ABSTRACT

The development of children is an important issue for school psychologists, researchers, healthcare practitioners, educators, and parents. Methods with demonstrated efficacy to screen for developmental delays in children are necessary because early detection of delays can begin the process of designing interventions, educating parents, and preparing young children for school. Parents play a major role in the detection process. Many research studies report that parents are accurate at reporting observable child development; however, sensitivity on screening tools is still modest for most instruments. In this study the role of family and child characteristics on agreement between the Nippising District Developmental Screen (NDDS) and developmental assessment using the Stanford Binet Intelligence Scales, 5th edition (SB5), the Peabody Picture Vocabulary Test, 3rd edition (PPVT-III), and the Bayley Scales of Infant Development, 2nd edition (BSID-2) was investigated. Pearson Chi-squared statistics were used to test hypothesized associations between the explanatory variables (child and family characteristics) and results from the parent-completed NDDS. Variables found to have significant associations were then analyzed using binary logistic regression analyses to determine which child and family characteristics predicted agreement between the NDDS and the developmental assessment. The hypotheses were partially supported. The results from the bivariate analyses support hypotheses for child gender and age, as well as family income and maternal age for children without delays (True Negatives), but not for children with delays (True Positives. These findings indicate the sensitivity and specificity rates for the NDDS vary largely by child gender and age, but that some family characteristics (specifically, family income and maternal age) are also associated with the likelihood of achieving True Positive and True Negative results.
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Chapter One: Introduction

The development of children is an important issue for school psychologists, researchers, healthcare practitioners, educators, and parents. Methods with demonstrated efficacy to screen for developmental delays in children are necessary because early detection of delays can begin the process of designing interventions, educating parents, and preparing young children for school. Risk factors for developmental delays are environmental and biological (Glascoe, 2005). Studies demonstrate that detecting developmental delay early is beneficial to not only the child and family, but also to entire communities (Bailey, Skinner, & Warren, 2005; Glascoe, 2001). Screening for developmental delays has taken many forms. Intricate instruments that require experienced professionals are typically reserved for children who have been identified as at risk for delay, whereas parent-completed developmental screening instruments have gained acceptance, and use, over the last decade to identify children at risk for delays. Developmental screening by professionals and parents requires accuracy to identify children who are in need of services. Thus, the focus of this study is the accuracy of parent reporting on developmental screening instruments.

Parents play a major role in the developmental delay detection process. Research provides evidence that parents can be accurate when asked to report observable child behavior (Glascoe, 2001). Parents spend valuable time with their children and they share the common goal of healthy child development with healthcare practitioners (Committee on Children With Disabilities, 2006). Healthcare practitioners see children routinely for immunization administration, well-child visits, and illness care. Therefore, providing healthcare practitioners with an efficient instrument that can be completed by parents has become a powerful technique for detecting developmental delay early.
Relying on parents as informants makes it possible for healthcare providers to spend time and money investigating the development of children who may need additional assessment and follow-up. Because parents are valuable to the developmental screening process, it is important to understand factors that may influence accuracy of their reporting. Several ideas have been suggested in the literature. For example, eliciting parental concerns (Glascoe, 1999) and asking parents specific questions about child behaviors in contrast to general questions about development may enhance, accuracy as does the use of instruments with demonstrated sensitivity and specificity. There is some evidence that parent and child characteristics may influence parents' assessment of appropriate developmental progress in their child. Because parents play such a valuable role in developmental screening, it is important to examine what parental and child characteristics influence accuracy of their observations as measured by developmental screening instruments.

According to Glascoe (1999; 1997; 1990), parents are accurate in perceiving developmental delays in their children regardless of parent education level or experience with multiple children. However, other researchers do not agree. Lagerberg (2005) points out that, "parents are good at assessing child characteristics - at least some parents, sometimes, and in some respects" (p. 1007). Although research by Glascoe has been widely accepted, her studies mainly investigate the accuracy of parent report on her own developmental instrument, the Parent's Evaluation of Developmental Status (PEDS). In addition, caution should be taken when discussing sensitivity and specificity of an instrument in the context of parent reporting on child development because even a tool with good sensitivity and specificity may not accurately predict delays (Lagerberg, 2005).
Questioning the accuracy of parent reporting is logical when the screening instrument has limited psychometric properties. However, instruments with relatively strong psychometric properties that rely on parent report may yield false negative and false positive screens. The literature to date overwhelmingly supports parent reports of development; however it is not clear whether the research really focused on the appropriate aspects of parent reporting. In this study parent and child characteristics of their accuracy on parent reported screening instruments is investigated

**Purpose of the Study**

The purpose of this study is to examine family and child characteristics that may influence agreement between parent report of developmental delay using the Nippising District Developmental Screen (NDDS) and in-depth assessments of child development by a professional. Data was taken from a normative, community-based sample of children and their parents from a validation study of the NDDS.

