FUNCTION OF LAUGHTER FROM A STUDENT WITH AUTISM

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by

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CERTIFICATION OF APPROVAL

I certify that I have read Function of Laughter from a Student with Autism by Timothy Joseph Runyon, and that in my opinion this work meets the criteria for approving a thesis submitted in partial fulfillment of the requirement for the degree Master of Science in Communicative Disorders: Speech-Language Pathology at San Francisco State University.

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The potential communicative functions of seemingly random outbursts of laughter from individuals with autism spectrum disorder (ASD) has yet to be fully researched. "Tyler," a 13-year old student with ASD who is included with his general education peers and exhibits the described behavior, is examined. A mixed-methods, intrinsic case study included video and audio observation, field notes, and a weekly parent survey to detail the child's laughter and the environment in which it occurred. Fifty-three episodes of laughter were analyzed using elements of functional behavioral analysis, acoustic analysis, and analysis of associated physical aspects (such as accompanying gaze and physical gesture). A gaze at the student's paraprofessional and a co-occurring full body movement emerged as the significant relationship suggesting a communicative intent to Tyler's laughter. Implication for inclusion practices and future research are discussed.

I certify that the Abstract is a correct representation of the content of this thesis.

Chair, Thesis Committee

5/15/15
Date

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Introduction

Current diagnostic criteria for autism spectrum disorder (ASD), as outlined by the Diagnostic and Statistical Manual of Mental Disorders, 5th edition, include "persistent deficits in social communication and social interaction across multiple contexts, as manifested by…deficits in social-emotional reciprocity… nonverbal communicative behaviors used for social interaction…and in developing, maintaining and understanding relationships," (APA, 2013, p. 50). The Centers for Disease Control and Prevention recently estimated the prevalence of autism spectrum disorders (ASD) in the United States to be 1 in 88 (Baio, 2012). With this increased prevalence will come an increase in the demand for special education services for this population, in addition to an increased presence of these individuals in the general education classroom. The National Center for Education Statistics (2011) estimates that, in the time period from 2007 to 2009, the total number of individuals 6 to 21 years old with ASD being served under the Disabilities Education Act who spend less than 21 percent of their time outside of the general classroom has increased from 34.6 percent to 37.4 percent. As their inclusion in the general education classroom increases, methods for recognizing and appreciating these individuals' unique behaviors must be addressed.

This study explores the role of laughter as a potentially unique communicative behavior in a student with ASD. Laughter is a basic form of communicating social connectedness and emotional states. The role of laughter in the lives of "neurotypical" (or typically developing) individuals has been extensively studied, dating back to the

naturalist and geologist Charles Darwin. Darwin (1872/1998) concluded that laughter can function both "to signal the occurrence of positive emotions such as happiness and joy" and to express "negative states such as anger, shame, and nervousness, possibly masking rather than displaying those states," (as cited in Owren & Bachorowski, 2003, p. 188). Owren and Bachorowski (2003) concluded that individuals also use laughter "to influence perceiver affect and associated behavior" (p. 195). In other words, laughter serves a social purpose between partners.

Laughter in human interaction has also been studied through the lens of conversation analysis (Sacks, Schegloff, & Jefferson, 1974). According to Glenn (2003), the earliest research into laughter in interaction can be attributed to Gail Jefferson and colleagues. These early researchers "became aware of the possible insights to be gained from not only noting the occurrence of laughter but also transcribing the sounds of laughter" (Glenn, 2003, p. 42). Glen also notes that "people orient not simply to the presence or absence of laughter in conversation, but to its length, placement, acoustic shape, and coordination with other bits of talk" (2003, p. 42). Jefferson's early research supported the notion that transcribing the sound of laughter would ultimately shed light on laughter's inherently social nature. Apart from developing a system for transcribing laughter's acoustical features, Jefferson and colleagues demonstrated how individuals utilize laughter in tightly controlled, highly specific ways – in conjunction with other sounds and actions, as brief aspirations accompanying speech, via streams of laughter constituting a full turn in interaction and varying in volume and tempo throughout, as

open and closed-mouth (nasal) laughter, as in-breath laughter – and for specific purposes – as a turn-taking cue, at specific recognition points, in response to other laughter, or to signify some change in the listener or speaker's understanding (Jefferson, 1974; Jefferson, Sacks, & Schegloff, 1977; Milford, 1977; Sacks, 1974).

Episodes of laughter with no apparent source or referent are a common behavior exhibited by individuals with ASD that has been little explored. According to the American Speech-Language-Hearing Association (n.d.), a symptom of ASD related to deficits in social skills includes "giggling or laughing for no known reason or at the wrong time." In the setting of the general classroom, unexpected outbursts of laughter can be regarded by peers and teaching staff as disruptive. According to Jefferson, Sacks, and Schegloff (1977), laughing is "indexical – it is referring to something, and hearers will seek out its referent" (as cited in Glenn, 2003, p. 48). If the "hearers" in the general education classroom – peers, paraprofessional staff, teachers – seek the referent of an autistic individual's laughter, and the laughter seems to have none in the present context, the ramifications for the autistic individual's effective inclusion into the general education setting are dire. If laughter is being used by the autistic individual as a bid for social interaction and thus has communicative intent – and this communicative intent is being ignored or written off – the risk to the autistic individual's development as a social being is also at risk. The following question therefore warrants further investigation – could episodes of laughter from an individual with ASD – ones that have no apparent source or referent – be serving a communicative purpose that has yet to be identified?

Review of the Literature

Little research has been undertaken with regards to a possible communicative function of laughter from individuals with ASD, particularly episodes of laughter that may not correspond to any apparent humorous stimuli. Much of what does exist on the topic has been incorporated into studies of individuals with Asperger's syndrome (a diagnosis included in previous editions of the Diagnostic and Statistical Manual of Mental Disorders and often considered a "higher functioning" manifestation of ASD) and their preference for and comprehension of certain forms of humor (Van Bourgondien & Mesibov, 1987; Emerich, Creaghead, Grether, Murray, & Grasha, 2003; Samson & Hegenloh, 2010; Samson, Huber, & Ruch, 2013; Weiss, Gschaidbauer, Samson, Steinbacker, Fink, & Papousek, 2013). These studies should not be discarded for the current study's purposes, however, as they provide evidence that laughter is indeed used by individuals with ASD as a reaction to humor, albeit with preferences for different types of humor than typically developing individuals (incongruity-resolution humor over nonsense humor, for example, according to Samson, Huber, & Ruch, 2013).

Other researchers have written about reactions to humor and the laughter of individuals with ASD in the context of a developmental model of language. St. James & Tager-Flusberg (1994) recruited six children with Down syndrome (ages 3 years, 3 months to 6 years, 9 months) and six children with autism (ages 3 years, 4 months to 6 years, 9 months) to participate in a study investigating "the early emergence and development of the naturalistic expression and understanding of humor," (St. James &

Tager-Flusberg, 1994, p. 603). The researchers utilized a single-subject, mixed-methods style of research, observing spontaneous interactions between the children and their mothers for one-hour periods, every other month. The mother and child participated in "play, or other loosely structured activities chosen by the mothers," (Tager-Flusberg, 1994, p. 606). They subsequently classified "humorous episodes" (as defined by the presence of laughter) using three scales – an intentionality classification, a social classification, and a cognitive developmental classification. The cognitive developmental classification attempted to capture the age-appropriateness of the humorous episode, and ranged from tickling (what the authors considered an early humor form) to jokes (a later-developing form of humor). The social classification indicated whether or not the children shared the humor with their mothers, and provided information about who initiated the humor and the reaction of the individual who responded. The intentionality classification captured "the level of intentionality evident in the child's involvement in the humor" and "was based on a combination of the cognitive developmental classification and the social classification," (St. James & Tager-Flusberg, 1994, p. 609).

Results revealed that the children with Down syndrome produced "significantly more episodes of humor than the children with autism," (St. James & Tager-Flusberg, 1994, p. 610). In the cognitive developmental dimension, children with autism created instances of humor up to the "verbal incongruity" stage of developmentally-ordered classes, but children with Down syndrome produced a significantly greater number of these episodes. The authors considered the "verbal incongruity" stage a more advanced

form of sharing humor, utilizing nonsensical semantic associations for comic effect (i.e., a reply of "the legs are on the head" when asked to make a sentence using the word "legs"). According to the authors, verbal incongruity humor requires awareness that the communication partner would find an incorrect answer humorous. Both groups produced a majority of humor episodes at the nonverbal level. No significant differences in classifications were found between the groups in the social dimension of humor (i.e., between child-initiated and mother-initiated humor, and subsequent response types, such as positive, negative, or neutral). In the intentionality dimension, all children with Down syndrome showed evidence of intentionality in their humor episodes (i.e., doing something silly and gazing towards the mother, expecting a reaction), while almost half of the humorous examples of children with autism did not show signs of intentionality.

This study supports the notion that children with autism react with laughter to humorous situations, and that individuals with autism find enjoyment in humorous situations from a very young age, even though these responses may occur at a lower frequency and with fewer signs of intentionality. According to results reported by St. James and Tager-Flusberg, children with autism are also capable of engaging in more developmentally-advanced forms of humor that require an understanding of expectation. Most relevant to the present study is their conclusion that young individuals with autism experience humor in distinctly social ways – "the vast majority of humorous episodes were socially shared experiences," (St. James & Tager-Flusberg, 1994, p. 614).

Reddy, Williams, and Vaughan (2002) developed a cross-sectional study in which 16 pre-school children with Down syndrome and 19 children with autism (matched on non-verbal mental age) participated. According to the researchers, "comparing different aspects of humorous interactions in children with autism and children with Down syndrome with patterns reported in typical development may help us better understand specific affective and socio-cognitive problems in autism," (Reddy, Williams, & Vaughan, 2002, p. 223). The design included two to three home visits, each approximately two weeks apart, during which a parent interview would take place, in addition to "a parent questionnaire about language production (the *MacArthur Communicative Inventory*), psychometric tests (*Bayley Scales of Infant Development* and the *Vineland Adaptive Behavior Scale*), and free play between parents and child and play-with-toys with and without the parents," (Reddy, Williams, & Vaughan, 2002, p. 224). The researchers audio recorded the parent interviews and videotaped the free play and play-with-toys sessions. In addition, parents were provided with audio recording devices to record contextual details of humorous exchanges or episodes of laughter from their children that occurred between visits by the researcher.

