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Efficacy of central auditory processing case history form used at the Louisiana Tech University Speech and Hearing Center

Michelle L. Smith
Louisiana Tech University

EFFICACY OF CENTRAL AUDITORY PROCESSING CASE HISTORY FORM USED AT THE LOUISIANA TECH UNIVERSITY SPEECH AND HEARING CENTER

by

Michelle P. Smith, B. S.

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Sheryl Shoemaker, Au.D., CCC-A
Interim Head of Department
Supervisor of Dissertation Research

Head of Department

Speech
Department

Recommendations concurred in:

Sheryl Shoemaker, Au.D., CCC-A (Head)

Matthew Bryan, Au.D., CCC-A

Approved:

Director of Graduate Studies

Dean of the College

Approved:

Dean of the Graduate School

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ABSTRACT

Central auditory processing disorder (CAPD) is a deficiency in processing of auditory information. Due to this deficiency, a variety of behaviors can be seen including listening difficulties in background noise, difficulties following oral instruction, and difficulties discriminating and identifying speech sounds. These behaviors result in inattention and academic difficulties. With these characteristics being present in other disorders such as attention deficit/hyperactivity disorder, language/learning deficits, and high functioning autism (i.e., Asperger's syndrome) diagnosis of CAPD becomes complicated.

The Louisiana Tech University Speech and Hearing Center uses a CAPD case history for a child that was adopted from Robert Keith in 2003. The purpose of this paper is to determine the efficacy of the subsections (e.g., general history, statement of the problem, birth and developmental information, medical history, personality traits and physical characteristics) through literature based research. Assuming that some items listed on the current CAPD case history are not supported by literature, a proposed new CAPD case history form for children will be developed based on information found.

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TABLE OF CONTENTS

LIST OF FIGURES

CHAPTER 1

Introduction

A hearing disorder is a condition that is prevalent in an average of 131 of every 1,000 school-aged children which can have adverse affects on communication, academics, and psychosocial development. An auditory condition, known as a central auditory processing disorder (CAPD), is a deficiency in the processing of auditory information that accounts for approximately 2 to 3% of children with communication disorders (American Speech-Language Hearing Association [ASHA], 2002) and can often be misdiagnosed as either an attention deficit hyperactivity disorder (ADHD), a language/learning disability (LD), or even an autistic spectrum disorder (ASHA, 2005). Despite these arbitrary labels (i.e., ADD, LD, autism), it is necessary for audiologists to establish an accurate diagnosis of the auditory system providing the necessary information with regard to treatment strategies and the development of appropriate intervention (ASHA, 2006b).

Unfortunately, there are no definitive studies identifying whether children suspected as having CAPD can be differentiated from children with similar disorders (i.e., ADD, LD, autism) on the basis of subjective assessment of behaviors (ASHA, 1996). The purpose of this paper is to delineate numerous definitions of CAPD, explain the documented literature relating to the characteristics of CAPD and similar disorders, and determine if the questions on the Louisiana Tech University Speech and Hearing Center's CAPD Child Case History form are appropriate when compared to documented literature.

Auditory Pathway

Diagnosis of CAPD is difficult because the process of audition involves attention, detection, and identification of a signal, all which are critical in order to use audible information effectively. The information of interest must be selected from all other sensory images for special consideration. At the cortical level, information is decoded and stored in the central auditory

nervous system (CANS) for future usage. A significant breakdown in any of these functions could lead to impairment or improper use of auditory information (Katz, Stecker, & Henderson, 1992). To further understand these processes, explorations of the anatomical characteristics of the outer ear, middle ear, inner ear, and auditory pathway to the cortex are addressed in this documentation.

Once a signal, either speech or noise, is generated from a sound source, it enters through the first peripheral portion of the auditory mechanism, the outer ear. The outer ear includes the auricle and external auditory meatus. The auricle, or the portion of the ear that is visible to the eye, is a cartilaginous appendage that is attached to the head. The external auditory meatus, also known as the ear canal, is a curvaceous tunneled structure made of skin, cartilage, and bone. The ear canal, which is approximately three millimeters in adults, begins at the auditory meatus and terminates at the tympanic membrane. The outer ear has three primary functions (1) to collect and funnel the signal into the external auditory meatus, (2) to aid in localization, and (3) to serve as a protective guard from foreign objects. Once the signal enters the opening of the external auditory meatus, the sound is then resonated within the external auditory meatus, enhancing frequencies between 2000 to 5500 Hz (Martin, 1997); it's these resonant frequencies that are critical for understanding speech (Katz et al., 1992). The sound is then projected to the tympanic membrane and into the middle ear system.

After speech or noise is collected, funneled, and enhanced by the pinna and external auditory canal, the sound waves enter the middle ear system. The middle ear system is a large air filled cavity in the mastoid portion of the temporal bone that spans approximately nineteen millimeters from the tympanic membrane to the end of the stapedial footplate. This portion of the auditory system houses the (1) tympanic membrane, (2) the ossicular chain, (3) the muscles that aid in the lever action of the ossicular chain, and the (4) Eustachian tube.

The tympanic membrane is a stiff translucent covering that barricades the middle ear components from the external auditory canal. The vibrations of the tympanic membrane, along with its concavity shape and large surface area, concentrate the signal to the ossicular chain. The ossicular chain is a system of connected bones, consisting of the malleus, incus, and stapes, that

are synchronized by the tensor tympani and stapedius muscles. Together, these bones react in conjunction with the tympanic membrane causing a "lever action" at the stapedial footplate to alternate it in and out of the oval window of the inner ear where it becomes hydraulic energy. The Eustachian tube is a membranous tube that runs from the nasopharynx in the oral cavity to the middle ear cavity; its primary function is to regulate the air pressure in the middle ear cavity with the environmental air pressure external to the body.

The inner ear is a fluid filled cavity consisting of two major components - the vestibular portion (i.e., vestibule and semicircular canals) and the cochlea. The vestibular system is the peripheral system that regulates balance; whereas the cochlea, houses the mechanism that allows for the process of communication (i.e., the organ of Corti).

The cochlea is a boney coiled channel that is etched into the temporal bone of the skull; within the cochlear structure are the scala vestibule, scala tympani, and scala media labyrinths. The scala vestibule and scala tympani are conjoined structures filled with perilymph that terminate at the oval and round windows respectively. The scala media, filled with endolymphatic fluid, divides the scala –vestibule and -tympani as well as houses the organ of Corti.

The organ of Corti is considered to be the outer end organ of hearing. It consists of the basilar membrane, tectorial membrane, inner hair cells, numerous supporting structures, and stereocilia. The basilar membrane is made of connective tissues that decrease in stiffness as it coils the two and one-half turns of the cochlea and thus, is tonotopically arranged (i.e., with high frequencies toward the basal end and low frequencies at the apical end). It is this frequency arrangement that halts the progress of the traveling wave when a specified frequency is encountered.

The tectorial membrane is a contiguous gelatinous flap that runs parallel with the basilar membrane of the cochlea. The inner and outer hair cells, containing filaments known as stereocilia, are also housed in the organ of Corti and are located between the tectorial and basilar membranes. The stereocilia of the outer hair cells are embedded in the tectorial membrane while the stereocilia of the inner hair cells are only fixed at the base. The stereocilia are located on top of the inner and outer hair cells and are arranged in a stair-step fashion from shortest to tallest;

deflection towards the shortest stereocilia causes hyperpolarization (i.e., closing the ion channels), and deflection towards the tallest stereocilia causes depolarization (i.e., opening the ion channels). During the depolarized phase or excitation phase, neurotransmitters are released at the base of the cell resulting in action potentials generated at the afferent terminals of the spiral ganglion. During the hyperpolarization phase or inhibition phase, the cells remain stabilized.

As the vibratory signal continues its path from the outer to inner ear, it meets its destination on the basilar membrane in the cochlea. Once prompted, the basilar membrane arcs inward, causing the outer and inner hair cells, which are embedded in the tectorial membrane, to be deflected towards the tallest stereocilia. The deflection of stereocilia opens the ion channels which results in depolarization and a waveform change from a hydraulic energy to an electrical potential. Neurotransmitters are subsequently released at the base of the cell resulting in the excitation phase of the inner hair cell. Action potentials are then generated at the afferent terminals and the electrical potentials stimulate the auditory nerve and later, processed in the cortex.

The CANS is a complicated system and varies in the functions that are carried out, and is comprised of numerous components which are acted upon both equivocally and sequentially. Anatomical locations include stations and pathways located in the brainstem, both sub- and primary cortices, and the corpus collosum. The following are auditory events that occur before a listener is consciously aware sounds are present (ASHA, 1996). Once electrical potentials reach the eighth cranial nerve, (i.e., the auditory nerve), the information is then sent to the brainstem where cochlear nuclei, superior olivary complexes, lateral lemnisci, inferior colliculi, and mediate geniculate bodies continue the electrical signal to it destination in the cortex.

The cochlear nucleus, the only nucleus that receives ipsilateral auditory input, is divided into three sections – the anterior ventricle, posterior ventricle, and dorsal cochlear nuclei. The majority of the electrical impulses cross to the contralateral superior olivary complex (SOC). The SOC divides into the medial nucleus of the trapezoid body, the medial superior olive, and the lateral superior olive; this is where binaural interactions occur between the two ears allowing for analysis of timing and intensity cues for localization.

From this juncture, the electrical potentials travel to the lateral lemniscus which is composed of fibers from both the cochlear nucleus and SOC and aid in separating low frequencies from high frequencies. The electrical impulses continue their journey traveling to the inferior colliculus where cells that are sensitive to interaural time and intensity cues also assist in sound localization.

From the inferior colliculus, auditory information is transmitted to the medal, dorsal, and ventral portions of the mediate geniculate body (MGB) located in the thalamus. Information is sent from the ventral MGB to Heschl's gyrus. Heschl's gyrus, also known as the auditory cortex, is the primary auditory reception area (Musiek, 1986). Properties of intensity, frequency, temporal resolution, and localization are further processed here prior to analysis in Wernicke's and Broca's area. It is at these final stages that the listener has experienced an auditory event (ASHA, 1996).

The cortex is separated into the right and left hemispheres and is connected via the corpus collosum. In most humans, the left hemisphere is dominant for speech, language, and arranging auditory signals; while the right hemisphere is dominant for spatial judgments, gestalt information, and musical intonation. The corpus collosum is a mylinated fibrous tract that connects the right and left hemispheres of the brain and serves as a thoroughfare to exchange information from hemisphere to hemisphere. Even though the brain's physical structure changes little after birth, the auditory system does not become fully mature until 11 to 12 years of age (Keith, 2000b). Neural plasticity of the cortex has also been documented. Imaging studies that suggested there are periods where the brain re-adjusts to cope with its given environment. For example, Chermak and Musiek (1992) described the recovery characteristics of stroke patients where children were able to recover from cerebral vascular accidents faster than older adults. When given appropriate stimulation, neural plasticity allows the central nervous system to essentially reorganize or modify information thereby maximizing the potential for rehabilitation.

Neuroelectrical impulse in the auditory cortex are faithfully represented and maintained throughout all levels of the CANS. Processing auditory information is complex and involves a number of sensory and cognitive behaviors. At the sensory level, the auditory system detects

sound and sorts it into frequency, intensity, and complexity. To illustrate the complexities of processing auditory messages in the CANS, Calearo and Antonelli (1973) determined that there are three major processes. The first is binaural separation were a signal in one ear is kept separate from a different signal in the other ear. Another process, discussed by the researchers, is the ability to fuse bits and pieces of information together (binaural fusion). If a single auditory message is divided into segments and these are delivered to each ear simultaneously, fusion takes place at the brainstem level and one message is heard. The final process described by Calearo and Antonelli was described the cross-over effect in which auditory messages, received by one ear, crossing over to the opposite temporal lobe. These processes are used in localization and lateralization, as well as ordering and sequencing of information prior to being used by higher-order cognitive processes. In higher levels of the central nervous system, complex patterns of sounds are decoded and are assigned meaning (Katz et al., 1992), and are influenced by factors such as attention, motivation, memory and decision processes (ASHA, 1996).

Most diseases that affect the CANS do not produce a peripheral hearing loss. In 1960, James Jerger described this as the "subtlety principle" whereby the "subtlety of the auditory manifestation increases as the site of lesion progresses from peripheral to central" (cited in Keith, 2000a, p. 344). That is, the more peripheral the dysfunction, the greater the impact it has on overall function. Central pathways, by virtue of the numerous over lapping pathways, allow for multiple avenues for a signal to be processed.

Standard hearing protocols, (i.e., pure tone and speech testing) are not sufficient enough to challenge the CANS; therefore, material that has been synthesized must be used. An example is distorted speech tests to reduced acoustic redundancy. This can be accomplished by altering the frequencies in a signal (e.g., filtered speech tests), by reducing the intensity of speech above simultaneously presented background noise (e.g., auditory figure ground), by using both interrupted speech and rapid speech (e.g., time compressed speech), or by dichotically presenting separate auditory messages to each ear simultaneously. These tasks are easily accomplished by persons with a normal central auditory system; however, speech intelligibility is poor for persons with CAPD (Keith, 1997, 2000b). Development of sensitized speech began in

the mid 1950s to the early 1960s. Pioneers of central auditory processing function used various methods to detect auditory pathology.

Lineage

Some of the first works for identifying pathological occurrences in the CANS were documented by Bocca, Calearo, Cassinari, and Migliavacca (1955); Goodman (1957); and Metzker (1959). Bocca et al. (1955) used alternating signals of low and high pass filters (e.g., altered speech signals or sensitized speech audiometry), to assess if the patient could integrate and summate information. By using synthesized speech, they found that auditory lesions were contralateral to the poorer performing ear. In 1957, Goodman used a comparison of pure tone thresholds to speech discrimination scores to determine the location of lesions. He found that poor speech discrimination scores in the presence of essentially normal hearing suggested brainstem lesions.

Matzker (1959) continued the research efforts of assessing central auditory functioning by using two newly introduced testing procedures: binaural auditory fusion (i.e., different signals presented to each ear simultaneously and then integrating into one signal) and localization tasks. Both of which were used as a site-of-lesion test. In his works, phonetically balanced words were introduced binaurally where part of the test word was sent to the right ear and the other part of the test word was sent to the left ear. Matzker then introduced a second set of phonetically balanced words diotically where both bands were received in either ear simultaneously thus eliminating any brainstem involvement. He theorized that if lesions existed, the subject would not be able to integrate the information and recognize both sets of test words. An examination of approximately 1000 subjects positively predicted pathological findings.