1. To what extent do child characteristics (gender, age, and health status) predict agreement between parent reports on the NDDS and developmental assessments of the child using the Stanford-Binet: Fifth Edition (SB5), the Peabody Picture Vocabulary Test, Third Edition (PPVT-III), and the Bayley Scales of Infant Development; Second Edition (BSID-2)?

2. To what extent do family characteristics (maternal educational, family income, family structure, and maternal age) predict agreements between parent report on the NDDS and developmental assessment of the child using the SB5, the PPVT-III and the BSID-2?
3. What set of child and family characteristics best accounts for agreement between parent report on the NDDS and developmental assessments of the child using the SB5, the PPVT-III, and the BSID-2?

Definitions of Key Terms

**Developmental Screening** is defined in the literature and in the present study as a process of monitoring children to identify those who are in need of further evaluation (Glascoe, 1999; 1990; Hamilton, 2006; Lee & Harris, 2005).

**Universal Screening** as defined in the literature and in the present study is a form of developmental screening that measures multiple areas such as cognitive ability, language, motor, and behaviour, and is used for early detection of developmental delays for populations of children (Hamilton, 2006).

**Targeted Screening** as defined in the literature and used in the present study, also a form of developmental screening, aims to identify children who are high risk for developmental delay, and may target specific groups of children who are at higher risk for delays (Lee & Harris, 2005). In addition, targeted screening could also be used as a term to investigate one specific domain of development more in-depth.

**Developmental Assessment** in this study is an in depth evaluation of children’s abilities that typically follows developmental screening. Many times children are referred for developmental assessment after receiving a positive screen for potential developmental delays. Developmental assessments are usually conducted by professionals with graduate training in the area (Glascoe, 1999; Hamilton, 2006; Lee & Harris, 2005). In this study widely used and well validated developmental assessment tools including the Stanford-Binet Intelligence Scales, Fifth
Development-Second Edition were used.

**Developmental Delay** is a term that is subjective according to who is using the term, and
what is being measured (Glascoe, 1990; 1999). In addition, the kind of delay is significant.
Developmental delays can be global, meaning an overall cognitive delay incorporating the
following delays: a language delay, a delay in motor skills, or a delay in behaviour. For the
purpose of this study a developmental delay is considered a standard score of one standard
deviation below the mean on the cognitive measures, and one flag on the screening measures.

**Parent characteristics** are psychosocial descriptive traits of the mother that may
influence her observations, perceptions, or abilities to be accurate at reporting her child’s
developmental behavior. In the present study, parent characteristics are defined as maternal
education, family income, family structure, and maternal age.

**Child characteristics** are descriptive traits that prior research has suggested may
influence a parent’s observations, perceptions, or abilities to be accurate in reporting child
developmental behavior. In the present study, parent characteristics are defined as age, gender,
and health status.

**Benefits of the Study**

The intended benefits of this study are to better understand the influence of family and
child characteristics on a parents’ ability to report and detect developmental delays in their
children. It is expected this study will inform research within the field of developmental
screening to take parent and child characteristics into account when developing and using parent
report screening instruments in the future.
Chapter Two: Review of the Literature

The purpose of this chapter is to review the current research on agreement between parents and professionals on developmental screening parameters. Parent-completed developmental screens will be critiqued and parent and child characteristics that influence agreement will be reviewed.

This chapter is organized around the following concepts: (a) definitions and categories of developmental screening, the screening instruments currently in use, and the role of parents in developmental screening; (b) parent characteristics that may influence parent observations of their child; and (c) the child characteristics that may influence parental observations of their child.

Developmental Screening

Developmental screening plays an important role of early childhood professionals including psychologists, early educators, nurses and others. Often only those children who are considered to be at high risk for developing delays are screened on a regular basis. Epidemiological evidence, however, shows that what determines developmental delays is complex and difficult to detect at the individual level (Hamilton, 2006) and thus there is a need for more widespread screening. This need has led to increased interest in universal, family, and community-based developmental screening throughout the early childhood years and an increased demand for screening instruments that are relatively inexpensive and easily administered.