Researchers coded the parents' reports in terms of the types of events that elicited laughter from the child, including tactile, auditory, and visual events, in addition to socially inappropriate acts. Researchers also coded parent responses to inquiries regarding their children's attempts to join in others' laughter, clowning, teasing by the child, and teasing by the parents. Results from the parental reports indicated that "there

were no significant differences between the autism and Down Syndrome groups in overall frequency of laughter reported by the parents," (Reddy, Williams, & Vaughan , 2002, p. 227). The researchers found differences, however, in terms of what the children in each group found funny. Of particular relevance to the current study, 88% of parents of children with autism indicated that their children would laugh for "no apparent reason", compared with 6% of parents of children with Down syndrome (Reddy, Williams, & Vaughan, 2002, p. 227). Researchers indicated that "all but one of the parents in the autism group spontaneously mentioned that the children laughed at strange or odd things, at odd times, or at incomprehensible or inappropriate stimuli," (Reddy, Williams, & Vaughan, 2002, p. 228). In addition, parents of children with autism reported that laughter was uncommon in response to funny faces, socially inappropriate acts, or other people's laughter.

Videotape of the children's free play and play-with-toy sessions were coded initially with the "identification of a laugh either from the child or from any other person present in the room when the child was also present," (Reddy, Williams, & Vaughan, 2002, p. 232). A laugh episode was "identified by the occurrence of a laugh from any person present in the room and consisted of one or more laughs by one or more people about a particular topic content," (Reddy, Williams, & Vaughan, 2002, p. 232). The researchers then analyzed each laugh episode in terms of the duration of the laugh, whether or not a laugh was started by the child, the "child laugh direction" (i.e., whether or not the child directed the laugh at another individual), and the child's response to

other's laughter. The researchers reported that children with autism "showed higher frequencies of unshared laughter in interactive situations and lower frequencies of attention or smiles in response to others' laughter," (Reddy, Williams, & Vaughan, 2002, p. 219).

Despite the small sample size, the results of the study by Reddy, Williams, and Vaughan have important implications on the current study. First, the researchers confirmed that episodes of seemingly random laughter occur often and are readily noticed by parents, thus warranting further investigation. Second, the researchers cast some doubt on St. James and Tager-Flusberg's (1994) conclusion that children with autism often share laughter and humor in socially meaningful ways. Reddy, Williams, and Vaughan argue for a distinct antisocial component to the ways in which children with autism utilize laugher. Their results suggest that if a child with autism laughs in response to something that he or she finds humorous, the source of the humor may not lie in the present environment.

Sheinkpf, Mundy, Oller, and Steffens (2000) studied the early vocal behaviors of two groups of children – 11 with developmental delays (9 boys and 2 girls with a mean age of 36 months) and 15 with a diagnosis of autism (13 boys and 2 girls, with a mean age of 45 months). The researchers matched the group of children with developmental delays to the group of children with autism based on expressive verbal ability and nonverbal mental age. For both groups, only children with emergent language (less than five words) or preverbal children were included. As a part of the testing battery

administered to the children in two consecutive weekly sessions, the researchers administered and video recorded the *Early Social-Communication Scales (ESCS)* – a measure of nonverbal communication behavior. The *ESCS* involves an examiner presenting the child with interactive games and toys designed to elicit social interaction, joint attention, and behavior regulation. Separate observers then coded each child's vocalizations and gestural acts. The children's vocalizations "were coded in ways that provided…characterizations of syllable structure, vocal quality, and counts of utterance features associated with specific emotional states (e.g., fussing and laughing)," (Sheinkpf, Mundy, Oller, & Steffens, 2000, p. 348). Vocal variables that researchers analyzed included a laugh ratio, defined as "the proportion of syllables where children were judged as laughing," (Sheinkpf, Mundy, Oller, & Steffens, 2000, p. 349). Results indicated no significant difference in the laugh ratios between children diagnosed with autism and those with developmental delays, however children with autism "produced a greater proportion of syllables with atypical phonation than did comparative children," (Sheinkpf, Mundy, Oller, & Steffens, 2000, p. 345). The researchers conclude that impacted vocal quality, rather than an overabundance or lack of laughter, could be a "positive early symptom marker of autism," (Sheinkpf, Mundy, Oller, & Steffens, 2000, p. 352).

The researchers' findings suggest that young children with ASD do not produce an abnormally abundant amount of laughter, nor do they underutilize the behavior. Due to the researchers' limited sample, however, this may not be true for all individuals with

ASD. Yet the conclusion informs the current study by indicating that the frequency of laughter may not be the feature that distinguishes the laughter of individuals with ASD from that of neurotypical individuals.

Researchers have also studied the acoustic properties of laughter from individuals with ASD in an attempt to link the acoustic details of different variations of laughter to specific functionality. Hudenko, Stone, and Bachorowski (2009) set out to better understand the assumed lack of emotion-related expressions in those with autism, particularly laughter, through acoustical analysis. To do this, the authors decided to quantify the amount of voiced and unvoiced laughter from a selection of children's laughing episodes. Hudenko et al. write that the two acoustic properties are functionally discrete – voiced laughter is associated with a positive internal state and unvoiced laughter, although evaluated less in the literature, is associated with navigating the subtleties of social interaction. The researchers predicted (via a nondirectional hypothesis) that voiced laughter would be present in both children with and without autism spectrum disorder. Via a directional hypothesis, Hudenko et al. anticipated that children with autism would produce less unvoiced laughter than their typically developing peers. The researchers also directionally hypothesized that those with autism would exhibit laughter that was more restricted in acoustic range – having lower fundamental frequency, less change in fundamental frequency, shorter laugh durations, and fewer laugh calls (laugh "notes" or "syllables") per laugh episode compared to peers without autism. The researchers utilized a single-subject, quantitative research method to

collect data, testing children individually using a laugh assessment sequence that was recorded via microphone and subsequently analyzed via computer. The laugh assessment sequence included a "surprise" tickle game, hitting an inflated balloon back and forth, building a tower of blocks with the child and then knocking it over, and popping bubbles. Participants included

> 15 eight- to ten-year-old children diagnosed with autism (13 male, 2 female), 15 typically developing children who were individually matched on both sex and chronological age (plus or minus 3 months of participant with autism), and 15 typically developing children who were individually matched on both sex and Verbal Mental Age (plus or minus 3 months of participant with autism). (Hudenko, Stone, and Bachorowski, 2009, p. 1394).

The researchers utilized the two comparison groups to get "a baseline of laugh production in typically developing children (group matched on chronological age) and to account for cognitive delays in the participants with autism (group matched on Verbal Mental Age)," (Hudenko, Stone, and Bachorowski, 2009, p. 1394). The researchers recruited all children from the greater Nashville, Tennessee area from 2001 – 2003. All children with autism had received a diagnosis from a licensed psychologist based on DSM-4 Text Revision criteria, and the researchers only included those individuals who completed the *Autism Diagnostic Observation Schedule – Generic Module 2* or higher.

The researchers found that on average, only 3% of the laugh episodes produced by those with autism spectrum disorders were unvoiced, compared with typically

developing peers, whose laughs were 37 – 48% unvoiced. The researchers also found that differences in acoustic measures (fundamental frequency, etc.) proved not significant between baseline groups and those individuals with autism, except for those involving voicing. Hudenko et al.'s study helps to establish that individuals with autism spectrum disorder utilize laughter in much the same way that normal-developing peers do – to express positive affect. The lack of unvoiced laughter produced by children in the study with autism spectrum disorder (underscoring a lack of diversity in the types of laughter utilized) suggests that their laughter is more closely linked to their own internal condition, as opposed to being shaped and amended by social situations. One must also consider, however, that the researchers designed pre-planned situations to elicit the children's laugher, and that the environment of the study was relatively controlled compared to "real-life" situations. By extension, the conclusions reached by Hudenko et al. may not pertain to the spontaneous laughter of autistic individuals in everyday life.

Auburn and Pollock (2013) used conversation analysis to investigate the laughter in interaction of a non-verbal child with severe autism. The authors utilized a score of 37 or over on the *Childhood Autism Rating Scale* to classify the child's autism as "severe" (Schopler, Rechler, & Rochen-Renner, 1988). Auburn and Pollock presented three sequences from videotaped interactions – the child informally engaging with his mother, participating in a cooking lesson, and interacting during an ABA therapy session. Analyzed episodes revealed that the child, via a "systematic sequence of multimodal actions, invites laughter, and thereby projects affiliation," (Auburn & Pollock, 2013, p.

138). The authors also argued that the child utilized laughter in both first and second pair parts of adjancey pair sequences as a means of joking and teasing, respectively. Schegloff (2007) described an adjancey pair – the basic unit of sequence organization in conversation analysis – as "composed of two turns, by different speakers, adjacently placed; that is, one after the other," (p. 13). The two turns composing an adjancey pair must be "relatively ordered," or

> differentiated into 'first pair parts' (utterance types such as question, request, offer, invitation, announcement, etc.) and 'second pair parts' (utterance types such as answer, grant, reject, accept, decline, agree/disagree, acknowledge, etc.) – types which are responsive to the action of a prior turn. (Schegloff, 2007, p. 13)

Additionally, first and second pair parts must be "pair-type related," (Schegloff, 2007, p. 13). In other words, any second pair part cannot be arbitrarily matched with any first pair part – the two must together emerge from a shared pair type (exchanges such as "greeting-greeting, question-answer, offer-accept/decline," etc.,) (Schegloff, 2007, p. 13).

The researchers demonstrated the efficacy of conversation analysis as a tool to inductively demonstrate the social use of laughter (during brief periods of interaction) by an individual on the autism spectrum. It is unfortunate, however, that the authors only focused their reported analysis on a single child when, as the authors write, "the organization of interaction we adumbrate was based on a larger corpus of naturalistic data," (Auburn and Pollock, 2013, p. 138). This larger corpus consisted of "12 hours of

videotape obtained from 11 children," (Auburn & Pollock, 2013, p. 138). The children ranged in age from four to eleven years and scored a value of 37 or over on the aforementioned childhood autism rating scale. The authors filmed five children in the home setting during family mealtimes, therapy sessions, and family interactions. The remaining six of the children were filmed at school. From this original corpus, the authors described having identified each episode of laughter initiated by a child (e.g., the child produced the first laugh) and whether the laughter was part of a shared or unshared experience. Unfortunately, Auburn and Pollock neglect to fully explain how they determined whether the laughter constituted a shared or unshared instance, and whether this label impacted which interactions were analyzed.

Following an analysis of the entire corpus of data, a pattern emerged, according to the authors – the children appeared to use "laugher or smiling in combination with eye gaze specifically to modulate or condition a contemporaneous action in such a way as to constitute it potentially as laughable," (2013, p. 138). The authors did not detail this original analysis. As mentioned previously, and for reasons unexplained, Auburn and Pollock illuminate this pattern by presenting data from only one child. Their argument would have been strengthened had they presented information from all of the naturalistic data collected, especially due to the wide age range of participants and the varying environments in which they were observed.

