____

11. Has your child ever been diagnosed with a social disorder such as conduct disorder or oppositional defiant disorder (ODD)? YES NO

If yes, please specify:

____

12. Has your child ever had a communication disorder? (For example: Having problems with understanding or producing speech, slow vocabulary development, difficulties recalling words or problems with producing sentences appropriate for his/her age.)

YES NO

If yes, please specify:

____

13. Has your child ever been diagnosed with a pervasive developmental disorder such as autism, Asperger's syndrome, Rett's disorder or childhood disintegrative disorder? YES

NO

If yes, please specify:

____

14. Has your child ever experienced learning difficulties such as dyslexia or attention-deficit / hyperactivity disorder (ADD/ ADHD)? YES

NO

If yes, please specify:

____

B. Parent Information:

1. What is the total yearly income of the household in which you live? (Circle one):

[NOTE: This should be household income, not personal income.]

Less than R80 000 R80 001 - R130 000 R130 001 - R180 000

R180 001 - R230 000 R230 001 - R300 000 More than R300 001

2. Education (highest degree or grade completed) of mother: __________________________

3. Education (highest degree or grade completed) of father: ____________________________

4. Highest occupational level of mother: (The best job you've had, not necessarily in terms of job satisfaction or pay, but rather in terms of things like prestige or social status attached to job.)

____

5. Highest occupational level of father: (The best job you've had, not necessarily in terms of job satisfaction or pay, but rather in terms of things like prestige or social status attached to job.)

____

Appendix D

Assent Form

University of Cape Town
Department of Psychology

Hello! We want to tell you about a research study we are doing. A research study is a way to learn more about something. We would like to find out more about how people understand how *other people* are feeling, and what they think. This is called theory of mind.

If you agree to join this study, you will be asked to listen to a few stories and look at some pictures. I will then ask you some questions about the stories. You will also be asked to do some tasks like drawing pictures, telling me about the meaning of some words, and building puzzles with blocks.

There will be two sessions, both about an hour and a half long. If you get tired, we can take a break at any time. You can also have a parent or guardian with you if you want.

You do not have to join this study. It is up to you. No one will be mad at you if you don't want to be in the study or if you join the study and change your mind later and stop.

Any questions?

If you sign your name below, it means that you agree to take part in this research study.

____________________ ____

Date (MM/DD/YEAR) Signature of Child/Adolescent Participant

Plagiarism Declaration

1. I know that plagiarism is wrong. Plagiarism is to use another's work and pretend that it is one's own.

2. I have used the ________ convention for citation and referencing. Each contribution to, and quotation in, this assignment from the work(s) of other people has been attributed, and has been cited and referenced.

3. This assignment is my own work.

4. I have not allowed, and will not allow, anyone to copy my work with the intention of passing it off as his or her own work.

5. I acknowledge that copying someone else's assignment or essay, or part of it, is wrong, and declare that this is my own work.

Signature ______________________________