Screening instruments in current use. Two instruments are used widely across North America in a universal approach to developmental screening. These include the Ages and Stages Questionnaire (ASQ, Squires & Bricker, 1999), and Parent’s Evaluation of Developmental Status
(PEDS, Glascoe, 1999). A third, Nippising District Developmental Screen (NDDS, www.ndds.ca retrieved April 29, 2007) has gained widespread use across Canada and is the focus of the present study.

Universal developmental screening instruments, which are those that measure multiple areas of concern, typically are individually administered and norm referenced as are other individually administered measures of abilities such as intelligence tests or social-emotional-behavioral rating scales. They also incorporate the psychometric properties. Examples of reliability are demonstrated through test-retest, inter-rater, and internal consistency. Validity evidence is demonstrated through concurrent, discriminate, and sometimes predictive studies (Glacoe, 2005; Hamilton, 2006; Lee & Harris 2005).

In recent reviews of current universal developmental screening instruments, Glascoe (2005), Lagerberg (2005), and The Committee on Children With Disabilities (2001) emphasized that a good screening instrument is one that is accurate, meaning it has sufficient sensitivity and specificity (typically 70-80%). Sensitivity is defined as the probability that the screening instrument will correctly identify children who show signs of developmental delays. Specificity is defined as the probability that the screening instrument will detect children who are developing normally. Screening instruments are not “error free” (Glascoe, 2005, p. 174), yet high levels of accuracy can be achieved. Lagerberg (2005), however, goes on to say that screening instruments that do not have predictive validity do not give accurate information about a child’s development. “It can be concluded that effective tests and screening devices with strong predictive validity do not exist at present” (p. 1007).

The ASQ was created by Dianne Bricker and Jane Squires from the University of Oregon in 1980(http://www.brookespublishing.com/tools/asq/index.htm retrieved on April 3, 2007). The
measure was revised in 1994 and currently contains 19 questionnaires for children ages 4-60 months. Scoring the ASQ takes between 1-5 minutes and can be scored by paraprofessionals or staff trained by professionals. Studies demonstrate that reliability is consistently high (reliability greater than .80, sensitivity ranging from 51% at the 4-month age to 84% at the 12-month age, and specificity ranging from 83.9% at the 4-month to 100% at the 60-month age) (Bricker & Squires, 1998). The ASQ was validated using the Bayley Scales of Infant Development, the Stanford-Binet Intelligence Scale, and the McCarthy Scales of Children’s Abilities (Squires & Bricker, 1999). It measures gross motor skills, fine motor skills, communication, cognition, and behavior (Glascoe, 2006; Lee & Harris 2005). Examples of items at the 36-month-old level include gross motor items such as hopping and standing on one foot for a length of time and fine motor items such as drawing and putting puzzle pieces together (Squires & Bricker, 1999).

The PEDS was developed by Francis Page Glascoe and published in 1997. This screen is unique in that it is based only on parent reports of concerns (Hamilton, 2006). It contains eight yes/no questions and two open-ended questions. The purpose of the PEDS is to “identify when a child should be referred, provided a second screen, counseled, or monitored for development, behavior, and academic progress” (p 30). It was written at a fifth grade reading level, takes approximately five minutes, and can be completed by parents while waiting for a healthcare provider appointment (Glascoe, 2005). Scoring the PEDS is simple and categorizes risk as low, medium, or high for the development of a delay. The PEDS psychometric properties fall within the normal range for current screening instruments. The sensitivity for all ages combined was 75% and the specificity for all ages combined was 74%. No predictive validity studies have been completed to date. The PEDS concurrent validity was evaluated through studies comparing it with the Woodcock-Johnson Psychoeducational Battery-Revised: Tests of Achievement,

A third commonly used instrument in Canada is the Nippising District Developmental Screen (NDDS). The NDDS will be described in more depth in the Chapter Three of this document. The NDDS is a parent-completed measure, with 13 versions, ranging from one month to six years (http://www.ndds.ca retrieved April 3 2007). It assesses seven major developmental domains: vision, hearing, speech-language, gross motor, fine motor, cognitive, and self-help skills. The NDDS is a yes/no checklist, the need for referral is indicated when the selection of one or more ‘no’ responses (i.e., the behavior in question has not been observed) is specified. If the health professional makes a referral based on one “no” answer, it is known as the one-flag rule. A more conservative flag rule is called the two-flag rule, which requires more than one “no” response on the NDDS to refer the child.