The Current Study

Previous studies that analyzed the use of laughter by young children with ASD have suggested both social and antisocial motivations for its use. That is, there were instances when autistic children used laughter to project attachment with others and share humorous experiences, and times when their laughter seemed to be void of any referent in the present environment. The current study sought to investigate how this behavior matures in an adolescent with ASD. Previous studies have limited their samples to those of young age and have not analyzed the laughter's pattern of occurrence over time. Instead, episodes of laughter have been quantified and compared to the amount of laughter produced by a control group, or have been categorized by researchers to draw additional conclusions – tracking the use of voiced and unvoiced laughter to measure a child's adeptness at navigating social subtleties, or analyzing the developmental "level" of humor that a child laughs at.

The current study attempted to evaluate whether or not an adolescent on the autism spectrum used laughter in ways that have yet to be commonly identified (i.e., beyond a response to humorous stimuli). The researcher did so by evaluating numerous characteristics of the adolescent's laughter to analyze its use by the participant over time, in an environment that had not been manipulated. Whereas past research into the use of laughter by those with autism have focused predominately on the quantity of laughter or its characteristics, the current study investigated the adolescent's laughter over time, in search of unique patterns of use.

Methods

The current study involved an autistic student with whom the researcher worked as a paraprofessional during the 2014 – 2015 academic year. The student was included in the general education classroom for both math and science courses, and the researcher worked in the same classroom to provide assistance to the autistic student and several other students with special needs. During this time, the researcher noted that the individual with ASD exhibited episodes of laughter with no apparent referent in the immediate context, and wondered if the behavior had a communicative function that the student's support staff, teachers, therapists, and peers were failing to recognize. The opportunity to complete a master's thesis as the culminating experience of a graduate program in speech-language pathology inspired a return to the classroom.

The Student Participant

The student, 'Tyler', was 13 years old at the time he was video-taped for this study. He lived with his parents and sister in a city in Northern California and attended a large public middle school in a city's suburban district. Tyler's primary language was American English, and his parents and sister also spoke English in the home. Tyler began receiving a private speech and language service at age 5 years, entered kindergarten at approximately 5 years, 9 months of age, and was diagnosed with autism at approximately 6 years, 6 months of age. Tyler has received special education services from the local school district since enrolling in kindergarten. Upon entering kindergarten, the student received speech-language services from the local school district. After receiving a

diagnosis of autism, the student qualified for physical and occupational therapy, but the parents described these services as ending soon after they started. Special education services also included full-time educational accommodations provided in a special-day class from kindergarten through the 5th grade. When the child entered the 6th grade, he began to be included in the general education classroom for several periods per day, as in the present study. Tyler currently receives seventy-five minutes per week of speech-language services, delivered on-site and in a separate therapy room with other students his age.

The individual demonstrated limited expressive language skills throughout the study's duration. Tyler had a spontaneous vocabulary of four rote phrases and approximately nine single-word utterances that he employed in the classroom setting, all of which he used in a meaningful and referential fashion. The rote phrases included, "I need help," "Can I go to the bathroom?" "Five minutes" (in response to how long of a break he needed), and "Mario costume" (a reference to his Halloween outfit). The single-word utterances included, "Yes," "No," "Sick," "Hurts," "Hot," "Rest," "Erase?" "Stamp," "Halloween," and "Mario costume." Otherwise, the child communicated spontaneously via gesture, specifically pointing, to bring the attention of those around him to particular items in his environment. The child occasionally demonstrated echolalia.

The researcher reviewed Tyler's Individualized Education Program (IEP) paperwork to validate his language abilities. According to a triennial assessment report

dated October 7th, 2013 and completed by a licensed speech-language pathologist (SLP) employed by Tyler's local school district, Tyler's language form (grammar) and content (semantics) appeared to be significantly below age level expectancy, based on Tyler's performance on the *Comprehensive Assessment of Spoken Language,* the *Receptive One-Word Picture Vocabulary Test – 4th Edition*, and the *Expressive One-Word Picture Vocabulary Test – 4th Edition.* Based on an informal language sample, Tyler had difficulty following conversational themes, expounding on conversational themes, replying appropriately to questions, constructing grammatically accurate sentences, and taking proper conversational turns. Relative strengths reported by the SLP included his commitment to hard work and his semantic lexicon. The SLP reported Tyler being 20-30% intelligible to novel listeners and 50% intelligible to trained or acquainted listeners. Tyler also presented with articulation errors, as well as several phonological processes. The "Social Emotional & Behavioral" and "Adaptive/Daily Living Skills" sections of the IEP document read that Tyler frequently requires adult prompting and assistance to transition between activities and properly handle emotionally stressful situations.

The Setting

A normal school day for Tyler and his neurotypical peers consists of seven periods of approximately fifty minutes, extending from 9:00 am to 3:30 pm. A lunch break is scheduled during period four, around noon. Like his typically developing peers, Tyler must enter a busy hallway between periods and navigate to his next classroom within four to five minutes. During this time, Tyler is sometimes accompanied by a

paraprofessional, but he is largely independent and unbothered by the commotion and sensory stimuli associated with the bustling movement and loud voices of over one thousand middle school students. Tyler attends math, science, an elective course (art), and physical education with his neurotypical peers in general education settings. During each of these four periods, a paraprofessional assists Tyler and several other special education students who are present. For social studies and language arts courses, a teacher instructs Tyler and other students with similar needs in a special day class setting.

Data Collection

In the current study, the researcher was a nonparticipant, complete observer. Observation took place in a general education science classroom, on the same day of the week (Thursday), over 12 weeks. The researcher selected this class and time largely due to the weekly, group-oriented lab projects that took place on Thursday. The researcher determined that a science class based largely on group activities would create an environment with more opportunities for communication than, for example, the math class in which Tyler was included with his general education peers. A better opportunity would therefore exist to study any communicative functions of Tyler's laughter. The researcher also wanted to determine if Tyler's laughter might in some way be associated with the placement of the science class in Tyler's school schedule and the excitement of soon leaving school for the day. The class met from approximately 2:30 – 3:30 pm daily, during school day's final academic period.

The class followed roughly the same schedule each Thursday. For the first ten to fifteen minutes of the class period, a pre-selected, roaming student stamped students' completed homework. The class simultaneously completed a "Do Now" activity – a short "warm-up" exercise related to the day's topic. For the next twenty to thirty minutes, the teacher presented the day's lesson and associated lab activity. The final third of the class was dedicated to students carrying out a lab project, or completing additional in-class worksheets or written assignments. Alterations to this schedule were noted in the researcher's field notes, and included examinations lasting the duration of the period, as well as days consisting entirely of student presentations. All students in the class sat around rectangular wooden tables with approximately four to six students per table. Tyler joined in this arrangement, and was not physically separated from his peers in any way.

This study is a mixed-methods, intrinsic case study utilizing both observation and survey components (Yin, 2014). Field notes were manually recorded and noted the approximate time and circumstances of any episodes of laughter from the student participant. General observations were also noted, including: 1) the topic and activity for the day, 2) the individual's perceived emotional state and behavior throughout the class period, 3) reactions to interaction between the individual and peers, 4) reactions to interactions between the individual, and teacher/support staff, and 5) extraneous sensory elements (lights, level of noise, etc.). The researcher utilized a Flip UltraHD video recorder to film the student during the class period, and an Olympus DS-40 Digital Voice Recorder (placed in closer proximity to the student than the digital video recorder, on a

table directly in front of him) to collect audio data. No audio or video data was collected during the first two observation periods, as this time was meant to allow the students, teacher, and paraprofessional to adapt to the researcher's presence. In total, the researcher collected 8 hours, 49 minutes, and 28 seconds of digital video and 8 hours, 33 minutes, and 33 seconds of digital audio.

In conjunction with each weekly observation, the student's parents completed an online survey that included three questions regarding the twenty-four hours prior to observation and one question regarding the previous week between observations. (See appendix A for the full text of the weekly parent survey.) The first question requested that the student's parents note whether or not Tyler received his normal breakfast and lunch prior to being observed. If he did not, they were given a chance to explain what changed. The second question requested that the student's parents note whether or not Tyler received his normal amount of sleep on the night prior to being observed. If he did not, they were again given the chance to explain what changed. The third question requested that the student's parents note whether, during the 24 hours prior to being observed, Tyler experienced any additional disruptions to his normal routine. If he did, the parents were given the chance to explain what occurred and were asked to rate the level of change to his routine (minimal, moderate, or substantial). Finally, the fourth question asked parents whether or not they remembered, in the week prior to Tyler's observation, any time when Tyler laughed and they recognized the source of the laughter. If they did, they were asked

to briefly explain the laughter's source and to estimate the approximate duration of the episode of laughter.

Data Reduction

The researcher initially worked to reduce the copious amounts of video and audio to a manageable data set. An integrative methodology was used to determine what data would be most relevant to the current study's objective. The researcher adapted the methods of analyzing video recordings described by Erickson (2006), whose "whole to part 'inductive' approach" focuses "on interaction process, and integrated study of literal referential meaning and metaphoric social meaning," (p. 190). This allowed for a more holistic approach to interpreting the video data. Instead of viewing the video recording to locate only episodes of laughter, the researcher utilized the full recording (and thus the full dynamic environment) of the classroom to inform decisions regarding the laughter's cause and social implications. Erickson suggests the following steps when analyzing video recording: 1) view the video recording as a whole, without stopping, writing additional field notes as both nonverbal and verbal phenomena of interest occur; 2) review the entire event again, this time stopping and replaying the video to create a timeline based on major changes in participant behavior (i.e., alterations in attention or body posture); 3) select, "within an episode of interest, a single strip of tape that contains a single sustained postural/distance/gaze configuration among all the participants in the interaction" and "transcribe the talk and the nonverbal behavior of the various speakers and listeners"; 4) continue to replay short clips within episodes of interest until one

obtains adequate descriptive information to begin answering the research questions (2006, p. 191 – 192).

The researcher followed these steps with several modifications. First, the researcher developed a timeline based predominately on when the child laughed – most often, it was the episode of laughter that represented the major shift in the child's overall behavior and the behavior of those around him. The laughter often drew other students' and staff members' attention towards Tyler. The researcher documented each episode of laughter by the video recording's digital time stamp and the approximate time of day. The researcher also noted major transitions in classroom activities and substantial changes in fellow classmates' positions in the classroom on field notes. Second, because the researcher only obtained permission to video record the observed child, it was often difficult to decipher the "postural/distance/gaze configuration" of all members of an interaction, even with the assistance of field notes taken in the classroom. For example, if Tyler's episode of laughter was accompanied by a specific body motion (i.e., clapping) and a specific gaze (i.e., towards a nearby student), only this information could be adequately observed, recorded, and verified. The student who Tyler gazed towards while laughing was neither video recorded nor the focus of the researcher's attention during live class observation – the researcher only recorded that Tyler looked at him or her. The researcher therefore only assigned information regarding gaze and accompanying body movement to the observed student. Ongoing conversations in the classroom were not transcribed, as none of Tyler's episodes of laughter occurred in the context of a

traditional interaction, with predetermined "speakers" and "listeners". Rather, the researcher devised a coding scheme to record the verbal and nonverbal activities in the surrounding environment during each episode of laughter. This coding scheme will be discussed more fully in a later section.