To determine where the lesion was located, Matzker used interrupted signals with varying pauses. When gap times were decreased, normal hearing subjects lateralize to the side where the signal was introduced first. If the subject heard the signal in the contralateral ear, the tests of localization predicted lesions in the central cortex.

In 1961, Kimura revolutionized central auditory processing testing when she introduced dichotic testing (i.e., presenting different auditory signals to each ear either separately or

simultaneously); it was not until this time did central auditory testing move from a site-of-lesion test to an assessment of how the cortex processes auditory information. In Kimura's works she conducted a study on 71 subjects with confirmed cortical lesions; all but six had undergone surgery to remove either the left or right portions of the temporal lobe, a portion of the frontal cortex, or a portion of the subcortical cortex. All subjects were tested pre and post surgical removal. After analysis, Kimura concluded that verbal stimuli is processed both ipsilaterally and contralaterally, even when information is presented to only one ear, and that verbal information is primarily processed in the left hemisphere.

For the following decades, studies on central auditory processing continued to make its transition from site-of-lesion testing to auditory processing testing, primarily within the adult population. Katz (1962) maintained that conventional testing, such as that of pure tones and speech audiometry, could not identify cortical lesions. Hearing disorders involving cortical lesions could only be identified by introducing difficult speech materials, placing a heavy burden upon higher auditory mechanisms; therefore, he developed the *Staggered Spondee Word* (SSW) test. This test was designed to sufficiently tax the central auditory system by first introducing decreased and increased extrinsic redundancies (i.e., introducing limited auditory signals and complex auditory signals in the presence of a competing signal) respectively. He found that individuals with central lesions had decreased scores even in the presence of normal peripheral hearing. He further substantiated other earlier works that supported the contralateral ear effect (Katz, 1962, 1968; Katz, Basil, & Smith, 1963).

In the 1970s and 1980s, theorists began to segregate in approaches to central auditory processing testing. Some theorists maintained that language difficulties in auditory perception of language were due to the breakdown in the central auditory nervous system. Others tended to believe that auditory problems are due to language disorders originating in the cognitive processes (Wertz, Hall, & Davis, 2002). Ideas to segregate language from audition gave way to new testing strategies.

Musiek and Pinheiro's *Frequency Pattern* and *Durational Pattern* (1987) tests were assessment procedures that did not use linguistic stimuli, but used different pitches and

durational tones to assess auditory integrity. Three consecutive tones, in a combination of high and low pitches or long and short durations were introduced to one of the subject's ear (monaurally). Scores were tallied by documenting the correct combination in which the signal is presented. Both tests (pitches and durations) yield bilateral deficits when lesions were suspected in at least one of the cortical hemispheres (Musiek, Baran, & Pinheiro, 1990).

Even though Orton and Myklebust identified auditory processing deficiencies in children with language learning problems in the mid 1930s and 1950s respectively (cited in Wertz, et al., 2002), it was not until advancements made by Keith (Wertz, et al., 2002) and both J. Jerger and S. Jerger (Keith & Jerger, 1991), in the mid to late 1980s, did audiologists take a keen interest in auditory processing disorders in children. These authors viewed CAPD from an educational perspective and sought to determine functional disorders of communication (Keith, 2000a).

Susan and James Jerger designed a test in 1984 that could be administered to children younger than six years of age, the *Pediatric Speech Intelligibility* (PSI). This test consisted of words and sentences that had both ipsilateral and contralateral competing messages at various intensity levels; the words/sentences were accompanied by pictures which allowed the child to point to the target signal perceived. The basic premise of the PSI was to assess the auditory processing abilities of a child based on their functional language skills by using age appropriate testing materials. Several studies suggested that children with confirmed lesions and associated deficits in language abilities did in fact have developmental dysfunction at the level of the auditory cortex (Jerger, 1987).

Central auditory processing disorder testing was further advanced by both audiologists and speech pathologists alike with the advent of a screening tool presented by Keith in 1986, the *SCAN*, which was later revised into the *SCAN-C* (Keith, 2000c). The *SCAN-C* was designed to evaluate the maturity or dysfunction of the auditory system and identify children who had problems with language resulting from auditory deficiencies. This test included filtered speech, speech embedded in noise, competing monosyllabic works, and competing sentences that were introduced to both ear simultaneously. Validation studies later determined that the *SCAN-C* not only identified children with processing difficulties but also children with learning and language

difficulties and children with hyperactivity; all performing poorly when compared to their normal peers (Keith & Jerger, 1991).

The tests developed up to this point were thought of, by some researchers, as inefficient (Bellis, 2003; Bellis & Ferre, 1999; Musiek, Bellis, & Chermak, 2005). Clinicians rarely used tests to identify deficits in localization, lateralization, and binaural interaction (i.e., the auditory processes and neural connection of both ears) abilities (Schow, Seikel, Chermak, & Berent, 2000), and tests that assessed the ability to perceive speech in noise, a common behavioral signifier of CAPD, was scrutinized. Critics claimed that tests devised to listen to target signals with competing background noise under headphones does not assess the client's typical environment, such as experiences within a classroom setting. Critics also questioned how previously developed CAPD testing protocols lacked in specificity overlooking influential global behavioral deficiencies such as motivation, attention, memory, cognition, and motor-skills (Cameron, Dillon, & Newall, 2006).

A recent behavioral protocol, the *Listening in Spatialized* Noise test (LISN®; cited in Cameron et al., 2006) sought to provide a valid measure of speech understanding in a virtual three-dimensional typical background noise (e.g., cafeteria noise) while controlling confounding global behaviors. This test differed from traditional CAPD testing in that it measures the performance of the subjects with both different tonal qualities (i.e., male and female voices used in varying combinations) and different speaker positions (i.e., target and competing signals through either the same speaker or through different speakers). Testing conditions are (1) same tonal voice presentation with a low signal-to-noise ratio (SNR) that required understanding of the target signal, in this case a story, in the presence of a distracter with the same voice; (2) a high SNR condition where the target and distracter voices are different and from different speakers; (3) the tonal advantage condition where different voices and different speakers are used; and (4) a spatial advantage condition where the same tonal voice is presented from different speakers.

In 2006, Cameron, Dillon, and Newall conducted a study with the LISN on two groups of children; one group suspected as having CAPD (n = 10) and one group of normal listening children (n = 48). Cameron et al., found that the group with CAPD performed significantly poorer

than the normal listening subjects with tasks involving increased background noise, with decreased target signals (signal-to-noise ratio of 3.4 dB), and on the spatial advantage measure. Even though this test has not been well documented, it suggested that some children with CAPD have deficits in binaural mechanisms that use spatial abilities to filter unwanted background noise.

With the passing years and with the advent of advancing technology, electroacoustic and elecrophysiologic procedures (e.g., otoacoustic emissions, immittance measures, and auditory event potentials) broadened the field of audiology. These tests may be sparsely available in clinical settings, are time consuming, and more expensive; however, these measurements circumvent extraneous variables that confound behavioral tests. Also, due to the high costs and low availability of neuroimaging instruments, these tools are rarely used to assess auditory processing deficits (Musiek & Lamb, 1985). Noteworthy, these processes are only used in imaging laboratories or select behavioral settings; thus, electro -physiological and/or -acoustical testing are preferred (Jerger & Musiek, 2000).

In the 1950s through the 1960s focus was on the identification of auditory lesions. From that point the ability to test children gave rise not only to central auditory integrity of the auditory system, it also provided information on whether there was a basis for a language-learning disability. Studies also suggested that these tests can assess the child's ability to processes speech under difficult listening conditions that can describe the child's ability to recognize, attend to, inhibit, and recall speech information. From this point it was possible to take the steps necessary to alleviate the negative effects of CAPD (Keith & Jerger, 1991).

With the approach of the new century, theorists directed their studies towards delineating CAPD from other disorders such as learning and language, autism, and attention deficit disorders commonly found in children (Keith & Jerger, 1991). These studies lead to various definitions and ample opportunity for debates.

Definition

Many initial pioneers of in the field of auditory processing developed their own definitions of central auditory processing disorders. These early definitions were based on anatomical

lesions within the CANS. Within the past few decades, individuals have been identified as having symptoms and signs of auditory lesions but do not have any evidence of an active disease process. These individuals display an inability to attend to, discriminate, remember, recognize, or comprehend information presented through audition especially when listening to distorted speech or when there are competing sounds present in the acoustic environment (Keith, 1986). In addition, the presence of communication difficulties experienced by individuals suspected as having CAPD, perplexed researchers since these individuals presented with essentially normal peripheral hearing (Matzker, 1959) and normal intelligence (Keith & Jerger, 1991). It then became a necessity to develop new tests to assess the cortical functioning as it related to the actual perception of auditory information.

With the approach of the new testing protocols in the seventies and eighties, came a divergence in approaches to evaluating central auditory processing. This split was primarily based on the hypothesized origin of the processing abilities. For instance, some theorists maintained that deficits within the language centers attribute to processing difficulties, (i.e., the top-down theory); others, tended to believe that difficulties with processing information were due to the specific mode of audition, (i.e., the bottom-up theory). Then there were other theorists emerging in the late twentieth century who considered that processing auditory information tasks involved both cognitive processing and auditory processing, which gave way to more broadly based assessments and multi-modality points of view (Young & Protti-Patterson, 1984).

Supporters of the top-down model consider that deficits of central auditory processing are limited to acoustical information at the basic phonetic level of speech. The premise of top-down processing states that one anticipates what is said using our knowledge of the world and our understanding of language therefore, we understand speech using our higher cognitive functions and depend little, or not at all, on the auditory signal for understanding spoken words (Kent, 1992).

Rees (1973, 1981), a supporter of the top-down theory, suggested difficulties in articulation, language development, and reading is actually a language disorder, not an underlying auditory processing disorder as suggested by audiologists. Linguists also contend that

most language processing (e.g., auditory processed signals) depend on higher level cognitive knowledge.

Bottom-up theorists believe that individuals depend on hearing every sound to understand what is said. The bottom-up processing theory is based on the selection of cues from a continuously flowing pattern having no distinct segments yet can be extracted by the listener into units of phonemes, syllables, words, phrases, and sentences. In contrast, the top-down processing theory is based on the predictability of the spoken message based on situational context, semantic-syntactic cues, and the cognitive resources of the listener (Kent, 1992). Bottom-up contenders theorized that individuals with difficulty in processing auditory information would arise when processing information that was too slow or processing information in the presence of background noise (Katz, et al., 1992).

Cacace and McFarland are known as huge proponents of the bottom-up theory (Cacace & McFarland, 1998, 2005; McFarland & Cacace, 1995). These researchers determined that, "CAPD is a modality specific perceptual dysfunction that is not due to peripheral hearing impairment" (Cacace & McFarland, 1998, p. 355). Their primary argument was in rationalizing the label CAPD. These researchers are adamant that perceptual dysfunctions are modality specific with the primary deficit in processing auditory information. McFarland and Cacace claimed that if CAPD existed, deficits in other sensory modes (e.g., visual, tactile) would not be seen; that is, the deficit would only be seen or apparent in the auditory domain (1995).

In 2000 a group of experts lead by Jerger and Musiek attempted to develop a consensus statement for the American Academy of Audiology (AAA). The primary focus of this meeting was an attempt to assemble recommendations on diagnosing auditory processing disorders in school-aged children. These researchers also proposed the name be changed from CAPD to simply "auditory processing disorder" (APD) in order to avoid attributing auditory processing deficiencies solely to either central loci or peripheral sites. Due to confusion, and to avoid debate on where the breakdown occurs, both APD and CAPD are used synonymously (ASHA, 2005).

Jerger and Musiek, along with their diverse group, defined CAPD as a deficit that is specific to the processing of auditory information, especially in complex acoustic environments.

Central auditory processing disorder may be associated with difficulties in attending to spoken language, understanding spoken language, and/or complicated language or learning development. It is apparent that this group agreed with an "auditory-specific perceptual deficit;" but, do admit that CAPD, "can occur independently or can coexist with other, non-auditory disorders," in other modalities (Jerger & Musiek, 2000, p. 468-469).

Within the literature it is documented that speech is perceived from both the auditory signal, (i.e., the bottom-up point of view), and on the familiarity of the context, (i.e., the top-down point of view). Theorists state that when analyzing acoustic signals, individuals select certain cues from uninterrupted patterns and place them into discrete segments (bottom-up). Predicting spoken language (top-down) is based on the context of the situation, the semantic and syntactic cues, and the cognitive resources of the listener. It is the combined functioning of both the top-down and bottom-up processes that account for the perception of spoken messages (Kent, 1992). Neurosciencetists support this theory reporting that there are few areas within the cortex that are solely responsible for a single sensory modality. Multisensory neurons interface and integrate sensory data while being supported by higher order cognitive domains of attention, memory, and language representation. Simply stated, multiple modes influence the most basic encoding of auditory stimuli (ASHA, 2005).

The American Speech-Language-Hearing Association, after their collaborative research efforts, conceded that auditory tasks are influenced by several complex systems. In 1996 and 2005, ASHA assembled a group of audiologists and speech pathologists, who were deemed as experts in central auditory processing to develop a consensus on the topic of central auditory processing disorders. This group presented the most generally accepted definition of CAPD that was based on their research efforts, clinical practices, and technical reports. According to the Members of ASHA's Working Group's definition:

> Central auditory processes are the auditory system mechanisms and processes responsible for the following behavioral phenomena:
>
> - Sound localization and lateralization

- Auditory discrimination
- Auditory pattern recognition
- Temporal aspects of audition, including
    - temporal resolution
    - temporal masking
    - temporal integration
    - temporal ordering
- Auditory performance decrements with competing acoustic signals
- Auditory performance decrements with degraded acoustic signals

These mechanisms and processes are presumed to apply to nonverbal as well as verbal signals and to affect many areas of function, including speech and language. They have neurophysiological as well as behavioral correlates.

Many neurocognitive mechanisms and processes are engaged in recognition and discrimination tasks. Some are specifically dedicated to acoustic signals, whereas others (e.g., attentional processes, long-term language representations) are not. With respect to these nondedicated mechanisms and processes, the term *central auditory processes* refers particularly to their deployment in the service of acoustic signal processing.