Erikson originally suggested the aforementioned technique for researchers who had collected video data in an educational classroom setting and who wished to primarily investigate the interaction between teachers and their students. While the researcher is only interested in the behavior of one student, similar methods can be applied here for two reasons. First, the student was observed and recorded in a classroom setting, and the methods devised by Erikson are based in this environment and structured to incorporate the classroom setting. As written previously, Erikson suggests segmenting one recorded "event" (in this case, a 50-minute class period) based on "major shifts in participants (in and out of the scene), of sustained postural and interpersonal distance configurations, and of major topics and/or speaking/listening activities," (2006, p. 191). Modified for the current study, noting the child's episodes of laughter in the context of major shifts in fellow classmates' movement and in classroom activities not only gave the researcher a means to organize copious amounts of video data, but allowed for a more organized analysis of how environmental conditions may or may not have impacted the presence, duration, and quality of laughter exhibited during the class period. Second, a "whole-to-part" methodology was crucial to the current study, as the researcher attempted to "identify patterns in data for which there [were] no strong orienting hypotheses,

predictions, or theories," (Derry et al., 2010, p.17). No previous research has sought to determine whether an episode of laughter from an individual with ASD – one that has no apparent source or referent – could serve a communicative purpose.

Following video analysis using the methods described by Erickson (2006), the researcher had gathered data associated with the time that the episodes of laughter occurred during each observation session, the direction of Tyler's gaze during each episode of laughter, and any associated physical movements accompanying Tyler's laughing. With regards to the information collected about Tyler's gaze and associated physical movements, patterns of behavior emerged that were suitable to the researcher's use of coding. The researcher identified a total of fifty-three episodes of laughter over the course of the ten-week observation period, totaling approximately 1 minute and 9 seconds of recorded laughter.

Coding

According to Derry (2007), "methods of analysis in which videotaped records are coded are rooted in the practices of *discipline observation*, a core feature of scientific methodology," (p. 33). While researchers utilizing video often "develop systems of analysis over the course of multiple research projects," creating any type of coding system "benefits from iterative cycles of work," (Derry et al., 2010, p. 21). The researcher did not develop the coding system associated with the child's gaze and physical movements over the course of several research projects, nor did there exist any predetermined coding schemes to organize the information that the researcher sought to

acquire. The researcher did, however, make multiple, repeated passes at viewing both micro and macro segments of video data, forming coding schemes based on "iterative cycles of work". The coding methods associated with the child's gaze and concomitant physical movements while laughing, for example, emerged from exhaustive viewing and reviewing, and are specific to Tyler's behavior and his classroom environment.

The researcher devised extensive coding schemas to analyze the laughter's occurrence as potential communicative device over time. The researcher incorporated numerous data points to cast as wide a net as possible, giving the child every opportunity to indicate whether or not an episode of his laughter – one that had no apparent source or referent – was serving a communicative purpose that had yet to be identified. The researcher analyzed the relationships between Tyler's laughter and the following: 1) the associated gaze and movements, 2) their antecedents and consequences, 3) conditions in the immediate physical environment, 4) remote antecedents, and 5) their acoustic qualities. Associated gaze and movements were reviewed because an individual will typically gaze in the direction of the specific individual with whom he or she is attempting to communicate. How an individual uses his or her body while communicating provides insight into the intent of the communication, how the individual feels, and the social appropriateness of communication. Antecedents and consequences of the laughter episodes, in addition to what occurred in the immediate physical environment, were analyzed because the action taking place around an individual – and what he or she does vocally or physically before and after communicating – impacts

when and how an individual might communicate. Perhaps, for example, an individual feels most comfortable communicating in a noisy environment, or tends to communicate immediately before or after initiating a specific action. The researcher evaluated remote antecedents, such as the amount of sleep that Tyler received the night prior to observation, as changes in these physiological necessities will impact how an individual communicates, if he or she chooses to do so at all. Finally, the acoustic properties of the child's laughter were analyzed to examine whether the child produced laughter with similar acoustic properties during similar situations over time. More detailed information about each coding scheme can be found in the following sections.

Gaze and movement. By coding specific behaviors, the researcher could better organize the phenomena associated with Tyler's episodes of laughter, and determine quantitative associations between various aspects of his behavior (i.e., between Tyler's gaze and his physical movements while laughing). More broadly, where one looks provides insight into who an individual might be attempting to communicate with, and how one uses his or her body while communicating provides insight into the intent of the communication, how the communicator feels, and the social appropriateness of the communication. Of the fifty-three original episodes of laughter, the researcher analyzed Tyler's gaze and movement during forty-nine episodes (fifty-three minus four episodes during which the researcher could not determine the direction of the student's gaze, as he was off-screen and no corresponding field notes existed). The gaze and physical movement coding scheme can be found in the table 2.1.

Table 2.1 – Coding Scheme for Gaze and Associated Physical Movement Accompanying an Episode of Laughter

Gaze	Associated Physical Movement
0 – Paraprofessional	0 – No associated physical movement
1 – Teacher **OR** Classmate*	1 – Clapping
2 - Directly across from/to either side of his person (level, toward the horizon), including towards projected media. Not towards a specific person.	2 – Hands covering his mouth
3 – Down, towards the table in front of him or towards the floor (slightly to fully below the horizon, including towards his school materials (i.e., binders, papers, etc.) and his backpack on the floor. Not towards a specific person.	3 – Full-body movement (i.e., "bouncing" in his chair or off the rear of his chair while seated, moving arms and hands with associated torso movement while seated, running/jumping in place while standing)
4 – Unable to determine (off camera)	4 – Unable to determine (off camera)

* Originally two separate coding categories, but too few instances occurred for robust statistical analysis. Prior to combining these codes, the researcher investigated potential relationships with other coding variables, as well as with qualitative observations. No obvious relationships were discovered. The two codes were also logically related, as a gaze towards either the teacher or the classmate while laughing occurred most often during classroom activities that were *led by the teacher or a classmate,* respectively – all eyes, including Tyler's, were on the person leading the activity.

Antecedents and consequences. To further describe the environment in which the laughter occurred, the researcher utilized methods derived from functional behavior analysis. Bijou, Peterson, and Ault (1968) first championed descriptive functional analysis, in which the researcher or applied-behavioral professional directly observes and records the behavior of an individual, later assessing this data to determine the antecedent and consequence of a behavior of interest (in this case, the behavior of laughing). This process, also known as the A-B-C method, aided the researcher in determining potential purposes (the "why") of the student's laughter. For behavioral specialists working in school settings, this information can be used to redirect the actions of individuals with

problem behaviors. The researcher never assumed that the subject's laughter equated to a "problem" behavior that needed to be redirected or eliminated completely, but rather determined the A-B-C method to be helpful in deciphering patterns of activity that could then be utilized to decide whether the child repeatedly utilized laughter in similar environmental conditions and/or specific social situations.

To carry out an accurate and detailed functional behavioral analysis in the current study, the researcher systematically located each video recorded episode of laughter and noted the subject's immediate antecedent action and subsequent, immediate consequence. The researcher based this information on the ten seconds surrounding the episode of laughter – five seconds before the start of the laughter, and five seconds following the termination of the laughing episode. Laughter occurring more than one second after the termination of a previous laugh was counted as a separate "episode". The researcher then modified the traditional functional behavior analysis procedures to accommodate the observed individual. Throughout the observation and data review, the researcher could not determine, from field notes or video evidence, a specific, recurring antecedent prior to or consequence following Tyler's laughing, whether the researcher looked at the ten seconds surrounding the laughter or the ten minutes surrounding the laughter. For example, it would be impossible for the researcher to conclude that, prior to a majority of Tyler's episodes of laughter, he wrote his name on an assignment.

Certain patterns of behavior emerged, however, that were suitable to the researcher's use of a more general coding scheme. Immediately prior to or immediately

following an episode of laughter (each by approximately five seconds), Tyler would occasionally complete one of two actions, sometimes both – he would make a vocalization, or he would move his body in some way. These occurrences were present often enough, and sufficient repetition of specific behaviors ensued, that what Tyler did vocally both before and after an episode of laughter, and what Tyler did physically before and after an episode of laughter, could be coded by the researcher. This coding scheme was used to look for patterns of phenomena occurring both before and after each episode of Tyler's laughter, and allowed the researcher to compare this functional behavior coding to other elements of Tyler's laughter, such as the aforementioned coding categories of gaze and physical movement (table 3.1). For example, if before laughing Tyler clapped his hands, and then during the laughter he gazed towards the paraprofessional, a repetition of this sequence across all video data may indicate an attempt by the student to communicate with the paraprofessional in some way. More broadly, what an individual does vocally and physically before and after he or she communicates impacts when and how the individual communicates. The coding scheme for Tyler's vocalizations and physical movements both before and after an episode of laughter – if Tyler completed such acts – can be found in table 2.2.

Table 2.2 – Coding Scheme for Vocalizations and Physical Movement: Five Seconds Preceding and Five Seconds Proceeding an Episode of Laughter

Physical Movement	Vocalization (based on researcher's qualitative judgement)
0 – Manipulates backpack	0 – High pitched vocalization (unintelligible, "sing-song" or otherwise)
1 – Manipulates school materials (i.e., pencil, pen, paper, scissors, etc.)	1 – Vocalization in student's primary/"normal pitch" ("sing-song" or otherwise) **OR** Low pitched/"guttural" vocalization ("sing song" or otherwise)*
2 – Manipulates body (i.e., rocks body forward/back or side to side, "bounces" in chair, stretches, straightens his back, rocks his knees, stands up, picks nails, claps, jogs in place, etc.)	2 – No vocalization
3 – Lightly touches lips with tips of fingers (Self-stimulatory behavior)	
4 – Brings pointer finger up to lips (as if telling someone to be quiet/ "shushing")	
5 – No physical movement	

* Originally two separate coding categories, but too few instances occurred for robust statistical analysis. Prior to combining these codes, the researcher investigated potential relationships with other coding variables, as well as with qualitative observations. No obvious relationships were discovered. The two codes were also logically related, as it was often difficult for the researcher to distinguish between vocalizations in Tyler's "normal pitch" and those vocalizations which were "lower" in pitch. High-pitched vocalizations, however, were unambiguously distinct.

Environmental conditions. It was also imperative to determine the environmental conditions immediately prior to and following Tyler's episodes of laughter. While traditional functional analysis procedures normally incorporate both the actions of the child and what occurs in the environment around the child, in the current study, these elements needed to be reviewed individually. The child inconsistently displayed physical movements and vocalizations before and after laughing, so the researcher decided to use coding to more generally classify the vocal and physical behaviors that did exist in the video data. While describing the environment presented fewer limitations – there was always some type of action in the environment, no matter when Tyler laughed – the researcher again chose to code the environmental activity. This

allowed for simpler comparison between what happened in the environment and the vocal and physical behaviors coded previously. While any type of coding scheme risks the loss of valuable descriptive information, if patterns did exist between the coded environmental conditions and the child's coded preceding and proceeding vocal and physical behaviors, then the researcher could further examine any environmental conditions in which these patterns occurred. For example, if Tyler made a full body movement while laughing, and displayed this behavior a majority of the time in the environmental context of unstructured work time, then the details of this unstructured work time – easily located via the digital video time stamps associated with each episode of laughter – could be considered for additional, qualitative information. Devising a simple coding scheme describing more general environmental conditions also allowed for easy comparison to other coding schemes, specifically those involving Tyler's gaze and physical movement *during* the episode of laughter. For example, if Tyler always gazed at the paraprofessional while the environment consisted of active teacher instruction, this may have provided insight into the intent of the laughter, if in fact Tyler was using it to communicate. The environmental condition could then be more fully investigated for additional qualitative information – perhaps the teacher was discussing a topic that was difficult for Tyler to understand, and the child used laughter (and a gaze at the paraprofessional) to get the paraprofessional's attention and seek help. The general environmental conditions were evaluated before the child's episode of laughter, during the episode of laughter, and following the episode of laughter.

In an attempt to provide consistency between the environmental coding scheme and the coding scheme related to the child's physical movements and vocalizations (and to standardize the three coding schemes in an attempt to replicate, as closely as possible, traditional functional behavioral analysis), the researcher evaluated the general environmental conditions five seconds prior to the episode of laughter and five seconds following the laughter's termination. If more than one environmental condition was present prior to and/or following the laughter, the researcher assigned the code representing the environmental condition in closest temporal proximity to the episode of laughter. The coding scheme associated with the environmental activities encompassing Tyler's episodes of laughter can be found in table 2.3.

Table 2.3 – Coding Scheme for Classroom Environment: Five Seconds Before and Five Seconds After an Episode of Laughter

0 – Teacher speech/action (directed at class)
1 – Nearby classmate speech/action (directed at teacher, paraprofessional, Tyler, or nearby classmate) **OR** Paraprofessional speech/action (directed at Tyler)*
2 – Unintelligible student/teacher chatter/ambient classroom noise (including projection/sound generated by media (video-based, audio-based, or computer-based)

* Originally two separate coding categories, but too few instances occurred for robust statistical analysis. Prior to combining these codes, the researcher investigated potential relationships with other coding variables, as well as with qualitative data. No obvious relationships were discovered. Both codes were also logically related, as most paraprofessional and classmate-related environmental activity took place in close proximity to Tyler.

Remote antecedents. To determine potential antecedents occurring outside of the classroom environment, the researcher utilized the results of a weekly survey completed by the student's parents (see appendix A). The survey consisted of four questions, three of which pertained to the twenty-four hour period prior to the researcher's observations. These questions pertained to the student's food intake, amount of sleep, and changes to

the student's normal routine. Disturbances in an adolescent's normal amount of food intake can detrimentally affect cognition and mood (Craig & Richardson, 1989; Cooper, Bandelow, & Nevill, 2011; Wesnes, Pinock, Richardson, Helm, & Hails, 2003; Widenhorn-Muller, Hille, Klenk, & Weiland, 2009). By extension, any missed meals or substantial increase or decrease in caloric intake in the hours prior to observation would likely have impacted the presence, duration, and quality of laughter displayed during the class period. The literature has also shown that individuals with ASD commonly exhibit trouble with their sleep, negatively impacting their quality of life, in addition to the lives of family members (Reynolds & Malow, 2011). Whether or not the laughter of the student is found to have a distinct communicative purpose, a lack of sleep (or significant change in the student's sleep pattern) would also have likely impacted the presence, duration, and quality of laughter displayed during the class period. Finally, there is plentiful evidence indicating that individuals with autism "have trouble adapting when a routine changes," (Centers for Disease Control, 2014, para. 4). If a routine change in the day prior to observation is substantial, this might impact the individual's mood and subsequent, spontaneous laughter during observation. In terms of the functional behavior analysis, these factors might explain, for example, the absence of laughter in an otherwise consistent antecedent pattern.

Acoustic qualities. Final data analysis procedures had the purpose of triangulating the results obtained from the "whole to part" video analysis, statistical analysis of potentially related coding schemes, and the code-based descriptive functional

analysis. Using the computer software Wave Surfer, the researcher performed acoustic analysis of all episodes of laughter exhibited by the student, collecting three primary points of data – the mean fundamental frequency (F0), the standard deviation of the mean fundamental frequency, and the melodic contour of the laugh. The software was programmed to search for fundamental frequency values between 20 hertz and 800 hertz. According Mannell (2008), "in speech perception, pitch is the perceptual correlate of fundamental frequency," (n.p.). After reviewing many episodes of Tyler's laughter, it became clear that his laughter consisted of noticeable differences in pitch, often in the same episode. If Tyler utilized laughter at specific pitches in specific situations, and did so repeatedly, this mean fundamental frequency measurement – a physical, numerical measurement – should have captured this relationship. For example, if the child not only gazed in a particular direction during several episodes of laughter, but also produced this laughter in a specific mean fundamental frequency range, this would have more robustly indicated an attempt at communication from Tyler (as opposed to having gaze be the only association). Such a situation would suggest that Tyler was using a specific gaze, at a specific pitch, to communicate some kind of information. Furthermore, if these episodes of laughter were also associated with repeated antecedent or consequence events, it would have given the researcher information about *what* Tyler was trying to communicate. Whereas neurotypical individuals utilize spoken language (in words and sentences) to communicate an idea or feeling, acoustic analysis would assist in specifying whether Tyler adjusted the pitch of his laughter to communicate particular thoughts or

emotions in explicit situations. Each mean fundamental frequency value was represented by a specific value in hertz (i.e., *155.28 Hz).* For simpler comparison with other coding schemes, the researcher utilized an additional coding method based on ranges of mean fundamental frequency values. The coding scheme associated with the mean fundamental frequency of Tyler's episodes of laughter can be found in table 2.4.

The standard deviation of the mean fundamental frequency and the melodic contour provided similarly valuable acoustic information for comparison with descriptive functional analysis coding, as well as the gaze and physical movement coding associated with each episode of Tyler's laughter. If comparing speech samples of the same speaker, the standard deviation of the mean fundamental frequency is a single numerical measure of pitch variation. Research has supported the notion that "the higher the standard deviation in fundamental frequency, the more a speech sample will be perceived as lively," (Hincks, 2005, p. 579). If Tyler utilized a specific pitch range in specific situations, and did so repeatedly, this standard deviation of the mean fundamental frequency measurement (also measured in hertz) should have captured this relationship. For simpler comparison with other coding schemes, the researcher utilized an additional coding method based on ranges of standard deviation values. The coding scheme associated with the standard deviation of the mean fundamental frequency of Tyler's episodes of laughter can be found in table 2.4.

While the standard deviation of the mean fundamental frequency represents pitch variation as quantified by a single numerical value, the melodic contour is a graphic

representation of the ways in which the fundamental frequency changes over time. According to Nwokah, Davies, Islam, Hsu, and Fogel (1993) – researchers who studied the acoustic properties of young children's laughter as related to vocal affect – "a contour is formed by the fundamental frequency variables at the beginning and end of the laughter vocalization, as well as by the peaks of the laugh," (p. 3081). Kent & Murray (1982) and Papousek (H.), Papousek (M.), & Koeseter (1986) created a system to classify the melodic contours of human speech (as cited in Nwokah et. al, 1993, p. 3081). Their coding scheme "consisted of seven categories – rising, falling, level (including slight fall), rising-falling, complex, and sequence," (Nwokah et. al, 1993, p. 3081). In the present study, the investigator simplified this coding scheme to three categories (see table 2.4). The revised coding scheme was based on the degree to which the fundamental frequency rose or fell over time, in addition to the melodic contour's overall shape. The degree to which the fundamental frequency rose and fell over time was obtained by subtracting the minimum fundamental frequency value from the maximum fundamental frequency value. The researcher obtained both numerical figures from the acoustic analysis software Wave Surfer. As with the mean fundamental frequency and the standard deviation of the mean fundamental frequency, patterns of similar melodic contours could be cross-referenced with common antecedents, consequences, physical movements during laughter episodes, and/or gaze approximations during laughter episodes to illuminate any potential communicative functions of the laughter itself. The

revised coding scheme associated with the melodic contours of Tyler's episodes of laughter can be found in table 2.4.

Table 2.4 – Coding Schemes for Mean Fundamental Frequency (F0), Standard Deviation of the Mean Fundamental Frequency, and Melodic Contour Shape

Mean F0 (Hz)	Standard Deviation of Mean F0 (Hz)	Melodic Contour Shape
0 = 125 – 175	0 = 0 – 25	0 = Low variability (slight rise **OR** slight rise & fall) Max F0 – Min F0 < 150 Hz
1 = 175 – 225	1 = 25 – 50	1 = Predominately falling (any value of Max F0 – Min F0)
2 = 225 and above	2 = 50 and above	2 = High variability (considerable rise & fall) Max F0 – Min F0 > 150 Hz

It is important to note that the researcher did not obtain acoustic information for each episode of laughter. Some episodes were marked as "inaudible," as the audio or video equipment did not record a strong-enough signal for processing, and the researcher determined Tyler to be laughing via observation of body movements and/or facial expression. Not all audible episodes of laughter were acoustically analyzed due to weak signal intensity. If the audio device recorded a simultaneous speech signal of equal or greater strength from a student or adult nearby, and the acoustic information from Tyler's laughter was compromised, the researcher did not include the episode of laughter in the analysis. As all recordings were made in a live environment, there was always the risk of other, ambient sounds being processed with Tyler's laughter. The researcher tried to acoustically analyze only those episodes of laughter during which Tyler's voice was the most prevalent.

Triangulation of Data

Finally, the researcher evaluated answers provided to the weekly survey's fourth and final question. This question gave Tyler's parents an opportunity to think back over the course of the previous week and to recall any episodes of their son's laughter with a knowable source. If the parents decided to share an experience (they could also decline), they were subsequently asked to briefly describe the source of their son's laughter and to estimate the corresponding laugh's duration. The researcher then cross-referenced this information with the approximate duration of laughing episodes recorded at school, and to the results of the "whole to part" video analysis and descriptive functional analysis – comparing any suspected classroom-based communicative functions of the laughter with what was reported from home.

Reviewed together, the information collected about every episode of laughter – the estimated duration, the time of day, Tyler's gaze and physical movements during his laughter, the vocal and physical behaviors surrounding each of Tyler's laughter episodes, and what's happening in the environment before, during, and after his laughter – provided a general sense of Tyler's use of laughter in his general education science class. The data was reviewed for patterns of repetition, and acoustic information – the mean fundamental frequency, the standard deviation of the mean fundamental frequency, and the melodic contour shape – was utilized for triangulation of data and reviewed for unique relationships (i.e., repetitive patterns of occurrence) with other coding variables.