A central auditory processing disorder (CAPD) is an observed deficiency in one or more of the above-listed behaviors. For some persons, CAPD is presumed to result from the dysfunction of processes and mechanisms dedicated to audition; for others, CAPD may stem from some more general dysfunction, such as an attention deficit or neural timing deficit, that affects performance across modalities. It is also possible for CAPD to reflect coexisting dysfunctions of both sorts. (ASHA, 1996, p.41)

In 2005, ASHA update the information and include advances that had accumulated in the ten years previous. After an extensive literature review in the fields of auditory and cognitive neuroscience, neuropsychology, and related areas, the 2005 ASHA Working Group described the

deficit of processing of auditory information by both symptomology and by patho- neuro-physiological nature. The symptomology portion of the definition remains as it did before (e.g., localization and lateralization, discrimination and recognition, temporal aspects of audition, etc.). The ASHA 2005 definition goes on to describe the nature of CAPD clearly excluding higher order cognition or language related dysfunctions such as, "phonological awareness, attention to and memory for auditory information, auditory synthesis, comprehension and interpretation of auditorily presented information and similar skills may be reliant on or associated with intact central auditory function" (p. 2). However, the definition stated that, "(C)APD may lead to or be associated with difficulties in higher order language, learning, and communication functions;" but, central auditory processing disorders are, "sensory processing deficits that are more pronounced in the auditory modality and, in some individuals, auditory-modality-specific effects may be demonstrated" (ASHA, 2005, p. 2). The 2005 Working Group goes on to describe that, "although (C)APD may coexist with other disorders (e.g., attention deficit hyperactivity disorder [ADHD], language impairment, and learning disability), it is *not the result of* these other disorders" (ASHA, 2005, p. 2), and it would be inappropriate to apply a CAPD diagnostic label unless deficits in the central auditory nervous system can be proven.

Characteristics

There have been several researchers who documented both symptoms and behaviors that have been associated with CAPD. Descriptions of CAPD have developed over the span of decades. The literature has a proliferation of terminology related to characteristics, symptoms, features, difficulties, and behaviors to reflect what children experience. The terminology used can be overlapping and confusing; therefore, in an attempt to organize the wealth of information and descriptions depicting deficits in the auditory processing system, a hierarchy tier is described.

The first tier in this hierarchy is the primary deficits or symptoms associated with CAPD, as defined by ASHA (1996, 2005). Behaviors, the second tier, are secondary characteristics that may result from the primary deficits and focus on the physical behaviors and social actions of the child (Bellis & Ferre, 1999; Chermak & Musiek, 1997; Katz, et al., 1992) as described by parents and/or teachers (Jerger & Musiek, 2000). The third and final tier depicts functional difficulties and

describes the linguistic, cognitive, and academic difficulties. These functional difficulties often arise as a direct result of the secondary behavioral characteristics.

The American Speech-Language-Hearing Association (1996, 2005) has defined the symptoms specific to the auditory system. According to ASHA, primary symptoms associated with CAPD are difficulties with localization and lateralization; auditory discrimination or pattern recognition; temporal processing, auditory performance with competing acoustic signals; and auditory performance when speech is degraded. According to ASHA, primary deficits that arise in any one of these areas would result in labeling a child as having CAPD.

Behaviors are actions and responses to stimuli and are secondary insults that may occur due to primary deficits. One such behavior is difficulty comprehending auditory information in the presence of competing noise and is one of the most widely documented behavioral consequences (ASHA, 1996, 2005; Chermak & Musiek, 1992; Hall & Muller 1997; Jerger, Martin, & Jerger, 1987; Jerger & Musiek, 2000; Keith, 1995, 1997, 2000a, 2000b, 2000c; Medwetsky, 2002). Difficulties with listening in the presence of background noise may lead to poor listening skills (Chermak & Musiek, 1992; Friel-Patti, 1999; Keller, 1992; Young & Protti-Patterson, 1984) or inconsistent auditory awareness (Keith, 1997, 2000a, 2000b, 2000c).

The observations of poor listening skills may lead parents and teachers to assume the child with CAPD has issues with attention (Cherry & Kruger 1983; Friel-Patti, 1999; Keith, 2000a, 2000b, 2000c; Smoski, Brunt, & Tannerhill, 1992). Researchers often describe children with attention problems as distractible and a daydreamer (ASHA, 2005; Chermak & Musiek, 1992; Keller, 1992; Medwetsky, 2002; Merrifield, Hall, & Merrell 1976). Children with both CAPD and attention issues are also described as having a short attention span (Battin, 1995; Chermak & Musiek, 1992; Singer, Hurley, & Preece, 1998) or having a lack of responsiveness (Johnson, Efield, & Sherman, 1981). Due to attention issues, many social problems can arise (Medwetsky, 2002). These may include hyperactivity (Chermak & Musiek, 1992; Johnson, et al., 1981; Keller, 1992), an uncontrollable temper (Battin, 1995; Johnson, et al., 1981; Keith 1997, 2000a, 2000b), or possibly withdrawn due to a poor self image (ASHA, 2005; Battin, 1995; Chermak & Musiek, 1992; Keith 1997, 2000a, 2000b, 2000c). Other secondary behavioral issues frequently described

by parents and teachers are lack motivation (Chermak & Musiek, 1992), poor motor coordination (Johnson, et al., 1981), lack of understanding humor (Keith, 1997), and playing with children below their developmental age (Battin, 1995).

It has been reported that due to primary symptomology (i.e., auditory discrimination, auditory figure ground) and secondary behavior issues (i.e., attention and poor listening skills), academic performances may suffer (ASHA, 2005; Medwetsky, 2002). Several researchers have document school failure for children with CAPD (Chermak & Musiek, 1992; Friel-Patti, 1999; Johnson, et al., 1981). Difficulties in reading (ASHA, 1996, 2005; Baran, 1998; Jerger, et al., 1987; Johnson, et al., 1981; Keith 1995, 1997; Medwetsky, 2002; Singer, et al., 1998), spelling (ASHA, 1996, 2005; Baran, 1998; Jerger, et al., 1987; Johnson, et al., 1981; Keith 1995, 1997; Medwetsky, 2002), and math (Jerger, et al., 1987) have also been documented by researchers.

Compromised memory skills, especially with long complex directions, have also been reported by researchers (ASHA, 2005; Chermak & Musiek, 1992; Friel-Patti, 1999; Hall & Muller, 1997; Jerger & Musiek, 2000; Keith, 1995, 1997; Singer, et al., 1998). These children often forget assignments or frequently ask for information to be repeated (ASHA, 1996, 2005; Battin, 1995; Friel-Patti, 1999; Keith 1995, 1997; Medwetsky, 2002; Sanger, Freed, & Decker, 1985). Other functional difficulties that may be present in children with CAPD are poor handwriting skills (Keith, 1995, 1997), difficulties with sound patterns in music and nursery rhymes (ASHA, 2005; Keith, 1997) and taking a long time to answer questions (ASHA, 1996, 2005; Keith, 1997).

As stated previously, individuals suspected as having CAPD frequently present with one or more of the illustrated behavioral characteristic; however, they are not exclusive to central auditory processing disorders. Some of the listed behaviors are observed in other disorders such as language-learning impairments, attention deficit/hyperactivity disorder (ADHD), and Asperger's syndrome (ASHA, 2005). The next sections documents the most prominent definition of these disorders along with their behavioral attributes in order to try to differentiate them from CAPD as well as document what the literature suggests about differential diagnosis.

Associated Disorders

Attention Deficit and Hyperactivity Disorder

The *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision* (DSM-IV-TR; APA, 2000) is used by primary care practitioners, psychiatrists, and other health care providers to diagnosis ADHD for children between the ages of 6 to 12 years old. Attention-deficit/hyperactivity disorder is a chemical disorder that affects the neurotransmitters within the cortex; this impairment inhibits individual's ability to appropriately plan, organize, and direct thoughts and behaviors (Fowler, 2002). Categorization of ADHD is separated into three distinct behavioral descriptions. These categories include (a) ADHD-predominantly inattentive type, in which behaviors cluster around difficulties in maintaining attention or responding to particular tasks, (b) ADHD-predominantly hyperactivity and impulsivity, in which the behaviors cluster around distractibility and an inability to stay on task, and (c) ADHD-combined type which is a combination of both inattentiveness and hyperactivity/impulsiveness behaviors (APA, 2000).

Diagnoses of children with ADHD, is primarily made from observable durational behaviors of the child, described behavioral patterns from parents or guardians, and behavioral checklists (APA, 2000).

The criteria provided in the DSM-IV-TR include:

Inattention

- often fails to give close attention to details or makes careless mistakes in schoolwork, work or other activities;
- often has difficulty sustaining attention in tasks or play activities;
- often does not seem to listen when spoken to directly;
- often does not follow through on instructions and fails to finish schoolwork, chores, or duties in the workplace (not due to oppositional behavior or failure to understand instructions);
- often has difficulty organizing tasks and activities;

- often avoids, dislikes, or is reluctant to engage in tasks that require sustained mental effort (such as schoolwork or homework);
- often loses things necessary for tasks or activities (e.g., toys, school assignments, pencils, books, or tools);
- is often easily distracted by extraneous stimuli;
- is often forgetful in daily activities.

Hyperactivity

- often fidgets with hands or feet or squirms in seat;
- often leaves seat in classroom or in other situations in which remaining seated is expected;
- often runs about or climbs excessively in situations in which it is inappropriate (in adolescents or adults, may be limited to subjective feelings of restlessness);
- often has difficulty playing or engaging in leisure activities quietly;
- is often "on the go" or often acts as if "driven by a motor;"
- often talks excessively.

Impulsivity

- often blurts out answers before questions have been completed;
- often has difficulty awaiting turn;
- often interrupts or intrudes on others (e.g., butts into conversation or games). (APA, 2000, p. 92)

The American Academy of Pediatrics (AAP) recognized that ADHD has as many as one third of it's diagnosed clientele with coexisting conditions such as oppositional defiant disorder, mood disorders, anxiety disorders, and learning disabilities (2000). Although CAPD was not listed among the coexisting disorders by the AAP it has been recognized by other authoritarians as separate yet co-existing conditions (ASHA, 1996, 2005; Chermak, Hall, & Musiek, 1999; Chermak, Somers, & Seikel, 1998; Keller, 1992; Riccio, Cohen, Hynd, & Keith, 1996) or even as autonomous disorders (Cook et al., 1993).

Children described as having CAPD are often characterized as having difficulties with hyperactivity, inattentiveness, and attention span (Chermak & Musiek, 1992). Keller (1992) compiled a comprehensive chapter, referencing many well known authors in various fields, attempting to differentiate auditory processing from attention-deficit/hyperactivity disorders. He provided his readers with a comprehensive listing of secondary behavioral characteristics, behaviors that are the direct result of the primary symptomology of impulsivity, inattention, and distractibility, as well as general and specific environmental characteristics pertaining to the ADHD child.

Of great importance, for the purposes of this document, is when Keller compared CAPD to ADHD and the social difficulties and behaviors noted in the school setting. Keller listed behavioral characteristics such as disorganization, short attention span, incomplete tasks, underachievement, careless work, lacking in instructional direction, restless, and disruptiveness as common behaviors described of both ADHD and CAPD children.

Social difficulties for both groups of children included poor peer relations and turn taking skills; aggressiveness; noncompliantness; and delinquent behaviors such as lying, stealing, and alcohol or drug. Just as CAPD's secondary characteristics causes functional difficulties in linguistics, cognition, and academics, so do ADHD's secondary characteristics. It was reported that approximately 34% of children with ADHD have specific learning difficulties that cause academic underachievement in various scholastic subjects (Keller, 1992).

Language and Learning Disabilities

The National Joint Committee on Learning Disabilities (NJCLD, 1998) is a group of representatives from well respected organizations such as ASHA, the Council for Learning Disabilities, the Association on Handicapped Student Services Programs in Postsecondary Education, and other affiliates. Representatives from these groups gathered, discussed, and concurred with each other to provide interested readers with an inclusive operational definition of learning disabilities. The definition of a language/learning disability has cumulated over several years beginning with statements made by the National Advisory Committee on Handicapped Children (NACHC) in 1967.

Based on this statement and many others, the NJCLD developed a new definition in 1981, revised it in 1990, states:

> Learning disabilities is a general term that refers to a heterogeneous group of disorders manifested by significant difficulties in acquisition and use of listening, speaking, reading, writing, reasoning, or mathematical skills.
>
> These disorders are intrinsic to the individual, presumed to be due to central nervous system dysfunction, and may occur across the life span. Problems in self-regulatory behaviors, social perception, and social interaction may exist with learning disabilities but do not, by themselves, constitute a learning disability.
>
> Although learning disabilities may occur concomitantly with other disabilities (e.g., sensory impairment, mental retardation, serious emotional disturbance), or with extrinsic influences (such as cultural differences, insufficient or inappropriate instruction), they are not the result of those conditions or influences. (NJCLD, 1998, p. III-258a)

The NJCLD listed the primary symptomology for a child with a language/learning disability as having a deficiency in acquiring the syntactical, semantical, morphological, and pragmatical interactions of spoken and written language. Although the NJCLD lists a broad summarization of characteristics, only those characteristics/features that are similar to documented CAPD and ADHD, discussed previously in this document, are listed. Associated (secondary) behaviors listed by the NJCLD include difficulty following directions; difficulties with letter and sound association; slow or poor memory skills; impulsiveness; trouble interacting with peers; and difficulties making friends. Functional academic difficulties included errors in math, reading, writing, spelling, and handwriting. The NJCLD panel cautioned that even though some behaviors and features listed above may appear in all children at some point, it is important to understand that several characteristics and features displayed over time could be warning signs of a language/learning disability.

One of the constructs underlying the stated definition is that impairments in learning language arise due to significant difficulties with oral and receptive cognitive skills. The difficulties in language/learning difficulties may co-exist with impairments such as sensory deprivation and

ADHD (NJCLD, 1998), two of the most common disabilities that are in dispute with CAPD (ASHA, 1996, 2005), but these conditions (e.g., sensory impairments, ADHD) do not result in a language/ learning disability (NJCLD, 1998).

Autism

Pervasive developmental disorders comprise a wide array of disorders including Autism Spectrum Disorder (ASD) or autism, Asperger's, childhood disintegrative disorder, Rett's disorder, and atypical autism also known as pervasive development disorder not otherwise specified (ASHA, 2006a). Relevant information on the topic focuses primarily on defining autism as it is stated today and autistic behaviors as they relate to audition.

Many definitions and categories have been documented since its conceptual symptomology in 1943 by Kanner (ASHA, 2006a). Today, the most widely accepted definition is regulated by the Individuals with Disabilities Education Improvement Act of 2004 which states:

> Autism means a developmental disability significantly affecting verbal and nonverbal communication and social interaction, generally evident before age 3, which adversely affects a child's educational performance. Other characteristics often associated with autism are engagement in repetitive activities and stereotyped movements, resistance to environmental change or change in daily routines, and unusual responses to sensory experiences. The term does not apply if a child's educational performance is adversely affected primarily because the child has an emotional disturbance as defined by IDEA criterion.
>
> A child who manifests the characteristics of "autism" after age 3 could be diagnosed as having "autism" if the criteria in the preceding paragraph are met. (cited in ASHA, 2006a, p. 4)

The American Speech-Language Hearing Association (2006a) developed an Ad Hoc Committee to provide speech-language pathologists a basic understanding of autism. As with ADHD, autism is diagnosed by qualified physicians, psychologists, and psychiatrists by identifying specific behavioral characteristics. ASHA (2006a) documented several symptoms and behaviors based on DSM-IV-TR.

The ASHA (2006a) Ad Hoc Committee reported three core symptoms that can guide professionals towards a diagnosis; they include deficiencies in (a) social interaction, (b) verbal and nonverbal communication, and (c) repetitive behaviors or interests. For each core symptom a suspected individual must display at least six traits to be diagnosed with an autistic disorder.

The first core symptom is impairment is social interaction which includes at least two of the following symptoms: impairment in the cognitive system that regulates nonverbal social interaction; lack of age appropriate peer relationships; lack of hobbies or interests; or lack of social and emotional exchange with others. The second evidentiary area is impairment in communication. Suspected persons must have at least one of the following symptoms: delayed or absent spoken language not attributed to hearing loss; depressed conversational abilities even though speech is developed; repetitive language dysfluencies; or lack of age appropriate make-believe and/or social play. The third and final area is symptoms that reflect repetition. One of the required six symptoms includes a heightened preoccupation with objects or parts of objects; a strict adherence to nonfunctional routines; or persistent repetitive motor movements.

Social interaction, verbal and nonverbal communication, and repetitive behaviors make up the core symptomology eliciting a diagnosis of autism. Other behavioral (secondary) characteristics and academic features apparent in individuals with autism include impairments in attention, depressed cognitive skills in speech and language, sensitive tactile stimuli, and motoric gestures (ASHA, 2006a). Children with autism also show difficulties with joint attention, an inability to recognize another person's facial expressions, gestures, intonations, and eye gazes patterns that allow for the ability to follow another person's focus of attention, shift gaze between people and objects, and follow what others are referencing (ASHA, 2006a).

Emerging cognitive skills that allow individuals to request objects, protest unfavorable events, and exchange experiences or ideas, are often limited in children with autism. Another behavior described by ASHA, is social reciprocity. This deficit limits the initiation of conversation, thus limiting the development of sophisticated language. A little less than half of the children with autism have difficulties using speech effectively; difficulties producing consonant sounds limit intelligibility. For many autistic children, *echolalia*, referring to the immediate or delayed repetition

of what is heard, becomes the primary means of communication. Later in life literacy skills fail to develop appropriately due to deficiencies in normal language acquisition limiting their functional use of books, story grammar, and problem solving, and reading comprehension (ASHA, 2006a).

Individuals with autism typically do not show distress or discomfort and their lack of emotions and attachment behaviors restricts the range of communicative functions sought from others. Symbolized gestures (e.g., showing, waving, pointing, and shaking hands) are often delayed or absent; instead of appropriately communicating, these children hit, scream, or run away from undesirable situations (ASHA, 2006a).

Poor organizational and spatial memory skills, especially with complex information, are also found to be a behavioral characteristic for individuals with autism. Even though global memory deficits (e.g., memory for language, recognition memory) are typically unaffected, children with autism find it difficult to remember or recall information presented in either the auditory or visual modes. Deficiencies in visual and auditory memory with complex patterns may be due to a lack of organizational support in the functional processes causing an individual with autism to regress using simpler rules in language (Williams, Goldstein, & Minshew, 2006).

Of particular interests in its relation to CAPD is a higher functioning form of autism, Asperger's syndrome, a sub-category within ASD. According to the classification system in DSM-IV-TR, children between the ages of 5 to 9 years are identified with Asperger's syndrome, instead of traditional autism, when intellectual abilities are comparatively normal to aged- matched peers, yet core symptoms of social functioning and repetitive behaviors are still apparent albeit in milder forms (APA, 2000).

Asperger's syndrome, as with language disorders, attention deficit disorders, and CAPD, is vastly documented in the literature. The behaviors displayed in these children often commingle and at times coexist. One challenge audiologists have is determining if difficulties children experience are due to CAPD, attention deficit/hyperactivity disorder, language-learning disorder, or autistic spectrum disorder. Differential diagnosis then becomes an essential part in determining treatment options for these children.

Differential Diagnosis

Descriptions in research, within the fields of audiology and speech pathology, alluded to many similarities between CAPD and other similar childhood disorders (i.e., ADHD, language/learning impairment, and Asperger's syndrome), making accurate diagnosis difficult (ASHA, 1996, 2005; Jerger & Musiek, 2000). For example, difficulties with auditory blending, discrimination of phonemes, auditory closure, or auditory memory may be present in children with either CAPD or ADHD (Keith, 1986). Confounding characteristics such as lack of attention, cooperation, understanding, or even motivation, further complicate accuracy (Jerger & Musiek, 2000).

Similar behaviors can describe individuals with CAPD, ADHD, language/learning disabilities, and/or Asperger's syndrome. Top behaviors documented in the literature include: poor listening skills, evident in background noise (Bellis & Ferre, 1999; Geffner & Lucker, 1994; Jerger, et al., 1987; Smoski, et al., 1992); academic failure (Bellis & Ferre, 1999; Chermak, et al., 1998; Gomez & Condon, 1999; Katz & Wilde, 1985; Krüger, Krüger, Hugo, & Campbell, 2001; Sloan, 1992); and difficulty discriminating and identify speech sounds (Bellis & Ferre, 1999; Jerger & Musiek, 2000; Moss & Sheiffele, 1994; O'Riordan & Passetti, 2006). Difficulty following and remembering long complex directions was another behavior that was documented in various disorders; these children often request for information to be repeated (Bellis & Ferre, 1999; Chermak, Tucker, & Seikel, 2002; Gomez & Condon, 1999; Jensen, Larrieu, & Mack, 1997; Jerger & Musiek, 2000; Koyama, Tachimori, Osada, & Kurita, 2006; Moss & Sheiffele, 1994; Williams, et al., 2006).

Inattention and distractibility, another frequently cited behavior among CAPD, ADHD, language/learning disability, and Asperger's syndrome was reported in the literature (ASHA, 1996; Bellis & Ferre, 1999; Cacace & McFarland, 1998; Chermak et al., 1999, 2002; Gomez & Condon, 1999; Jensen, et al., 1997; Jerger & Musiek, 2000; McFarland & Cacace, 1995; Moss & Sheiffele, 1994; Riccio et al., 1996; Stach, 1998). Even though social inappropriateness was not cited as a top behavior by researchers, it is felt that descriptions of this behavior assist in determining CAPD from other disorders.

Audiological assessment procedures, which are beyond the scope of this document, are often inadequate to differentiate children suspected with CAPD from other disorders such as those previously mentioned by ASHA (1996, 2005) and Jerger and Musiek (2000). In order to demonstrate the complexities of differential diagnosis, studies that illustrate comparative analysis between CAPD and other disorders will be discussed.

Studies conducted by Chermak and her colleagues (Chermak, Hall, & Musiek, 1999; Chermak, Somers, & Seikel, 1998; Chermak, Tucker, & Seikel, 2002) focused on the most commonly occurring behaviors of CAPD and ADHD. Four-hundred questionnaires were sent to both audiologists and pediatricians who ranked common behaviors, similar to both CAPD and ADHD, on a Likert scale ranging from 1 (*never observed*) to 5 (*always observed*). A total of 130 respondents were analyzed to determine which behaviors were frequently observed. Results revealed 41 characteristics common to both CAPD and ADHD disorders that were observed the most by practitioners and audiologists alike. What was interesting to researchers was the order of the rankings. Two of the studies (i.e., Chermak, et al., 1998; Chermak, et al., 2002) ranked inattention (Likert scale ranking 4.36 and 4.45 respective to each study) and distractibility (Likert scale ranking 4.27 and 4.04 respectively) as being the most observed of the top four behaviors for physicians; yet, these behaviors were not ranked above a 3.70 by audiologists. Audiologists observed difficulty hearing in background noise (4.40 and 4.28 respectively) and difficulty following oral instructions (4.20 and 4.33 respectively) as the most commonly noted behaviors.

Chermak, Hall, and Musiek (1999) speculated that children with CAPD have deficits in attending to auditory information which results in academic difficulties, where as, children with ADHD were found to be associated with a heightened activity level and poor self-control (i.e., poor behavior regulation), accounting for their lack of understanding acoustic stimuli. Another distinction determined by Chermak et al. is the origin of these disorders. Central auditory processing disorders are thought to be a sensory deficit and is restricted to the auditory modality were as ADHD is thought to be a deficiency in the cognitive processes and affected by supramodal influences. For example, the inattentiveness of a CAPD child primarily occurs with

auditory information that is presented with background noise where the inattentiveness of an ADHD child occurs in not only the auditory mode, but the visual and tactile modes as well.

Bellis and Ferre (1999) detailed four case studies. Each subject was referred to the researchers for language/learning difficulties and each displayed similar behavioral characteristics (e.g., difficulties hearing in background noise, difficulties following oral instructions, inattention, and social inappropriateness) all of which are found to be associated with CAPD, ADHD, language/learning disabilities, and autistic spectrum disorders. Each subject was administered CAPD protocols in order to identify if auditory processing difficulties existed.

Case 1 detailed a 9 year old female who complained of difficulties hearing in background noise; but, when given visual cues, difficulties were greatly reduced. Previous testing suggested normal expressive language skills, reasoning abilities, general knowledge, and age-appropriate visual processing and motor skills. Even though broad cognitive abilities were within the normal limits, deficits in comprehension, ordering, and remembering auditory information and difficulties with reading, spelling, and written language were identified. Results on CAPD testing revealed deficits in the auditory cortex, specifically with auditory closure and auditory analysis, "...which are necessary for decoding auditory input" (p. 322). The academic difficulties experienced by this child were presumed to be due to her inefficient discrimination abilities and the difficulties in noise were attributed to the inability to consistently distinguish between important and insignificant auditory information which caused auditory fatigue. This child was managed via classroom modifications and assistive listening devices.

Cases 2 and 3, both 9 year old males, were also referred for academic and auditory figure ground difficulties. Cognitive evaluations revealed intellectual capacities to be within the normal ranges; however, the boy from Case 2 exhibited delays in motor abilities and in visual/auditory association skills. The boy from Case 3 exhibited weaknesses in social judgments, receptive language skills once verbal instructions became complex, and deficiencies in expressive language. Additional testing for both subjects revealed auditory processing skills to be appropriate with the exception of difficulties with interhemispheric functioning and difficulties

with recognizing prosodic parameters respectively. These children were managed by speech-language pathologists; the boy from Case 2 was also managed by an occupational specialists.

Case 4 depicted a 10 year old male who reportedly had academic deficits, listening difficulties, problems following directions and inattentiveness. When CAPD testing was conducted, he scored well within the normal limits on all tests. He was referred to a pediatric neurologist for ADHD who placed him on appropriate medication; performance at school and inattentive behaviors were notably improved.

Gomez and Condon (1999) also reported on similar behaviors among children with CAPD, ADHD, and learning disabilities. Behaviors cited were inattention, comprehension of auditory stimuli, and language/learning delays. They examined the CAP abilities of children with ADHD, ADHD with LD, and no disabilities. The researchers used 3 groups of 15 subjects each; all were non-medicated and had normal hearing. Most participants with ADHD received their diagnosis in pediatric medical and psychology clinics; others were rated by both parents and teachers on the DSM-IV scales, but were not clinically diagnosed with ADHD. All non-disabled children were from mainstream classrooms and did not meet the DSM-IV criteria for ADHD. All subjects were screened for learning disabilities and for their reading abilities. Gomez and Condon found that children with lower central auditory processing scores were strongly associated with learning disabilities rather than with ADHD. Findings suggested that (1) both ADHD and CAPD are associated with inattention and hyperactivity, (2) children with ADHD perform poorly on CAP tasks, (3) there is a high comorbidity between ADHD and CAPD, and (4) no difference was noted between CAPD children with or without ADHD.

Social inappropriateness was not one of the top behaviors found among CAPD, ADHD, language/learning disabilities; however, these behaviors are often described in individuals with autism (Jensen, et al., 1997; Koyama, et al., 2006). Even though few studies documented differential diagnosis between CAPD and autism (e.g., Bellis & Ferre, 1999), Koyama, Tachimori, Osada, and Kurita's study (2006) sought to differentially diagnosis children with high-functioning autism (e.g., Asperger's syndrome) and ADHD. These researcher compared assessment scores to determine cognitive functioning and autistic tendencies. Subjects chosen were two groups of

27 children each; Group 1 had autism and Group 2 was diagnosed with ADHD. All participants were comparable in age, gender, and intellect. When the researchers compared the assessment scores on administered tests, they determined that children with autism had greater disturbances with peer interaction and non-verbal communication; whereas the children diagnosed with ADHD had increased activity levels.

Some researchers have found that differential diagnosis is almost impossible. Krüger, Krüger, Hugo, and Campbell (2001) suggested a transdisciplinary model to help clinicians develop evaluation and intervention programs for children with CAPD, language disorders, or sensory deprivation. Nineteen English speaking children with the mean age of approximately 7 years of age were randomly selected from an elementary school; the children had been previously diagnosed with CAPD, language disorders, or sensory integration dysfunction. All children had normal peripheral hearing and were enrolled in remedial classes of some sort (i.e., education, speech and language therapy, occupational therapy). To determine if a problem existed, the professionals assigned a *1* when language reception, verbal expression, and auditory deficits (e.g., auditory closure, analysis, memory, discrimination, sequencing, and blending) were apparent. They assigned a *0* when the following were deficient: fine-motor abilities, eye-hand coordination, figure-ground perception, visual motor integration, visual closure, body awareness, visual analysis and synthesis, balance, eye movements and tactile defensive reactions.

According to Krüger et al., results suggested that most children in this study displayed deficits in various modalities (i.e., visual, auditory, motoric, and concentration modalities), and in both linguistic and attention skills (78%). The researchers claimed the combination of presenting deficits in various modalities may have been the cause for the child's poor academic performances, language abilities, central auditory processing abilities, and sensory integration issues. The researchers concluded that language and CAPD skills cannot be separated from skills involving the visual modality and that only 2 of the 19 subjects were described as having a pure language or pure central auditory processing deficit.