Qualitative information from parent surveys and field notes provided a richer description of any statistically robust patterns of data.

Statistical Analysis

The researcher placed all coded and continuous numerical data into an Excel spreadsheet. Each episode of laughter populated its own row. The order of the rows was based on the episodes' chronological occurrence. The researcher organized the coding and numerical values associated with each episode of laughter into separate columns (i.e., duration in seconds, mean fundamental frequency, antecedent vocal activity, gaze, etc.). In addition to the data points previously described, the researcher associated each episode of laughter with the date of its occurrence, also in a separate column, located just to the right of an episode's assigned numeric value. This allowed for simpler cross-referencing with field notes and survey data.

The researcher then examined the spreadsheet for repeated patterns of occurrence in the data, across all episodes of laughter. The researcher sorted, in ascending order, each column of numerical data individually. The sorted column was then compared with all unsorted columns of data to easily distinguish patterns. For example, the researcher sorted the "Gaze" column in ascending order, from the lowest "Gaze" coding variable (0 – Paraprofessional) to the highest "Gaze" coding variable (4 – Unable to determine). A logical cluster of laughter episodes (i.e., all episodes of laughter assigned the "Gaze" coding variable "0") were highlighted across all columns of data to search for patterns of repetition. Did all or most episodes of laughter when Tyler gazed at the paraprofessional,

for example, occur while Tyler carried out a specific physical movement? Did all or most episodes when Tyler gazed at the paraprofessional share a common environmental antecedent? If enough repetition existed between two coding variables (for example, a gaze towards the paraprofessional repeatedly paired in the data with a full-body physical action) these columns of data were transferred to a separate spreadsheet and recoded categorically, using a binary system.

In the new spreadsheet, each coding variable associated with the two corresponding coding schemes (i.e., for Physical Movement: 0 (No Physical Gesture), 1 (Clapping), 2 (Hands over Mouth), 3 (Full-Body Movement) and for Gaze: 0 (Paraprofessional), 1 (Teacher or classmate), etc.) was assigned a specific column. The rows of data remained the original chronological numerical codes associated with each episode of laughter. The two corresponding sets of coding scheme data from the original spreadsheet (for all episodes of laughter) were then transferred to each respective, component categorical column (i.e., the original physical movement data was copied to each column now corresponding to individual physical movement codes, and the gaze data was copied to each column now corresponding to individual gaze codes). The data was then converted to the variables "0" or "1", with the binary variable "1" representing that an event occurred and the binary variable "0" representing than an event did not occur. If, for example, the researcher assigned the original physical movement code of "3" to a specific episode of laughter, that episode of laughter would receive a "1" in the "3 – Full-Body Movement" column and a "0" in the remaining physical movement

coding variable columns (i.e., 0 – No Physical Gesture, 1 – Clapping, etc.) of the new spreadsheet. If, for the same episode of laughter, the researcher assigned the original gaze code of "1", that episode of laughter would receive a "1" in the "1 – Teacher or classmate" column and a "0" in the remaining gaze coding variable columns (i.e., 0 – Paraprofessional, 2 - Directly across from/to either side of his person, etc.). An example of this coding translation can be found in the figure 2.1.

Reclassifying the coding data with binary variables allowed for statistical analysis utilizing binary logistic regression. According to Fields (2009), "in its simplest form, this means that we can predict which of two categories a person is likely to belong given certain other information," (p. 265). In the current research, the goal is not to discover which of two categories a *person* belongs to (for example, male or female), given certain predictor variables (for example, alcohol consumption and smoking rates), but rather which of two categories an *episode of laughter* belongs to (for example, a laugh associated with a gaze at the paraprofessional, or a laugh not associated with a gaze at the paraprofessional) given certain predictor variables (for example, a full-body movement during the laughter). Using binary logistic regression, the researcher not only determined whether the predictor variable accurately anticipated whether a new laugh will or will not have a certain quality associated with it, but the method allowed the researcher to predict whether a new episode of laugher (one that happens in the future, in the same setting, without the researcher observing it) will or will not have a that same quality, given the same predictor variable. In other words, binary logistic regression

allowed for an estimation of the likelihood that a specific quality of Tyler's laughter would accurately predict the presence of another specific quality of Tyler's laughter, ultimately providing insight into the strength of association between the two qualities. More specifically, given the dependent variable and the predictor variable, binary logistical regression analysis provided the researcher with an odds ratio ("Exp (B)") and a significance rating associated with the overall accuracy of the statistical model.

After extensive examination of the original Excel spreadsheet, the researcher noted repetitive patterns of coexistence between the codes of various schemes (for example, between a low variability in the laughing episode's melodic contour ("0") and unintelligible student chatter in the environment prior to the child's laughter ("3")). The researcher then selected the complete, corresponding data set, recorded over all episodes of laughter (related to the previous example, the melodic contour coding and the environmental antecedent coding, respectively, over fifty-three incidences of laughter), and converted this information into a binary coding schema. Finally, the researcher entered the binary data into the statistical analysis software SPSS to run binary logistic regression analysis.

An example of this statistical investigation from coding to final analysis aids in illuminating the researcher's process. After evaluating all coding schemes, the researcher found that **a gaze at the paraprofessional (the "Gaze" code "0")** was often accompanied by a **physical movement involving Tyler moving his entire body (the "Physical Movement" code "3")**. Figure 2.1 displays this relationship in the original

coding of data, with the "Gaze" column ranked in an ascending order from a "Gaze" code of "0" to a "Gaze" code of "2". The yellow portions highlight the repetitive correspondence between the two coding variables. The relationship is then shown in the context of the subsequent binary coding transformation. The blue portions highlight the binary coding equivalents of the yellow-highlighted relationship in the original coding scheme. The blue portions of the data also highlight what the researcher analyzed via binary logistic regression analysis.

Figure 2.1 – Translation of Original Coding Scheme to Binary Coding Scheme

Gaze	Gesture
0	3
0	2
0	1
0	3
0	1
0	3
0	3
0	3
0	3
0	3
0	3
0	3
0	3
0	3
0	1
0	2
0	3
0	0
0	0
1	2
1	1
1	1
1	0
1	1
1	1
1	0
2	3
2	3
2	0
2	1
2	0
2	1
2	2
2	3
2	0
2	1

Original Coding

Gaze 0	Gaze 1	Gaze 2	Gaze 3	Gesture 0	Gesture 1	Gesture 2	Gesture 3
1	0	0	0	0	0	0	1
1	0	0	0	0	0	1	0
1	0	0	0	0	1	0	0
1	0	0	0	0	0	0	1
1	0	0	0	0	1	0	0
1	0	0	0	0	0	0	1
1	0	0	0	0	0	0	1
1	0	0	0	0	0	0	1
1	0	0	0	0	0	0	1
1	0	0	0	0	0	0	1
1	0	0	0	0	0	0	1
1	0	0	0	0	0	0	1
1	0	0	0	0	0	0	1
1	0	0	0	0	0	0	1
1	0	0	0	0	1	0	0
1	0	0	0	0	0	1	0
1	0	0	0	0	0	0	1
1	0	0	0	1	0	0	0
1	0	0	0	1	0	0	0
0	1	0	0	0	0	1	0
0	1	0	0	0	1	0	0
0	1	0	0	0	1	0	0
0	1	0	0	1	0	0	0
0	1	0	0	0	1	0	0
0	1	0	0	0	1	0	0
0	1	0	0	1	0	0	0
0	0	1	0	0	0	0	1
0	0	1	0	0	0	0	1
0	0	1	0	1	0	0	0
0	0	1	0	0	1	0	0
0	0	1	0	1	0	0	0
0	0	1	0	0	1	0	0
0	0	1	0	0	0	1	0
0	0	1	0	0	0	0	1
0	0	1	0	1	0	0	0
0	0	1	0	0	1	0	0

Binary Coding Scheme Used for Statistical Analysis

(In both examples, all rows equal individual episodes of laughter)

The researcher determined inter-rater reliability by randomly selecting fourteen episodes of laughter for a Communicative Disorders graduate student to code the student's accompanying gaze and the gesture. A 93% coding agreement (13 of 14) existed. Of the fourteen episodes, seven were associated with a gaze at the paraprofessional and a full-body movement. A 100% coding agreement (7 of 7) existed for this subsection. Stills of Tyler engaging in such laughter can be found in appendix B.

Results

The most striking relationship between coding variables, and the association that produced the most robust statistical results, involved the gaze and physical movement coding schemes. From early in the observation period – including during the two observation sessions prior to video and audio recording – the researcher noticed that, when Tyler laughed, he would often also look at the paraprofessional. Over the course of ten weeks and forty-nine episodes of laughter, 38.8% of Tyler's episodes of laughter occurred in conjunction with a **gaze at the paraprofessional,** the most prevalent of the five "Gaze" coding categories.

As highlighted in figure 2.1, a physical movement involving Tyler moving his entire body often accompanied a gaze at the paraprofessional. For the binary logistic regression analysis, the researcher assigned **"Gaze 0 (Gaze at the Paraprofessional)"** as the indicator variable and **"Gesture 3 (Full-Body Movement)"** as the dependent variable. In other words, the researcher wanted to know whether or not a gaze at the

paraprofessional could significantly predict whether Tyler made a corresponding, full-body movement. The results of the statistical analysis can be found in table 3.1.

Table 3.1 - Results of Binary Logistic Regression with "Gaze at the Paraprofessional" as Indicator Variable and "Full-Body Movement" as the Dependent Variable

Exp (B)	95% C.I.		Significance	n =
	Lower	Upper		
11.143	2.731	45.461	.001	49

Based on forty-nine episodes of laughter coded over a ten week period, Tyler is approximately eleven times more likely to make a full-body gesture while simultaneously gazing at the paraprofessional as opposed to when he is not gazing simultaneously at the paraprofessional.

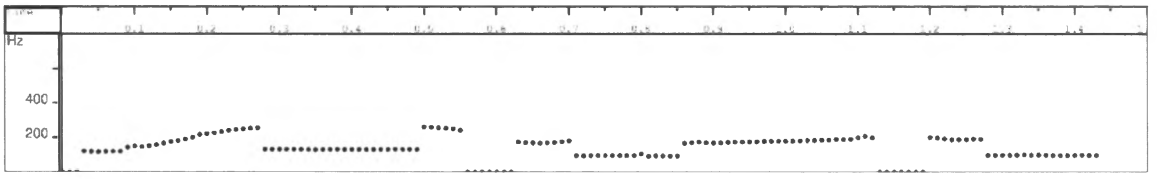
Beyond the association between a full-body movement and a gaze at the paraprofessional, there seemed to be no other relationships between coding variables that would illuminate potential communicative purposes of Tyler's laughter. There also did not appear to be repetitive co-occurrences among coding data or continuous numerical data (i.e., time of day, duration) when only examining those episodes of laughter associated with the significant combination of full-body movement with a simultaneous gaze at the paraprofessional. Of the forty-nine episodes of laughter investigated by the researcher, twelve occurred with this significant combination (gaze at the paraprofessional and full-body movement). The duration of these episodes ranged from 0.3 seconds to 5.5 seconds, and occurred between approximately 3:00 pm and 3:30 pm during the class period. None of the coded functional behavioral antecedents or consequences – in the environment, in Tyler's vocal behavior, or in his physical behavior

– emerged in a significant, repetitive pattern of occurrence, when evaluated in the context of these twelve episodes.