With the varying and overlapping symptoms among CAPD, ADHD, language/learning disabilities, and autistic spectrum disorders, the development of a case history must be presented

in a way that is neither biased nor misleading towards one disorder or the other. In addition, the method used to gather information for the case history, especially when cases involve children, must be explored. The remaining sections of this document consist of parental concerns and the development of the case history. Chapter 2 will describe the usefulness and effectiveness of parental concerns. Chapter 3 will describe the efficacy of questions asked on the case history and offer the development of a new pediatric case history to be used by the Louisiana Tech University Speech and Hearing Center.

CHAPTER 2

Parental Concerns

The purpose of this report is to determine if the Louisiana Tech University Speech and Hearing Center's case history form, specifically designed for children, in an effective tool in gathering parental input, especially in relation to central auditory processing disorders. Parental reports regarding pediatric development has been used for decades. Physicians, particularly pediatricians, have been urged by the American Academy of Pediatrics to detect children with developmental problems including those with speech and language issues, learning disabilities, autism, and attention deficit concerns. Most physicians rely on direct observation and descriptions given by the parents or caretakers to guide their diagnosis (Glascoe, 1991). According to Dewey, Crawford, and Kaplan (2003) parental concerns, when carefully elicited and interpreted, can be extremely accurate in detecting children with disabilities.

In 1970, Broussard and Harnter studied the developmental outcomes of children based on parental assessments. To gather their data these researchers requested input from parents with concerns regarding their child's development and parents without concerns. Each parent was asked to answer age specific developmental questions when their child reached 6 weeks of age. The researchers evaluated/assessed all children with various psychological and developmental measures four and one-half years later. Broussard and Harnter's findings revealed that 70.6% of the parents who had concerns at the six week mark rated their child as more difficult. Follow-up testing conducted by the researchers four years later, confirmed that the parental suspicions did, in fact, find the children to have developmental and/or psychological issues (83%). These results suggested that parents' opinions must have some validity when predictions of childhood problems are suspected.

Knobloch, Stevens, Malone, Ellison, and Risemberg (1979), also conducted a study to validate the accuracy of parental reporting related to infant development. The researchers

developed a questionnaire that depicted behavioral patterns (i.e., fine and gross motor, language, social development, hearing, vision) for children between ages 4 weeks to 36 months. Responses were scored utilizing a coding system developed by the researchers. The rankings were categorized from 0 to 3 (normal=1; questionable =2; abnormal =3; and undetermined =0). Five hundred twenty-six subjects were selected from a peri-natal center to participate in the study. Of the total number of subjects, 427 parents claimed their child was developing normally with the remaining subjects (n = 99) characterizing their child has having either minor or major signs of abnormal development.

Within these two groups, normal versus abnormal development, Knobloch et al. conducted standardized testing to quantify parental reports. Of the 427 children reported by parents as having normal development, 94% were accurate. Of the remaining 99 subjects with suspected deficits, 93% of the children were found to have developmental issues. These findings suggested that parental reporting should be used by health care professionals to identify and initiate early intervention.

Dr. Frances Glascoe served as an educational specialist on an autism and developmental diagnostic team for the department of pediatrics at Vanderbilt University. As the author and editor of several journal articles and chapters, her research focused on the accuracy of developmental and behavioral screening measures. Dr. Glascoe authored several developmental and behavioral screening tests including *Parents' Evaluation of Developmental Status* (PEDS) a very brief surveillance and decision-support tool on developmental and behavioral needs for children from birth to 8 years old. Dr. Glascoe and many of her colleagues performed various studies that focused on parental concerns and several aspects of childhood development.

In 2000, Glascoe summarized many of her findings from previous studies conducted from 1989 to 1998. The approaches in each study were designed to detect developmental and behavioral problems in children. The studies were based on nearly 1,000 diversified families whom were seeking services from primary care physicians. Parental concerns were elicited by way of standardized questionnaires developed by Glascoe. In each of these studies, childhood

development was measured utilizing standardized testing and was administered by licensed professionals.

Cumulative findings of these studies determined that parental concerns have high levels of sensitivity in detecting children with disabilities (74-79%). When children were not reported as having a disability by parents, the researchers founded high levels of specificity (70-80%). Glascoe assigned labels called parental predictive values that determined the correct prediction of development by parents. She used negative parental predictive values that were the percent of children with normal development and positive predictive values that were the percent of children who perform below average. Once the values were calculated, the researcher then compared the cumulative predictive values to standardized testing scores.

The comparisons revealed that parents correctly identified their child as developing normally by a negative predictive value of 94%. Thirty-seven percent of parents positively predicted that their children were not developing normally; further analyses determined that many of the parental developmental concerns included not only health related concerns, but also concerns regarding IQ, scholastic achievements, and/or speech and language development. To facilitate a course of treatment, Glascoe concluded that eliciting parental concerns can be used either alone or in conjunction with other questioning as a screening tool when concerns are directed towards childhood development.

In 1991, Glascoe investigated if parents' concerns, regarding speech and language development, reflected true deficits and could these parental concerns function as a pre-screening measure. One hundred fifty-seven parent-child dyads were sought from the medical sector. The children's ages ranged between 6 to 77 months; none of the children had any acute medical problems and the researchers controlled for extraneous variables (e.g., age, health status, socioeconomically background).

To obtain the measurements on parental concerns, the researcher administered specific evidence based interview questions about their child's learning and development. The answers from the parents were then compared to the child's scores on age equivalent standardized inventories that were administered to each child. Data suggested most parents (83%) correctly

identified their child as normal. Seventy-two percent of the time, parents had valid concerns regarding their child's speech and language development. Glascoe determined that parental concerns could be used as a guide for practitioners to aid in referring children suspected of speech and language delays and for further evaluations by licensed professionals.

In 1991, Thompson and Thompson mailed a questionnaire to 49 families of hearing impaired children to determine if hearing loss in children was first identified by the suspicions of parents. Of the 49 cases, 48 of the children were first suspected as having a hearing impairment by their parents. Early intervention for the remediation of hearing loss occurred 8.87 months sooner than if professionals discovered the hearing loss at regular well baby visits. These results stressed the importance of professionals listening to parental concerns.

Studies have also been conducted to determine if parental concerns predict attention-deficit disorders. Mulhern, Dworkin, and Bernstein (1994) investigated whether parents' concerns of impulsivity, distractibility, and over-activity affected their child's school performance, and were these evidentiary for a diagnosis of an attention deficit/hyperactivity disorder (ADHD). The researchers conducted a comparative study of 245 children, with a mean age of 8.1 years, whom were documented as having learning and/or behavioral issues via written histories obtained from the parent. The parental responses were then compared with the results of standardized tests for ADHD issued by professionals designated by the researchers.

After standardized testing, Mulhern et al. determined that school related problems due to impulsive, distractive, over-active behaviors were found in 92% of subjects. When compared with standardized tests results, 44% were diagnosed with a learning disability, 38% with ADHD, and 20% with emotional disorders. The findings of specific parental concerns revealed a correct diagnosis of ADHD in 38% of children. Even though parents' specific concerns did not highly predict a diagnosis of ADHD, their concerns did result in diagnoses of associated disabilities (i.e., learning and emotional disabilities). The researchers attributed the lack of correlation between parents' specific concerns and a diagnosis of ADHD on the differences of various environments of the children (e.g., children may act differently in school versus the pediatrician's office); lack of understanding of childhood development (e.g., attributing the lack of attention to ADHD when the

actions may be due to cognitive impairment); and parents' perceptions of normal stage related behaviors due to family related stressors (e.g., marital strife, disorganized family environment). Mulhern and fellow researchers suggested their findings supported recommendations that professionals should take into consideration parental concerns of their child's behavior and development and the information should be used as guidance for further evaluation and referrals.

Another study regarding parental concerns and attention problems was conducted by Dewey, Crawford, and Kaplan in 2003. This group of researchers evaluated whether parental reports of everyday cognitive functioning contributed to a diagnosis of attention deficit disorder, a reading disorder, or a combination of both. The researchers assessed four groups of children with a mean age of 8 years; 90 subjects with normal skills were used as a control group; 60 subjects were determined by standardized testing to have a reading disability (RD), 49 with ADHD, and 50 with both RD and ADHD. Parents were asked to rate their child using various standardized rating scales of memory, cognitive abilities, coordination, learning styles, and academic performances.

Dewey et al. found that 73.8% of the subjects were correctly classified by standardized tests as RD, ADHD, or RD + ADHD. The standardized questionnaire administered to parents indicated moderate sensitivity, but low specificity; in other words parental concerns did identify difficulties with their children, but did not necessarily correctly correlate those difficulties with ADHD, RD, or ADHD + RD. In summary, the results of Dewey and others suggested that parental concerns may help to clarify their child's difficulties and may be important in help determining the standardized testing procedures chosen by professionals.

Glascoe and Dworkin (1995) reported that certain types of clinical information, such as parents' opinions and concerns, seem especially predictive of children's developmental and behavioral status. Research suggests that when pediatricians incorporate parental data, clinical impressions increase in accuracy. Parental data is also useful in making informative observations of children, specifically parental concerns regarding the child's development, language-learning issues, and attention deficits. Glascoe and Dworkin stated that clinical judgment, based on parental concerns, could function as a screening tool where children would

be referred for further diagnostic evaluation even though there could be a 28% chance of over-referrals.

Despite parental familiarity, how parents evaluate their child's development and their recall ability in recollection of milestones should be addressed. Glascoe and Dworkin (1995) suggested parents express their child's behavior by way of appraisals or descriptions. Parental appraisals of their child are opinions of development and behavioral status expressed in estimations, predictions, and concerns. Parental descriptions are long-term memory reports of nonjudgmental depictions of their child's current skills and accomplishments.

Glascoe and her colleague surmised that for the most part, parents correctly recall the developmental age of their child when compared to standardized testing results (65%). Approaches to eliciting parental opinions often require predictions or guesses of their child's future functioning. Glascoe and Dworkin determined that approximately 78% of parents determine their concerns based on the emotions, behaviors, and development of their child.

In 1935, Pyles, Stole, and MacFarlane initially investigated the accuracy of childhood development given by parental reports. These researchers obtained 252 medical records to document developmental milestones of children from birth to 2 years of age and then compared the results to the mothers' report that were recorded in 3 month intervals. Areas of questioning to the mother included her physical condition during pregnancy, duration of gestation, duration of labor, and the weight of the baby at birth. Questions regarding the first year's development of the child included the age the child walked alone, the age the first tooth appeared, the weight at 12 months, and history of disease during the first year.

Pyles et al. documented that the mother's condition during pregnancy was reported with 22% accuracy indicating an extremely low agreement between the reports and the primary records. Eighty-nine percent of mothers accurately reported the gestational duration. Sixty-one percent accurately reported information for their duration of labor; however, when compared to all participants, only 10% were in exact agreement. The weight of the child at birth was correctly reported in 96% of the cases; however, when compared to the total number of all participants, only 59% were accurate. During the first year of developmental history, 84% accurately recalled

the age their child walked alone; 80% accurately recalled the age the first tooth appeared; and 79% were in agreement with the weight of their child at one year of age. Mothers were reported to accurately recall diseases during the first year with an accuracy of 62%.

Pyles, et al. concluded that their findings were questionably high. These inflations may have been due to the frequent visits (e.g., three month intervals) and questioning by the research assistants. Pyles and fellow researchers concluded that mothers often forget, consciously or unconsciously, or minimize certain difficult instances about their child. It was also noted that some mothers overestimated childhood milestones such as walking alone, obtaining the first tooth, birth weight, and weight at twelve months; the researchers claimed that parents tend to error in the direction that far exceeded the normal developmental patterns. It was also interesting to note that the researchers suggested that mothers with several children and mothers of their first born had a tendency to overestimate normal developmental patterns. Pyles and colleagues conducted correlation studies to determine if the mothers' educational background had any effect on recalling information; they found no apparent relationship on any item except a small difference for weight of infant at birth. The researchers did not make any inferences as to if this information can be clinically applicable.

In 1941, McGraw and Molloy sought to determine if specific questioning regarding childhood development would result in greater accuracy of reports by mothers. The researchers speculated that inaccuracies could be due to the failure to observe circumstances in the first place, to suppress disagreeable experiences, or not attaching significant meaning to developmental milestone causing a simple lapse in memory. Besides the two sets of questions, this study differed from the Pyles et al.'s study in that the ages of the children ranged from 2 to 8 years of age, extending the intervals of questioning beyond the quarterly basis. These researchers asked only questions regarding the development of the infant, which expanded on Pyles and others developmental questions previously administered in 1935. Adding to the previous research, additional questions included sitting alone, rolling over, drinking from a cup, reaching for objects, beginning to talk, and if and when the child had their vaccinations.

These researchers asked 42 mothers two sets of questions regarding their child's development. The first set was the verbal questioning and the second set had accompanying pictures. These responses were then compared to the child's health records documented by their pediatrician. Responses were judged to be accurate if the mother's report agreed within 1 month of the date recorded in the health records.

The first interview findings (i.e., where only questions were asked) suggested that 35% of mothers did not recall instances of severe or moderate illnesses/surgeries (e.g., ear infections, myringotomy, chickenpox, tonsillectomy, bronchitis) at all; 33% recalled the time correctly within 1 month; and 37% could not remember when the events took place. On average, the mothers deviated from accurate accounts by an average of 3 months. Even when the mothers recalled a specific illness, they frequently failed to remember the exact time of its occurrence. McGraw and Molloy reported their average discrepancy was larger than the Plyes' study.

With regard to questions related to behavioral developmental milestones, 23% were accurate, 46% deviated by more than 1 month; and 31% did not recall any information. McGraw and his colleague reported finding that mothers tend to report an earlier date than what corresponded to the medical records for developmental milestones of standing, walking, sitting alone and rolling over; these findings are in agreement with Pyles et al.'s (1935) study that mothers tend to overestimate developmental patterns.

In the same study, the second interview was conducted 2 months later where both questions were asked and action pictures were shown (e.g., child standing, walking, sitting alone, rolling over). When all of the behavioral items were considered in the second interview, the percentages of incorrect versus correct responses were equal; whereas during the first interview, incorrect responses were double the percentage of correct responses. No other specific comparisons (e.g., percent that were accurate, deviation by more than one month, or not recalling any information) were reported by the researchers. They did report, however, that mothers continued to state overachievements in childhood development. Based on their results, McGraw and Molloy determined that more specific questioning could evoke more accurate reports. They

also reported the same effect as Pyle's 1935 study that mothers often fail to recall illnesses and surgeries of their child and overestimate developmental milestones.

Glascoe, MacLean, and Stone, (1991) studied the relationship between parents' concerns and significant behavior problems. The study focused on the meaning behind parental concerns to help pediatricians decide how to respond to complaints regarding their child's behavior. Ninety-five parents with various demographics, educational levels, and healthy children with the approximate age of 48 months were asked to participate. The first question asked to parents sought to gain information regarding concerns about the child's learning and development. Responses from the parents were categorized as follows: no concerns, concerns about behavior control, gross and fine motor development, receptive and expressive language skills, personal-adaptive skills, social affective, school skills, medical status, and global development. An additional question, probing each domain listed above, was asked to ensure parents did not omit any concerns. Following the questioning, parents were asked to fill out a behavior inventory to report problems their child experienced.

Analysis from the parental questioning revealed that out of the total number of subjects, 61 parents did not report any concerns; when these children were tested and results analyzed, 91% were found to be normally functioning. A total of 34 parents noted concerns about their child's behavior; when this group was tested and analyzed, 41% of the children were identified with behavior problems. Analysis of the behavioral inventory revealed that 20 of the 95 children failed the behavioral inventory and 14 of these children had parents with concerns. Seventy-five children passed the behavioral inventory; when testing was conducted, 55 of these children were found to be functioning within normal ranges revealing. Approximately 1/3 of the children in need of referrals were not identified by parental concerns.

Githens, Glass, Sloan, and Entman conducted a similar study in 1993 relating to how well mothers remember maternal and prenatal conditions during labor, delivery, and postpartum post four to six years from delivery date. One hundred-two subject telephone responses were compared with information obtained from the mothers' and infants' medical records. The

researchers determined that an 89% agreement existed between the mothers' responses and their respective charts.

Research has found that parents may accurately observe and report on the presence or absence of specific behaviors but perceptions of normalcy of developmental progress may diverge markedly from professional estimates of the child's status. It is important to recognize that parents have both advantages and limitations when recalling developmental milestones. Sometimes, the parents are inaccurate, but generally, the descriptions of current abilities are reliable even though parents tend to over-estimate developmental milestones. Research supports that parents are often correct when their children have developmental delays and are highly accurate when detecting major handicaps (Dworkin, 1989). However, it was reported by Dworkin that parents are less adept to report subtle developmental problems for several reasons. One reason parents fail to report developmental delays is their knowledge often varies from person to person and they often fail to appreciate the significance of developmental delays. Even when parents are suspicious of their child's lack of development, they may deny the problem in an attempt to deal with their anxiety or may lack the confidence in their own observations.

In an attempt to define how parents answer question regarding the development of their child, Glascoe and Dworkin (1995) analyzed three areas: How parents were asked questions, the meaning of parental concerns, and what influences parental responses. Summarizing their research, Glascoe and Dworkin noted that professionals in the health care industry should state their questions carefully to elicit and organize parental concerns. For example, elicitors should use *concerned* instead of the word *worried* in order to encourage responses from parents. The researchers also suggested relating *development* with *learning* to improve parental understanding, and help parents to focus their responses on information more valued by physicians and associated professionals. In order to facilitate appropriate course of therapy or referrals, the researchers suggested categorizing parental concerns by developmental domains of gross and fine motor, cognition, speech and language, hearing, etc.

In 1990, Glascoe and MacLean conducted a research project that sought to determine how parents seek and use developmental information when appraising their child. One-hundred

parents, with children at the age of 37 months and who were seeking well-baby pediatric evaluations, were chosen for their study. Parental responses were elicited by standardized questionnaires previously designed; items chosen for analysis included articulation and language development, motoric skills, and behavioral and social controls. Elicited responses were placed into three categories: (1) concerns the mothers had about the developing learning styles of the children, (2) determining why they thought their child was having difficulties or why they thought their child was developing normally, and (3) determining the information parents used to judge how his or her child was developing.

For the first category, eliciting information regarding any concerns, the results were divided into two responses, those that had positive appraisals or no concerns and those that thought their child had issues. Fifty-five of the 100 parents indicated they had no concerns. When asked why they thought their child was developing normally, 80% gave descriptions regarding specific developmental aspects such as cognitive skills, social behaviors, language skills, and motor skills. The parents were then asked the final category of what sources did they use; 55% of parents used several sources such as comparing their child with other children who were developing around the same age, talking with professionals, and literature research. Of the 100 parents, the remaining 45% expressed some concerns. When the researchers asked the parents why they thought problems were arising, 64% provided explanations such as medical problems, family environment, and behavioral and mental status of the child.

When the researchers further analyzed their data, Glascoe and MacLean concluded that parents make judgments about the quality of their child based on four separate models. The first model determined that parents may view child development based on a set of cognitive, linguistic, social, and gated domains. The second model implies that most (67%) parents compared their observations with the behaviors of other children. The third model suggested that parents instinctively determine if their child is developing normally or atypically; these responses suggested, according to the researchers, that parents had prior experiences with child development. The last model indicated that parents often create theories from their own conclusions such as concurrent medical problems, family history, and environmental/behavioral

contributions possible to try and seek answers to why they think their child is developmentally delayed. Glascoe and MacLean implied that their findings may be useful for professionals who are involved in screening and referring children for other services.

Regarding what influences parental responses, Glascoe and Dworkin (1995) determined that a large portion of parental concerns are predetermined by existing family histories of depression, anxiety, panic disorders, and maternal stresses (e.g., divorce) as possibly causes and could account for a large percentage of over-referrals. On the other hand, parents with a history of mental illness may be more likely to offer accurate clinical information; but, may also be the main contributors to both developmental and behavioral problems in their children.

The purpose of using parental reports is to increase the accuracy of clinical judgment in detecting children with developmental and behavioral problems. The advantages of using parental input include ease of use; takes little time, eliminate eliciting information directly from young children; and provides an opportunity of family involvement (Glascoe, 2000). Chermak, Styer, and Seikel (1995) also claim that families should be involved throughout the entire evaluation process. Systematic observational findings should be discussed with parents or caregivers and referrals should be made when applicable for further evaluation and, if warranted, provision of support and services should be recommended. Although there were no peer reviewed studies that specified the parental involvement in the case history process concerning central auditory processing, several articles have been cited reflecting the views of parents on behavioral identification and gathering the information to obtain optimum information for improving clinical judgments.

CHAPTER 3

Case History

Since the 1850s, completing a patient history has been *the* fundamental procedures in the medical field (Gillis, 2006). Prior to the 19th century, the case history played a central role even forgoing, and in some instances replacing, the medical examination (Nicolson, 1993; Shorter, 1993). Later, with advances in technology (e.g., stethoscope, x-rays, imagery, lab testing), physicians used the case history to determine their overall impression of the patient. The formality of taking a case history taking continued but did not seem to produce useful data (Gillis, 2006). It was not until the mid 20th century that the patient's history proceeded into more of an interview. Symptoms described by patients were classified into distinct entities: (1) a superficial story presented by the parents or patient and (2) a deep *true* history revealed by the skill of the interviewer (Gillis, 2006).

Rosenberg (1978) wrote a chapter, *Case History: The First Test*, which claimed that pertinent information gained in the case history can be useful in differential diagnosis. Even though this chapter primarily focused on a general case history for adults, it provided useful information for diagnosticians. Willeford and Burleigh's (1985) chapter, *Case History*, offers audiologists two separate in-depth case history forms specifically designed for children suspected of having CAPD. These researchers claim that a developmental history depicts a narrative of past events and behavioral issues that may identify patterns and certain behaviors for some children, especially for children suspected with CAPD.

Differential diagnosis of CAPD remains problematic; difficulties with attention, and impulse control as well as learning deficits are evident in many behavioral disturbances in children. Since these characteristics are similar among children suspected as having CAPD, ADHD, language/learning disability, and autistic spectrum, a complete and thorough case history is of utmost importance when determining the type and the extent of a disorder (ASHA, 1996). While

objective measures of attention, impulse control, activity level, and language learning are not within the scope of practice for audiologists, observing behaviors and parental input may help diagnosticians differentiate CAPD from other disorders.

Simpson (1982) claimed that the initial contact session between parents and an evaluator plays a vital role. This initial session covers many points regarding the development of child, establishment of rapport with the parents, soliciting relevant information regarding their child's history, gaining a better understand of parental concerns, and informing parents of the process to be performed. Establishing rapport facilitates a positive working relationship and increases the success of future encounters. Noting situations of auditory behavior as well as direct observation of the child's strengths and weaknesses that relate to vision, motor coordination, speech, and language skills can be extremely useful as to the type and extent of the disorder. It provides the necessary information about the nature of the complaint, helps to formulate clinical testing strategies, and sheds light on possible factors contributing to the hearing impairment (Jerger, 1998; Keith, 2000b; Musiek & Lamb, 1985; Stach, 1998; Willeford & Burleigh, 1985).

Well formulated questions can give the parents or caretaker the opportunity to state their concerns and describe their child's behaviors. Battin (1995) suggested that open-ended questionnaires allow parents to describe the child's behavior and personality. Descriptions of birth, health, and development should be carefully review by the examiner to gain insight. For example, a family history of hyperactivity in the parents may indicate a genetic disposition to their children; events during pregnancy (i.e., heavy smoking and drinking) may increase the risk of hyperactivity; prenatal nutritional deficits or infection of the mother may have an effect on the mental development of their child (Katz & Lasky, 1983).

Specific health and developmental questions should be obtained from the parents. Health inquires should regard the families' past medical histories and pre- and post- natal conditions of the mother and baby. Developmental questions should focus on both previous and current issues in behavior, emotional development, speech and language development, hearing and auditory behaviors, and educational progress (ASHA, 1996; Keith, 2000a, 2000b; Willeford & Burleigh, 1985). Insight into the auditory behaviors of the child and how they relate to suspected

disorders may derive clues to understanding the etiology. Willeford and Burleigh (1985) claimed that, ". . . awareness of these behaviors and their frequent association with CAPD can lead to earlier diagnosis of these children and, hopefully, avoid the school failure and frustrations that become personal traumas" (p. 63).

Robert Keith is well known for clinical procedures, tests, and screening protocols that help to assess the needs of children (Wertz, et al., 2002). Over the years, Dr. Keith developed his version of the central auditory case history form which was based on Willeford and Burleigh (1985) CAPD case history for children as well as other various resources. The categories that he included were the general history, the statement of the problem, the birth and development information, the medical history, the personality traits and physical characteristics, the speech and hearing history, the reading history, the educational information, and a separate questionnaire that rates characteristic that is used by parents or teachers (R. Keith, personal communication, January 23, 2008).

Approximately five years ago, the Louisiana Tech University Speech and Hearing Center (LTSHC) adopted the CAPD case history form developed by Keith. Since that adoption, LTSHC has formulated questions and categories designed to fit the needs and population of their clinic which is highly suggested by researchers (R. Keith, personal communication, January 23, 2008; Willeford & Burleigh, 1985). The purpose of this document is to discover the relevance of using the categories and information that was suggested by Dr. Keith, as well as others, as they relate to central auditory processing disorders. The following sections will either reveal relevant documented literature to support the existing opinions or reveal categories that are not scientifically supported. Each section of the current CAPD case history of LTSHC is investigated, discussed, and then compared to existing literature.

Part I - General History

The general history section of the LTSHC CAPD case history addresses the demographic information, the family members, and their existing medical conditions if applicable (see Figure 1). This section should include the patients name, case number, date of examination, birth date, age, address, and telephone number. For children, the names of the parents and the school the child is

attending as well as the source and reason of the referral should be included (Rosenberg, 1978). Although there are no specific documentations that support demographic information, it must be obtained on all clients for identification and contact purposes. Family members can give insight into other conditions existing in the home that may lead to predetermining a condition. Information on the primary language will assist clinicians in assuring that any interpretations from standardized tests are appropriate (Keith, 2000a). A general understanding of the family's environment will help clinicians to strategize their course of treatment (Simpson, 1982).

GENERAL HISTORY:

Child's Name: _____ Age: _____ D.O.B._____
Address:_____
City: _____ State: _____ Zip Code: _____
Phone:_____
Name of person answering questionnaire:_____
Does the child live with both parents? YES NO If no, which parent is the primary custodial guardian?_____
Relationship to child: _____
Has your child been seen in this center before?_____If yes, when? _____
Father's Name: _____ Age: _____
Occupation: _____Education: _____
Mother's Name: _____ Age: _____
Occupation: _____ Education:_____
Other Children in the Family:

NAME	AGE	GENDER	ANY PROBLEMS?

List other adults in the home: _____
What is the primary language spoken in your home? _____
Other

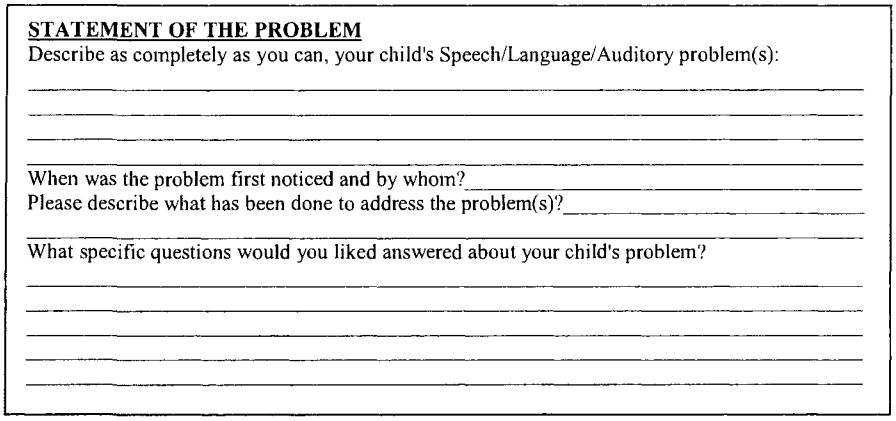
Figure 1 – General History

After review of this section, two changes are recommended (see Appendix A for changes). The first recommended is to add the clinical identification number in order to reference the case history form to the clinical records. The second is to move *Relationship to child* under the line labeled *Name of person answering questionnaire.*

Part II - Statement of the Problem

There are several reasons to obtain parental perception of the problem. First, no one will have more information about the child than the parents. Second, this method is the most effective

way of allowing parents to express their concerns (Simpson, 1982; Willieford & Burleigh, 1985). Simpson (1982) claims that a discussion of the problem is used to determine whether past diagnostic information (i.e., previous testing or diagnoses) can be provided by the parents, this in turn, gives the interviewer the necessary information to evaluate the parent's knowledge relative to the issue at hand. Finally, this strategy determines if the parent's perception of the child matches the professional's suspicion of a particular disorder. Figure 2 depicts the LTSHC's statement of the problem. No changes to this section are recommended.