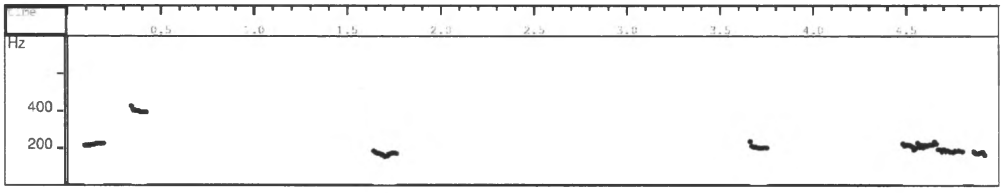
Finally, the episodes of laughter associated with a gaze towards the paraprofessional and a simultaneous full-body movement did not share a significant association with any particular acoustic property measured. The mean fundamental frequency value among these twelve episodes of laughter ranged from 133.64 Hz to 248.91 Hz. The standard deviation of the mean fundamental frequency ranged from 9.46 Hz to 67.04 Hz. And as seen in figure 3.1, the melodic contours of these episodes of laughter varied widely from one episode to the next.

Figure 3.1 – The Melodic Contours of Several Episodes of Laughter: Laughter Associated with Gaze Towards the Paraprofessional + Full-Body Movement

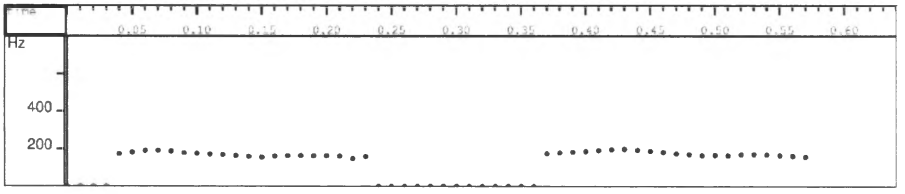
October 9th, Episode 2 – 1.5 seconds, representing High Variability (max f0 – min f0 > 150 Hz)



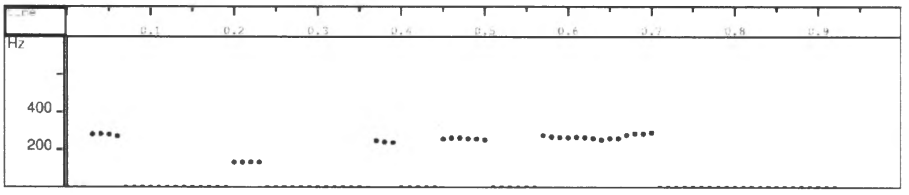
October 9th, Episode 5 – 5 seconds, representing High Variability (max f0 – min f0 > 150 Hz)



October 16th, Episode 2 – 0.64 seconds, representing Low Variability (max f0 – min f0 < 150 Hz)



October 30th, Episode 11 – 1 second, representing High Variability (max f0 – min f0 > 150 Hz)



The qualitative data, however, provides important details about Tyler's laughter associated with a gaze at the paraprofessional and a co-occurring full body movement. Field notes suggest that the stimuli for Tyler's laughter exists at times in the classroom (Tyler's present environment) and at times in his own mind. When the researcher first observed Tyler laughing, making a full-body gesture, and gazing at the paraprofessional, a guest lecturer was talking about the continent of Africa and a trip he once took there. A

student asked, "You went to Africa? Did you see tigers?" It was during this classmate's question that Tyler turned towards the paraprofessional and laughed while simultaneously moving his body. This sequence of events may have suggested that Tyler was excited for the topic, or his classmate's question, and he reacted by sharing his excitement with the paraprofessional. In another instance when Tyler employed the significant combination of gaze (towards the paraprofessional) and gesture (full-body movement), the teacher was performing an experiment on the overhead projector with sodium particles and water. As the teacher added the sodium particles to the water, the mixture began to create smoke. The paraprofessional instructed Tyler to get up so that he could better see the experiment, but the teacher warned not to get too close – "because sometimes it does pop," the teacher said. The paraprofessional then said to Tyler, "Okay, that's okay. You're fine right there." The mixture's reaction then became more dramatic – complete with smoke and crackling sounds – and the teacher made an extended /u/ sound (to express that she was fascinated by the experiment). It was at this point that Tyler laughed, with corresponding gaze and gesture. Again, Tyler looked to be expressing his interest in what was going on in the present environment.

In a third example of Tyler laughing while simultaneously gazing at the professional and moving his body, it was not immediately clear if an environmental stimuli had caused Tyler to laugh. Tyler and a paraprofessional were working on a test, and the paraprofessional read a test question out loud with Tyler – "When an [unintelligible] balloon is [unintelligible] exposed to cold air…" Simultaneously, the

teacher responded to another student's question – "A is true. If it's a right word. If the underlined word seems right, make it A." Tyler then made a brief, high pitched vocalization and laughed while the teacher continued, "…making the sentence." After Tyler's laugh concludes, the paraprofessional continued to read the question with Tyler – "Which one?" he asks, "A or B?" Tyler then stretched his arms behind his head and let out a sigh, eventually responding "A". Field notes indicated that Tyler was working diligently on his test for the majority of the class period. Why, then, did he laugh? A clue might lie in the high-pitched vocalization heard directly prior to the laugh. It is possible that Tyler had momentarily lost focus on his exam, and a funny or entertaining thought came into his mind. The high-pitched vocalization could have been Tyler's way of repeating a specific script – of vocally acting out the situation in his head, whatever he was remembering. At the end of the script (or at some point during Tyler's remembering a humorous situation), Tyler laughed. This type of situation was not an isolated occurrence. The researcher noted multiple times in field notes of humming or other "sing-song" vocalizations, in high and low pitches, that Tyler created prior to or following an episode of laughter. But regardless of whether or not an easily-recognizable referent for Tyler's laughter existed in the present environment – Tyler didn't *just* laugh. He purposefully moved his body while looking at the paraprofessional.

The parent survey data provided valuable insight into Tyler's use of laughter outside of the classroom setting, in addition to how his use of laughter related to his overall emotional state (therefore confirming that his laughter is indeed tied to how he

feels emotionally). The weekly information provided by Tyler's father to the fourth question of the survey, asking to describe any episodes of laughter that he witnessed during the week and to report the laughter's referent, related to a particular sequence of laughter episodes observed by the researcher. Of the twelve episodes of laughter associated with Tyler's use of a gaze towards the paraprofessional and a full-body movement, four occurred during the October 9th observation and were associated with video media. At approximately 3:00 pm on October 9th, the paraprofessional cued up a video for the entire class to watch. The video was related to the topic of the day – solids, liquids, and gasses. When Tyler saw that the paraprofessional was cueing up this video, he got up out of his chair and approached the paraprofessional. Based on his facial expressions and body movements, he appeared excited. He then returned back to his seat, and the paraprofessional returned to be next to Tyler. The paraprofessional reported to the researcher that Tyler enjoyed the characters in the cartoon – Tim (a teenager) and Moby (a robot) – as he had watched several of their videos in a separate special education class. After the video's conclusion, the teacher administered a computer-based quiz associated with the video, and this appeared to make Tyler very excited. He smiled, he could hardly keep his body still. The aforementioned sequence of four episodes of laughter occurred at this time. This particular video media (and associated quiz) created a very positive experience for Tyler – an experience he wanted to share with the paraprofessional.

The weekly survey suggested that Tyler's father observed Tyler laughing in similar situations. "He…laughed at funny things on TV," his dad wrote one week. Other

survey responses indicated that Tyler laughed "when he was playing video games" and while repeatedly watching "the same You-tube videos" and "previews on the DVD 'Tangled.'" Both inside and outside of the classroom environment, the child reacted very positively to video media that he had a history of enjoying in the past. Tyler's way of communicating his excitement was via his laughter.

Weekly survey responses to the fourth question also indicated that Tyler used laughter to engage with his family, similar to how he appeared to use gaze in the classroom to engage with the paraprofessional. "Tyler wrote down the wrong word while writing, and laughed at himself. He wanted me to laugh with him," his father reported one week. Survey data also reaffirmed that Tyler's laughter was directly associated with his emotional state, sometimes even unconsciously – "one night, he was laughing in his sleep," his dad reported. In another survey response, his father reported that, "Tyler was excited about the open house at [a local] High School. He kept reminding us to go. When we got there, there was this look on his face of 'inner excitement', which we hardly ever see. He was smiling for a long time." His father also reported laughter on the same evening.

Tyler's laughing behaviors also appeared to be a direct reflection of his emotions for the opposite reason – when his father reported events that impacted Tyler's sleep, eating, or normal routine in the twenty four hours prior to the researcher's observation, Tyler was not seen laughing. For example, no episodes of laughter were observed on September 25th. In the twenty-four hours prior, Tyler's father reported that his son's

routine had been disrupted in a "moderate" way (defined in the survey by an alteration impacting one to two hours of his son's time) – due to "a neurology appointment Wednesday afternoon, he missed the last two periods of school. Homework was done late. Both mom and Tyler were frustrated doing homework late at night. Tyler appeared stressed out." Episodes of laugher were also not reported on October 2nd. In the twenty-four hours prior, Tyler experienced a seizure that impacted his sleep (his father reported that he "tossed and turned quite a bit" the night before observation), in addition to his normal routine. Both examples suggest that when Tyler feels poorly, he does not laugh. When he feels good – when he wants to share a funny moment, share his excitement related to a favorite video or a new high school, or even share a cheerful mental state related to a stimuli that might only exist in Tyler's mind – laughter plays a key role in Tyler's expression of positive feelings.