STATEMENT OF THE PROBLEM

Describe as completely as you can, your child's Speech/Language/Auditory problem(s):

When was the problem first noticed and by whom?

Please describe what has been done to address the problem(s)?

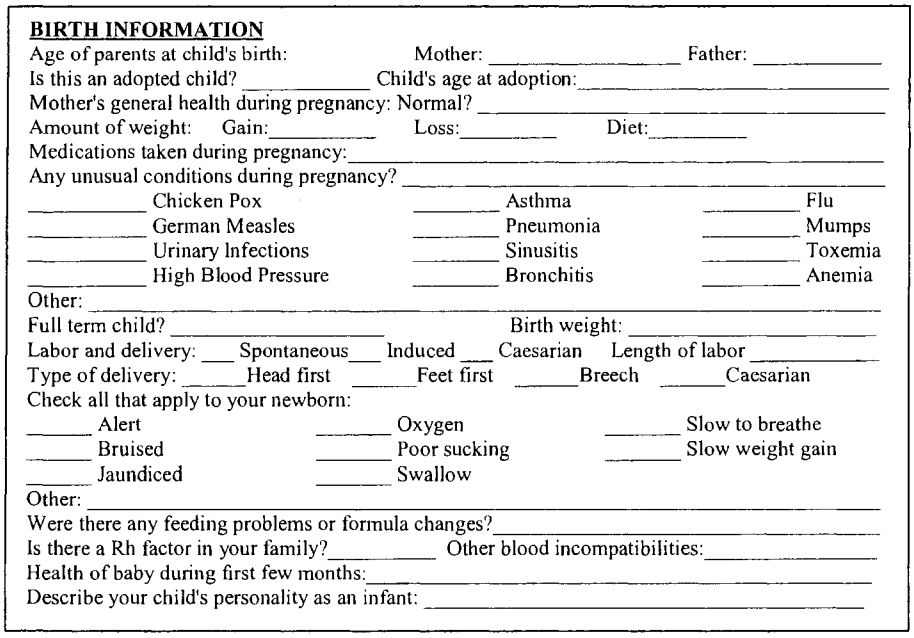
What specific questions would you liked answered about your child's problem?

Figure 2 – Statement of the Problem

Part III - Birth and Developmental Information

Questions regarding the health of the mother and developing child, such as those in Figure 3, are used to gain an understanding of factors that may impact hearing capabilities and possible underlying cause of CAPD (Willeford & Burleigh, 1985). The birth history consists of significant events that have occurred since the time of conception such as complications during pregnancy or delivery (Simpson, 1982). Biological, genetic, and peri-natal high risk indicators (e.g., hereditary childhood hearing impairment, prenatal infections, congenital malformation) as well as post-natal high risk indicators (e.g., birth weight of the child, hyperbilirubinema, bacterial meningitis, and asphyxia) identified on the case history form, may signify possible developmental issues (ASHA, 2004, Shonkoff & Phillips, 2000; Willeford & Burleigh, 1985). Hodges (1980) listed

several examples on why it is important to gather birth information; for instance, a history of rubella during the first trimester could explain bilateral sensorineural hearing losses in a child; a history of threatened miscarriages could lead to anoxia to the fetus, possible resulting in the birth child with a hearing loss; and a history of incompatible blood types between the mother and child could lead to a hearing impairment (i.e., Rh incompatibility). The only recommendation for this section is to delete the information regarding feeding and formula changes. It is recommended that this information be gathered in the next section, *Developmental Information*.



BIRTH INFORMATION

Age of parents at child's birth: Mother: _____ Father: _____
Is this an adopted child? _____ Child's age at adoption: _____
Mother's general health during pregnancy: Normal? _____
Amount of weight: Gain: _____ Loss: _____ Diet: _____
Medications taken during pregnancy: _____
Any unusual conditions during pregnancy? _____

_____ Chicken Pox	_____ Asthma	_____ Flu
_____ German Measles	_____ Pneumonia	_____ Mumps
_____ Urinary Infections	_____ Sinusitis	_____ Toxemia
_____ High Blood Pressure	_____ Bronchitis	_____ Anemia

Other: _____
Full term child? _____ Birth weight: _____
Labor and delivery: ___ Spontaneous ___ Induced ___ Caesarian Length of labor _____
Type of delivery: _____Head first _____Feet first _____Breech _____Caesarian
Check all that apply to your newborn:

_____ Alert	_____ Oxygen	_____ Slow to breathe
_____ Bruised	_____ Poor sucking	_____ Slow weight gain
_____ Jaundiced	_____ Swallow	

Other: _____
Were there any feeding problems or formula changes? _____
Is there a Rh factor in your family? _____ Other blood incompatibilities: _____
Health of baby during first few months: _____
Describe your child's personality as an infant: _____

Figure 3 – Birth Information

The interviewer should request specific data regarding the development and the age that landmarks were reached, such as those used in Figure 4 (Willeford & Burleigh, 1985). Significant information may include the age at which the child talked, walked, toilet trained, as well as specific illnesses, accidents, and behavioral manifestations (Simpson, 1982). Concerns regarding developmental milestones could lend information regarding cognition, expressive language skills, and perceptual-motor skills. Limited understanding of word meanings and relationships or a lack of symbolic play could suggest delays in cognition. Limited vocabulary, difficulties understanding

one-step directions, and inappropriate spontaneous communication could indicate comprehension deficits. And, problems in gross or fine motor coordination (e.g., jumping, dressing) or difficulties coloring or drawing pictures could indicate possible delays in perceptual-motor skills (NJCLD, 2006). Questions relating to birth and developmental milestones can guide the clinician to administer testing materials that is linguistically appropriate (Stach, 1998).

The following recommendations are advised for the development section. The use of simple words, combining words, naming objects, and engaging in simple conversation should be removed. This information, excluding naming objects and engaging in simple conversation, is gathered in the speech and language portion of the CAPD case history. (See Appendix A for changes in both the birth and developmental sections).

DEVELOPMENTAL INFORMATION

Identify the age at which your child completed the following: (approximate ages are fine)

Turned from stomach to back: _____ Sit alone: _____

Crawl: _____ Walked alone: _____

Dress self: _____ Tie shoes: _____

Cut with scissors: _____ Skip: _____

Ride a bike: _____ Fed self: _____

Bowel trained: _____ Bladder trained: _____

Used single words (e.g., no, mom, doggie, etc.)_____

Combined words (e.g., me go, daddy shoe, etc.)_____

Named simple objects (e.g., where's doggie?, etc.)_____

Engaged in simple conversation_____

Does your child have difficulty walking, running, or participating in other activities which require large or small muscle coordination? If so, please describe. _____

Are there, or have there ever been, any feeding problems (e.g., problems with sucking, swallowing, drooling, chewing, etc.)? If yes, please describe. _____

What leisure activities does your child like to engage in alone? _____

What activities does your child like to do with his parent(s) or others?_____

At what age did your child begin to play organized sports? Which sport?_____

What is your child's reaction to organized sports?_____

Where there any factors that you considered that may have interrupted your child's "normal" development? If so, please describe. _____

Figure 4 – Development Information

Part IV - Medical History

This section relates to the medical problems associated with hearing loss and hearing conditions, giving the clinician insight into auditory problems (see Figure 5). "Diseases such as meningitis, scarlet fever, mumps, measles, tuberculosis, syphilis, diabetes, multiple sclerosis, and seizures are important to include" (Roseberg, 1978, p. 79). Injuries to the head (e.g., concussions,

and skull fractures) as well as ototoxic medications (e.g., aspirin and quinine) may indicate hearing impairment (Rosenberg, 1978). Medications that are prescribed could allude to current auditory capabilities; for example, Ritalin, a medication primarily given to patients with ADHD, could signify the difficulties paying attention to auditory information (Hodges, 1980). Chermak, et al. (1995) reported that children with a history of recurring otitis media with effusion may be associated with CAPD; these children have difficulties with recognizing monosyllabic words in the presence of background noise or may need a more favorable signal to noise ratio to comprehend sentences then those of their age related peers without difficulties.

MEDICAL HISTORY

Is your child generally health? _____

Which of the following has your child experienced? Please note Age/Severity

Medical conditions:

Tonsillitis_____	Head injuries _____	Pneumonia _____
Frequent Colds _____	Earaches _____	Allergies _____
Seizures_____	Croup_____	Asthma_____
Measles _____	Mumps _____	Meningitis_____
Chicken pox_____	Digestive upsets _____	High fever_____
Mastoiditis_____	Encephalitis_____	Headaches_____
RSV_____	Sinusitis_____	Tinnitus_____
Convulsions_____	Rubella_____	Scarlet fever_____

Other: _____

Surgeries:

Adenoidectomy _____ Tonsillectomy_____

Ear Surgery(tubes)_____ Number of tubes_____

Does anyone in the family (parents, siblings, uncles, grandparents, etc.) have a similar problem? ___

Has your child ever been tested for allergies? _____When? _____

Results_____

Describe any accidents or hospitalizations of your child_____

Is your child taking any medications? Please list, identify, and note any negative reactions that may have occurred with each medication._____

Are your child's immunizations up-to-date?_____

Figure 5 –Medical History

In keeping with the theme of medical conditions, it is recommended that this section be moved immediately after the birth history and prior to the development sections. The LTSHC describes a detailed list of medical conditions; however, important conditions mentioned by Rosenberg (i.e., tuberculosis, syphilis, diabetes, and multiple sclerosis) have been mistakenly overlooked; it is recommended that these conditions be added in order to prompt parental recall of information. The reader is diverted to Appendix A for the recommended changes.

Part V - Personality Traits/Physical Characteristics

Analysis of the child, gives the parents the opportunity to comment on attitudes towards school, home, and friends. It is also a time to expand on their child's likes, dislikes, hobbies, and leisure activities. Behavioral characteristics and social traits can also be discussed in this section. These items can give the clinician insight into patterns of antisocial or withdrawn behaviors, temper tantrums, sleeping patterns, hyperactive behaviors or destructive/aggressive behaviors. Analyzing parental concerns also allows parents to talk about their child's strengths and weaknesses (Simpson, 1982). Figure 6 details personality traits and physical characteristics that span across similar disorders (e.g., CAPD, ADHD, language/learning disability, Asperger's syndrome) which are currently used in the CAPD case history form at LTSHC.

PERSONALITY TRAITS/PHYSICAL CHARACTERISTICS

Which of the following descriptors best identify your child? Circle as many as are appropriate:

hyperactive	poor social skills	tires
circles under eyes	easy to anger	dependent
nasal voice	bed wetting	joint aches
good memory	self-sufficient	under-active
puffiness around eyes	independent	aggressive
too happy	itchy rashes	takes turns
frequently nauseated	difficulty sleeping	responsible
aggressive	under-active	distractible
impulsive	short attention span	calm
doesn't try	too controlled	has few friends
depressed	easily frustrated	irritable
sulks	dawdles	hard to love
lacks confidence	temper tantrums	disorganized
doesn't share	follows directions	poor memory
good social skills	cries easily	fast worker
fearful	follows directions	bruises easily
helps other	hard to love	competitive

Check all that apply

_____Appears to have a hearing loss
_____Has difficulty comprehending speech in the presence of background noise
_____Has difficulty processing distorted or rapid speech
_____Has an expressive and/or receptive language problem
_____Has poor auditory memory
_____Has difficulty following multi-step commands
_____Frequently says "huh" or "what"
_____Has poor phonic skills
_____Has poor reading, writing, and spelling abilities
_____Has a history of chronic otitis media
_____Inconsistently responds to auditory stimuli
_____Frequently requests that auditory information to be repeated
_____Needs for increased time to respond
_____Is sensitive to loud sounds
_____Has difficulty with localization (finding a sound source)

Does your child prefer to be a leader or a follower? _____

Does your child have any unnatural fears? _____

What additional information would you like to tell us about your child's behavior?

Figure 6- Personality Traits and Physical Characteristics

Analysis of Figure 6 reveals several recommendations. Many traits and characteristics are repeated; for example, *inattentive* is mentioned in both the top and bottom lists. It is recommended that these items be limited to one listing. The second recommendation is to separate common traits and characteristics into columns. For example, traits that depict normal or average development (e.g., follows directions, good memory, and good social skills) should be placed on one column, while traits that depict autistic tendencies (e.g., poor social skills, hard to love, and sensitivity to loud sounds) be placed in another.

Another recommendation is to move some items that appear in *check all that apply* that would be better asked in other sections. For example, the item that asks if there are any problems with reading, spelling, or writing, should be moved to the education section. This way, the person filling out the CAPD case history form is already thinking about these items. Furthermore, it is recommended that parents or guardians rank the top 10 behaviors from 1 (*most noticeable*) to 10 (*least noticeable*). Utilizing the Likert rating system allows audiologists to determine if characteristics, such as inattention, distractibility, and fidgety, are ranked as primary characteristics (i.e., rating 1) leading towards ADHD characteristics. If these same characteristics are ranked towards the bottom and auditory difficulties in background noise is ranked *1*, then CAPD suspicions are warranted. The revised CAPD case history form in Appendix A will reflect these recommendations.

Part VI - Speech and Hearing History

Speech and language developmental delays may be the first symptoms of a hearing impaired child prompting parents to seek help (Stach, 1998). The information obtained in this section is of vital importance to CAPD case history; however, data of speech and language development, in confirmed cases of CAPD, is lacking. Middle ear infection during the critical period for language development has adverse effects on speech and language acquisition (Willeford & Burleigh, 1985); thus, identification of current suspicions, and past occurrences, of hearing history should be obtained. Even though middle ear pathology is not addressed in the speech and hearing history portion of the Louisiana Tech University Speech and Hearing Center (Figure 7), it is gathered in the medical information section (see Figure 5). After further analysis of

the speech and hearing section, no changes are recommended. It is recommended, however, that this section immediately follow the education section discussed later in Chapter 3.

SPEECH AND LANGUAGE HISTORY

What age did your child:

speak his/her first word_____ use two word sentences? _____

Does your child use speech: Frequently ___ Occasionally ___ Never _____

Does your child use speech or gestures? (Give examples)_____

Which does your child prefer to use:

complete sentences_____ phrases _____

one or two words _____ sounds _____

How well can your child be understood by:

Parents_____ Stranger_____

Brothers and sisters _____ Friends and playmates_____

Check all that apply

_____Responds to greetings _____Makes requests

_____Attends to tasks _____Takes turns

_____Describes events _____Maintains topics

_____Sequences actions _____Defines words

_____Imitates activities or conversation _____Interacts with same age peers

_____Volunteers for activities _____Follows multi-step commands

If your child has difficulty with speech and/or language, what do you think may have caused the problem(s)?_____

HEARING HISTORY

Describe your child's auditory behavior-

_____

Is noise a factor in your child's ability to understand information? Please describe:

_____

Describe your child's response to sound (e.g., responds to all sounds, responds to loud sounds only, inconsistently responds to sounds, etc.)

_____

Are there any other speech, language, learning or hearing problems in your family? If yes, please describe.

_____

Figure 7- Speech, Language, and Hearing History

Part VII - Reading History

Figure 8 depicts reading difficulties for the child with CAPD; this behavior was consistently documented by researchers (Bellis & Ferre, 1999; Gomez & Condon, 1999; Keith, 2000a, 2000b, 2000c). No formal documentation was found that describes information that should be included in this section. Recommendations advised in Appendix A consist of moving this section to follow the *Education* section and to rename this section *Academic Achievements/Difficulties*.

READING HISTORY
How does your child feel about reading? _____
Has your child changed schools recently? What was the effect on his reading ability?
_____
What comments do you get from the school about your child's reading ability? _____
At what age did your child begin to recognize letter by sight?_____
At what age did your child begin to identify the sounds of letters?_____
Does your child like to read to himself? _____
How do you rate your child's reading problem? Mild, Moderate, or Severe
_____ Does not know letters and sounds
_____ Can not decode words (sound out word)
_____ Poor comprehension of what he reads
_____ Inattentive to instruction
_____ Inadequate reading vocabulary
How often do you read to your child?
_____frequently _____often
_____occasionally _____seldom
Does your child reverse numbers or letters when reading or writing?
Does your child learn best by:
Seeing_____ hearing_____ doing_____

Figure 8- Reading History

Part VIII - Educational Information

In this section (see Figure 9), parental perception of the child's success and failures in school and their causes are the primary focus of this section. Answers to questions about school placement and progress help the audiologist to orient the consequential recommendations towards academic needs (Stach, 1998). Willeford and Burleigh (1985) claim that past and present academic performance gives insight into the ramification of the child's CAPD. Children with CAPD are able to perform well in a variety of environments; they do well up until around the third grade, but when instruction becomes more complex, children with CAPD tend to break down and experience greater difficulties with academics. Knowing which subjects are more difficult or frustrating for the child will assist in differential diagnosis. For instance, if the child experiences difficulties in spelling or handwriting this may suggest CAPD; but, if the academic problems occur across various academic subjects (i.e., language arts, reading, math, social studies), this may be more suggestive of a linguistic deficit.

Many changes are recommended for this section. The *Other* section can be appropriately disbursed throughout the document. It is recommended that this section be moved to follow the speech, language, and hearing sections. The *Academic Achievements/Difficulties,* formally titled *Reading History*, should follow educational information. Refer to Appendix A for revisions.

EDUCATIONAL INFORMATION

School/Pre-school_____

Address: _____

Principal's Name: _____

Teacher's Name: _____

Grade:_____

Has he/she ever failed a grade? _____Which grade(s)_____

Does he/she excel in any subjects? _____

Does he/she have any serious difficulty in any subjects? _____

How does he/she feel about school and his/her teachers? _____

Has he/she ever had any psychological tests? _____

When: _____

Where: _____

By Whom: _____

Where the results interpreted to you? _____

OTHER

Have any other speech-language specialists or audiologists seen your child? Who and when? What were their conclusions or suggestions?_____

Have any other specialists (e.g., physicians, psychologists, special education teachers, etc.) seen the child? If yes, indicate the type of specialist, when the child was seen, and the specialist's conclusions or suggestions._____

Does the child now receive special services? If yes, where? Describe.

_____

How does your child interact with others (e.g., shy, aggressive, uncooperative, etc.)?

_____

If enrolled for special education services, has an Individualized Educational Plan (IEP) been developed? If yes, describe the most important goals as discussed with you. If you have a copy of this IEP, please attach it to this form.

_____

Provide any additional information that might be helpful for providing services to your child.

_____

Figure 9- Educational Information

Conclusion

Many aspects of central auditory processing have been demonstrated ranging from how signals are processed in the CANS, to pioneer advancements of CAPD, to controversies that plague terminology (i.e., definitions, modality specificity). Differentiating CAPD from associated disorder such as ADHD, language/learning disabilities, and Asperger's syndrome, have been addressed. Difficulties understanding speech with competing background noise, following and remembering long complex directions, discriminating speech sounds, and inattention are the most common behaviors among CAPD, ADHD, language/learning disabilities, and autistic spectrum disorders.

Determining which behaviors dominate a child's personality, along with academic achievements/failures and past medical history, assist audiologists in determining which disorder the child is more prone to have. For example, if a child presents with difficulties in reading and

spelling, and not necessarily in all subjects, this may lead the audiologists to suspect CAPD over a language/learning disability.

The purpose of this document was to determine if the CAPD case history form for children at the Louisiana Tech University Speech Language and Hearing Center contains information that is evidenced based. Based on an extensive literature search, appropriate recommendation and alterations were suggested (Appendix A). Future research efforts may include utilizing the recommended case history form to determine if characteristics and behaviors noted by parents did, in fact, predict central auditory processing disorders.

APPENDIX

LOUISIANA TECH UNIVERSITY SPEECH AND HEARING CLINIC'S CASE HISTORY FORM FOR CHILDREN - REVISED

LOUISIANA TECH UNIVERSITY
SPEECH AND HEARING CENTER

P.O. BOX 3165
120 ROBINSON HALL
RUSTON, LA 71272
Phone: (318) 257-4766
Fax: (318) 257-4492

Auditory Processing Case History

Date: _____ Clinic ID_____

We are pleased that you have chosen to have your child evaluated at the Louisiana Tech University Speech and Hearing Center. In order to give us as much information as possible, we request that you complete this questionnaire and return it to as soon as possible to the address shown on above. An appointment for your child will be scheduled at that time. If you have additional test results, school papers, personal observations that you wish to share with us, please enclose them with this questionnaire.

GENERAL HISTORY

Child's Name: _____ Age: _____ D.O.B._____

Address: _____ Phone:_____

City: _____ State: _____ Zip Code:_____

Name of person answering questionnaire:_____

Relationship to child: _____ Has this child been seen in this Center before?_____

If yes, when? _____

Does this child live with both parents? Yes No

If no, which parent is the primary custodial guardian?

_____

Father's Name: _____ Age: _____

Occupation: _____Education:_____

Mother's Name: _____ Age:_____

Occupation: _____ Education:_____

Referred by:

_____

Other Children in the Family:

NAME	AGE	GENDER	ANY PROBLEMS?

List other adults in the home:

What is the primary language spoken in your home? _____ Other? _____

STATEMENT OF THE PROBLEM

Describe as completely as you can, your child's Speech/Language/Auditory problem(s).

When were the problems first noticed and by whom?

Please describe what has been done to address the problem(s).

What specific questions would you liked answered about your child's problem?

BIRTH INFORMATION

Age of parents at child's birth: Mother: _____ Father: _____

Is this an adopted child? _____ Child's age at adoption: _____

Mother's general health during pregnancy: Normal? _____

Amount of weight: Gain: _____ Loss: _____ Diet: _____

Medications taken during pregnancy: _____

Any unusual conditions during pregnancy?

_____ Chicken Pox	_____ Asthma	_____ Flu
_____ German Measles	_____ Pneumonia	_____ Mumps
_____ Urinary Infections	_____ Sinusitis	_____ Toxemia
_____ High Blood Pressure	_____ Bronchitis	_____ Anemia

Other: _____

Full-term child? _____ Birth weight: _____

Type of Labor: Spontaneous_____ Induced _____ Length of labor_____

Type of delivery: Head first _____ Feet first _____ Breech _____ Caesarian _____

Check all that apply to your child as a newborn:

_____Alert	_____ Oxygen	_____ Slow to breathe
_____ Bruised	_____ Slow weight gain	_____ Jaundiced

Other: _____

Is there a Rh factor in your family? _____ Other blood incompatibilities: _____

Health of baby during first few months: _____

Describe your child's personality as an infant: _____
_____
_____

MEDICAL HISTORY

Is your child generally healthy? _____

Which of the following medical conditions has your child experienced?

	Age/Severity		Age/Severity
Tonsillitis		Mastoiditis	
Head injuries		RSV	
Pneumonia		Meningitis	
Frequent Colds		Sinusitis	
Earaches		Digestive upsets	
Allergies		Asthma	
Seizures		Tinnitus (ringing ears)	
Rubella		Convulsions	
Scarlet Fever		Croup	
Encephalitis		Measles	
High Fever		Mumps	
Headaches		Chicken pox	

Surgeries:

	Age		**Age**
Tonsillectomy		Ear Surgery (tubes)	
Adenoidectomy		(number of tubes placed)	

Other: _____

_____

Does anyone in the family (parents, siblings, uncles, grandparents, etc.) have similar problems?

_____

Has your child ever been tested for allergies? When? Results?_____

_____

Describe any major accidents or hospitalizations of your child.

_____

_____

Is your child taking any medications? Please list and identify and note any negative reactions that may have occurred with each medication.

_____

_____

Are your child's immunizations up-to-date? _____

DEVELOPMENTAL HISTORY

Identify the age at which your child completed the following (approximate ages are fine):

Turned from stomach to back: _____	Sat alone: _____
Crawled: _____	Walked alone: _____
Dressed self: _____	Fed Self _____
Tied shoes: _____	Cut with scissors: _____
Skipped:_____	Rode a bike: _____
Bowel trained: _____	Bladder trained: _____

Established hand preference: _____

Does your child have difficulty walking, running, or participating in other activities, which require small or large muscle coordination? If so, please describe

_____

_____

_____

Are there, or has there ever been, any feeding problems (e.g., problems with sucking, swallowing, drooling, chewing, etc.). If yes, please describe

_____

_____

_____

Were there any factors that you considered may have interrupted your child's "normal" development? If so, please describe _____

_____

SPEECH AND LANGUAGE HISTORY

What age did your child use:

Used single words (e.g., no, mom, doggie, etc.) _____

Combined words (e.g., me go, daddy shoe, etc.) _____

Named simple objects (e.g., where's doggie?, etc.) _____

Engaged in conversation _____

Recognize letters by sight_____

Identify the sounds of letters_____

How often does this child use speech: Frequently _____Occasionally _____Never _____

Does your child prefer to use speech (e.g, sounds, single words, short phrases, complete sentences) or gestures? (Give examples) _____
_____
_____

How well (e.g., very well, some, not at all) can your child's speech be understood by:

Parents_____ Strangers_____

Brothers and sisters _____ Friends and playmates_____

If your child has difficulty with speech and/or language, what do you think may have caused the problem(s)?

_____
_____
_____

Has the problem changed since it was first noticed? _____If yes, please describe changes.

_____
_____

Check all that apply:

_____Responds to greetings
_____Attends to tasks
_____Describes events
_____Sequences actions
_____Imitates activities or conversation
_____Volunteers for activities
_____Makes requests
_____Takes turns
_____Maintains topics
_____Defines words
_____Interacts with same age peers
_____Follows multi-step commands

PERSONALITY TRAITS/PHYSICAL CHARACTERISTICS

1. Circle *all* appropriate descriptors that best identify your child.
2. Rank the top 10 in order from 1(*most noticeable*) to 10 (*least noticeable*).

__good memory
__good social skills
__self-sufficient
__calm
__independent
__takes turns
__follows direction
__responsible
__helps others
__has friends
__good memory

__impulsive
__short attention
__hyperactive
__irritable
__disorganized
__inattentive
__easily frustrated
__restless/squirmy
__aggressive
__distractible
__disturbs others

__poor auditory memory
__difficulty understanding speech with competing noises
__difficulty understanding complex directions
__often request information to be repeated
__temper tantrums
__demands must be met immediately
__poor social skills

__tires
__depressed
__has few friends
__hard to love
__doesn't try
__sulks
__under-active
__fascinated by objects
__easy to anger
__frequent outburst
__moody

What leisure activities does your child like to engage in alone? _____
_____

What activities does your child like to do with his parent(s) or others? _____
_____

At what age did your child begin to play organized sports? Which sports? _____
_____

What is your child's reaction to organized sports? _____
_____
_____

How does your child interact with others (e.g., shy, aggressive, uncooperative, etc.)?
_____
_____
_____

What additional information would you like to tell us about your child's personality, physical characteristics, or other information that might be helpful for providing services to your child?
_____
_____
_____

HEARING HISTORY

Describe your child's auditory behavior._____

_____

_____

Is noise a factor in your child's ability to understand information? Please describe:

_____

_____

Describe your child's response to sound (e.g., responds to all sounds, responds to loud sounds only, inconsistently responds to sounds, etc.)

_____

_____

_____

Are there any other speech, language, learning or hearing problems in your family? If yes, please describe.

_____

_____

EDUCATIONAL INFORMATION

Name of School/Pre-School_____

Address: _____

Principal's Name: _____

Teacher's Name: _____

Current grade:_____ Has he/she ever failed? _____ Which grade(s)?_____

Does your child learn best by: seeing _____ hearing _____ doing_____

How does he/she feel about school and his/her teachers? _____

_____

Have any other speech-language specialists or audiologists seen your child? Who and when? What were their conclusions or suggestions?

_____

_____

_____

Have any other specialists (e.g., physicians, psychologists, special education teachers, etc.) seen the child? If yes, indicate the type of specialist, when the child was seen, and the specialist's conclusions or suggestions.

_____

_____

If enrolled for special education services, has an Individualized Educational Plan (IEP) been developed? If yes, describe the most important goals as discussed with you. If you have a copy of this IEP, please attach it to this form.

_____

_____

_____

ACADEMIC ACHIEVMENTS/DIFFICULTIES

Which subject(s) does he/she excel in?_____

Which subject(s) does he/she have any serious difficulty with? _____
_____

How does your child feel about reading? _____
_____

Has your child changed schools recently? What was the effect on his reading ability?
_____

What comments do you get from the school about your child's reading ability? _____
_____

Does your child like to read to himself? _____

Rate your child's reading problem(s)? Mild, Moderate, or Severe

_____ Does not know letters and sounds

_____ Cannot decode words (sound-out word)

_____ Poor comprehension of what he/she reads

_____ Inadequate reading vocabulary

How often do you read to your child?

_____ frequently _____ often

_____ occasionally _____ seldom

Does your child reverse numbers or letters when reading or writing? _____

Please send copies or attach reports, finding, IEPs, etc. that would be helpful in the evaluation and remediation of the client to:

Louisiana Tech University Speech, Language, and Hearing Center
Department of Speech
P.O. Box 3165
Ruston, LA 71272

Person completing this form_____

Signed_____ Date _____

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