Discussion

The researcher originally decided to study this individual's laughter because, beginning as a paraprofessional working with the child, the researcher did not have adequate time to determine whether or not seemingly random outbursts of laughter could be, for this child on the autism spectrum, a unconventional means of connecting socially with those around him. The researcher's initial question, the core of the study, asked the following – could an episode of laughter from an individual with ASD – one that has no apparent source or referent – be serving a communicative purpose that has yet to be identified? Qualitative data, including field notes, the weekly survey, and transcripts of

the conversations occurring in the classroom during Tyler's laughter, helped to answer an equally important question – what were events that occurred in Tyler's environment that made him laugh? Before investigating the communicative purposes of Tyler's laughter that have no apparent referent, the researcher needed to investigate the episodes of laughter that had readily apparent sources in Tyler's environment. According to field notes and responses to a weekly survey question inquiring about laughter observed in the home environment, Tyler enjoyed video and computer-based media with which he was familiar. He repeatedly watched You-tube videos at home, or showed great excitement (via hardly keeping his body from moving!) when familiar computer-based characters appeared on the projection screen at school. Visual stimuli proved to be a source of Tyler's laughter, and it appeared that his laughter was an obvious expression of the joy he felt while engaging in these activities.

Additional qualitative data supported the notion that Tyler's laughter was a direct expression of his emotional state. Via a previously-discussed survey response, Tyler's father reported that Tyler used laughter to express his "inner excitement" upon arriving for an information session at a local high school. Also according to Tyler's father, the child had been well aware of this event prior to it taking place – "he kept reminding us to go," his father wrote. The laughter, in this case, appeared to be a culmination of Tyler's anticipation. Field notes and survey data also dictated an equally striking phenomenon, highly related to Tyler's internal emotional state. Simply put, when something had happened to Tyler (in the 24 hours prior to observation) that the literature describes as

having negative emotional impacts on an adolescent with autism – lack of sleep and a change to routine – the researcher did not observe Tyler laughing. Just as the presence of laughter supported Tyler's expression of a positive internal state, a negative internal state caused a dearth of laughter.

So exposure to certain stimuli – particularly video and computer-based media – caused Tyler to laugh, and it appeared that this laughter was a manifestation of a positive, even joyful internal state. Perhaps most important to the current study, the qualitative data also revealed that, in the home setting, Tyler wished to experience this internal state with another person. In another previously revealed survey item, Tyler's father wrote of how, after Tyler wrote the wrong word on a homework assignment, it caused the child to laugh. His father wrote that his son "wanted me to laugh with him." His father did not explain how he knew this, but the observation parallels what the researcher observed and concluded to be taking place in the classroom.

In the environment of his science class, Tyler appeared to laugh at stimuli both in the environment (computer characters that he recognized) and, as the research question implies, stimuli that doesn't exist in the environment (laughing in a formal test-taking situation). Based on the sing-song type vocalizations surrounding many of the episodes of laughter that did not have a referent, it seemed that the child, in the midst of a more formal situation, began to remember some kind of stimulus that had, in the past, made him happy. Instead of simply thinking about the entertaining stimuli, Tyler reacted as if

the stimuli were in his present environment, his internal state turned decidedly positive, and he laughed.

Whether or not the laughter observed had a readily apparent referent, however, Tyler would often seek out another person to share this moment with. In a significantly meaningful way, this person was often the paraprofessional. A specific gaze over forty-nine episodes of laughter and ten weeks of observation clearly emerged as the most prevalent – towards the paraprofessional. This gaze was statistically associated with a nearly consistent, co-occurring physical act – a full-body movement. While the direction of an individual's gaze provides insight into who an individual is attempting to communicate with, how we use our bodies while communicating provides insight into the intent of our communication and the degree to which we are experiencing a specific emotion. Tyler appeared to be utilizing this full-body movement as a means of gesturing towards the paraprofessional – as a way of getting his or her attention and communicating just how good he felt. He does not just move one part of his body, but his entire body became associated with a gaze at the paraprofessional. In essence, two traditional elements of communication, gaze and gesture – particularly when they are combined during a communicative act – are associated with the child's laughter, suggesting that some episodes of Tyler's laughter have communicative intent. Ultimately, it did not matter whether or not Tyler's laugher was associated with the present context – Tyler utilized his laughter as means of sharing his positive feelings with another human being.

Whether or not this communicative purpose was truly "yet to be identified" is a question that can only truly be answered by those closest to Tyler. His father, via his survey responses, appeared to be already experiencing the social capacities of Tyler's laughter at home. Tyler certainly did not appear to be utilizing his laughter in a way that one might expect words, delivered in a desired cadence, to be used – he did not use a particular melodic pattern of laughter, for example, to communicate a specific thought or idea in specific situations. The student did formulate, however, a highly explicit method (utilizing laughter, a specific gaze, and specific gesture) by which he attempted to engage with another person (the paraprofessional) in a specific environment (his 7th period science class) during specific situations (times the student felt joyful). During these times, laughter – as opposed to language – functioned as the primary mode by which Tyler transferred his voice to his desired communication partner.

Conclusions

The current research provides potentially promising, relevant advice for speech-language pathologists and other professionals working with students on the autism spectrum who are included in the general education classroom. Functional use of the current research might involve being mindful of potential physical aspects such as gaze and gesture that might co-occur with a child's laughter. As in the present study, repeated patterns of behavior that are associated with these aspects could indicate an attempt at communication. If a pattern is found, and if the child has good receptive language, those supporting the individual should consider not immediately telling the student to be quiet

(shushing) after he or she erupts into laughter. Even if an individual supporting the child cannot decipher the exact intent of the laughter, the individual can acknowledge the laughter and explain how the environment is not a particularly good time to communicate in that way. A supportive individual might ask the student to "store" the moment for later and, at a point later in the day or the class period, allow the student to show him or her what he or she was excited for, happy about, or trying to communicate. One might consider allowing the individual to explain him or herself via an augmentative-alternative communication device, writing, drawing pictures, or on a computer.

More broadly, the researcher believes it is important to always investigate any repetitive, unconventional, or eccentric behaviors in children with autism spectrum disorders, and to keep one's mind open to the possibility that such a behavior may be the means by which an individual with autism is attempting to communicate, or to reach out socially. Those with autism spectrum disorders will inherent difficulties, to various degrees, in the areas of social communication, language, and pragmatic skills. If an individual develops with a different sense of appropriate communication, it makes sense that he or she may develop communicative behaviors that may not make sense right away to neurotypical individuals. Via the quantitative and qualitative study of these behaviors, it may be possible to give individuals with ASD a better quality of life, while also gaining a deeper understanding of the disorder itself.

Limitations & Future Directions

The current study had several primary limitations. Since this was a grounded theoretical case study, used to explore the idea of laughter as a communicative device for children with autism, and not a quantitative study meant to generalize across all children with autism, measuring external validity was not appropriate. In the future, it would be beneficial to design studies that observe multiple individuals on the autism spectrum who exhibit the same patterns of laughter as Tyler. These studies could investigate whether other children on the autism spectrum utilize laughter, along with specific gaze and gesture behaviors, in an attempt to engage socially with others – specifically, those children of middle school age who are included in the general education classroom. The current study also involved observations in a single setting at one point during the child's school day. Future studies may include observation procedures carried out over multiple environments, including unstructured times such as the lunch period. Additional observation in the home environment would also be beneficial, for comparison with school data and triangulation of any significant patterns found in the school setting.

An additional limitation of the present study involves the paucity of inter-rater reliability data. The present study relied a great deal on coding to organize and simplify a large corpus of data. The time and resources were not evaluable for additional confirmation of the researcher's coding. In lieu of the enormous coding duties carried out in the present research, future studies conducted in a similar fashion might consider coding only the gaze and gestures accompanying a child's episodes of laughter. If

specific patterns emerge, additional acoustic and functional behavioral analysis information can be gathered only on the episodes of laughter associated with the specific, repetitive pattern of occurrence.

If future observations involve a child on the autism spectrum who has more extensive expressive language ability, researchers might consider the use of conversation analysis in lieu of functional behavioral analysis. Sacks, Schegloff, & Jefferson (1974) developed conversation analysis (CA) as a means of examining interaction in naturalistic settings. According to Glenn (2003), "CA starts with an assumption that people organize their interactions with each other in systematic, describable ways," and CA research "starts from an assumption that talk is orderly and that this order may inhere in the smallest details, so that no feature may be dismissed a priori or assumed to be irrelevant," (p. 35). Furthermore, Glenn argues that laughter, as an inherently human, systematic, and socially organized construct, can be studied using CA "because there is a pattern and order to laughter…we can study it to learn how people achieve such order," (p. 52). For future research, CA would allow for a detailed account of the verbal and nonverbal elements bordering the student's episodes of laughter. If a student's use of laughter mirrored patterns found in the CA canon of interactions between typically developing individuals, then the researcher would have a solid evidence base upon which to conclude that the individual with autism indeed uses his laughter in a social manner. If the student's use of laughter strayed from its common usage amongst typically developed individuals, this would support autistic individuals' inherent social dysfunctions and,

furthermore, a utilization of laughter to express individualistic positive affect – lacking awareness of others' emotional states and interactional progress. Future researchers might consider utilizing transcription methods standardized by Jefferson (2004) for use in CA.

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Appendix A

The following survey was administered and completed online by Tyler's parents on a weekly basis.

1. Did Tyler receive his normal breakfast and lunch on Thursday?
If parents responded "no" to the above question, they were provided with question 2:

2. Briefly explain what changed about his breakfast or lunch (i.e., if Tyler missed the meal completely, if he ate something different from his normal diet, if he was provided a normal breakfast or lunch but did not eat it, etc.).

3. Did Tyler receive his normal amount of sleep on Wednesday night?
If parents responded "no" to the above question, they were provided with question 4:

4. Briefly explain how his sleep varied from what is normal.

5. During the 24 hours prior to Tyler's observation (approximately 2:30 pm on Thursday), was Tyler's routine at home disrupted in any way (i.e., by unanticipated schedule changes, unanticipated health issues, etc.)?
If parents responded "yes" to the above question, they were provided with question 6 and 7:

6. Briefly explain how his routine changed and why. (For example: "Missed soccer practice because of a cold".)

7. Rate the level of change to his routine. (For example, a "substantial change" would be missing school for one day or more due to illness. A "moderate change" would be missing a 1-2 hour activity due to schedule changes or illness. A "minimal change" would be any impact to his schedule of less than 1 hour in duration, such as running late or missing the bus/train.)

Substantial
Moderate
Minimal

8. Can you recall a time in the last week when Tyler laughed and you knew the source of his laughter (i.e., what caused him to laugh)?
If parents responded "yes" to the above question, they were provided with question 9 and 10:

9. Please briefly explain the laughter's source.

10. Please estimate the approximate duration of the episode of laughter.

2 seconds
10 seconds
30 seconds
1 minute
5 minute
10 minutes
over 10 minutes

Appendix B

The following are frames from video data that show Tyler laughing while simultaneously gazing at the paraprofessional and making a full-body movement. This co-occurrence of gaze and gesture was deemed statistically significant, and suggested that Tyler was attempting to communicate and share his positive inner state with the paraprofessional. When the paraprofessional is not shown in the frame, she is standing behind the student and to his right.

September 18th, 2015

October 9th, 2015

October 9th, 2015

October 9th, 2015

October 16th, 2015