Although the NDDS has become a popular screen to use in many health care facilities across Canada, there have not been many evaluation studies on the NDDS. It was originally developed in Ontario in 1993. One study that did attempt to evaluate the NDDS was the Ontario Healthy Babies/Healthy Children (HBHC) evaluation, which eventually changed the scoring rules of the screen (Dahinten & Ford, 2004). Validation work by Dahinten and Ford suggests that the sensitivity and specificity of the NDDS varies by the severity of the delay being targeted, the scoring rule used, the age version, child’s gender, and the developmental domain of interest. For example, for infants and toddlers, they found sensitivity rates ranging from 50% (when using the two-flag rule and cut-off of ≤ 1.0 SD below the mean on the criterion measure) to 100% when the NDDS was used to identify those who were severely delayed (i.e., ≤ 2.0 SD) (Dahinten, Ford, Canam, Lapointe, & Merkel, 2007). Sensitivity rates were lower for 36-month
olds, and there were gender differences, with the instrument showing lower sensitivity for females than for males.

The advantage of the NDDS when compared to the ASQ and the PEDS is that it requires a short administration time, shorter than the ASQ, while still capturing a majority of domains important to early child development. As discussed above, there are limited validation studies of the NDDS. However, it was created in Canada to address Canadian health care needs for a developmental screening instrument unlike most of the other developmental screening instruments that were developed in the United States and brought to Canada. The NDDS also asks more specific developmental information than the PEDS, thereby attempting to identify areas of learning and development that may signal potential delays, but that may not be highlighted in parental reports. In addition, the NDDS has an accompanying parent handout that includes age-appropriate activities for parents to engage in with their children, as a means of increasing parent education about child development and learning (http://www.ndds.ca retrieved April 3 2007).

The ASQ, PEDS, and NDDS are three developmental screens that possess the characteristics recommended by Glascoe as useful for identifying children who may be at risk for developmental delay. Next, what is known about the parent’s role in developmental screening will be examined.

The parent’s role in developmental screening. Although sensitivity rates in the 70% range have been widely established for several developmental screening instruments, screening tests are still not widely used (Bailey, Skinner & Warren, 2005; Hamilton, 2006) by practitioners who see and assess children on a regular basis. In the past, parents were excluded from the screening process because health care workers considered parents biased. Healthcare workers
did not believe parents could recall and report an accurate representation of their child’s development due to social desirability or other factors that may bias a parents’ opinion about development (Henderson & Meisels, 1994). According to Hamilton (2006), 35-45% of parents polled by the National Survey of Early Childhood Health did not recall ever having their pediatrician inquire about developmental delays.

Research has shown that relying on parental concerns, mainly by asking parents to complete a screening measure, may save time and money. Parents tend to be more reliable when responding to specific items than when responding to general inquiries about developmental milestones or clinical judgment in a visit (Glascoe, Foster, & Wolraich, 1997; Hamilton, 2006). As explained by Glascoe and Dworkin (1995), tools that rely on parental descriptions of current achievements can provide important information with moderate reliability and validity.

In a study investigating how parents appraise their child’s development, Glascoe and MacLean (1990) investigated whether parents could be accurate with a modest amount of knowledge about child development. In a sample of 100 parent-child dyads from predominately urban/suburban neighborhoods, parents were asked to complete the PEDS to assess their child’s development, than they were given a questionnaire to record demographic data, and asked questions about “information thought to effect their perceptions of their child’s development” (p. 281). Glascoe and MacLean chose this population because the children were considered overrepresented for risk of developmental delays (e.g., low SES and premature infants). Results indicated that the parents who had positive appraisals of their own children (no concerns) compared their children in a positive way to other children, and based their appraisals on experience, literature about development, or visits with health care professionals. Parents with concerns about their child’s development also engaged in comparison but, interestingly, most
compared their child unfavorably to other children. This study investigated parents concerns about child development, but did not investigate whether parents were accurate at identifying developmental delays, much less whether parent characteristics influenced their ability to identify delays. The Glascoe and MacLean study provides evidence that parents engage in comparisons to better understand and confirm their beliefs about how their child is developing.

In support of the Glascoe and MacLean study, Dichdeltelmiller et al. (1992) conducted a study to investigate the relationship between parental experience and knowledge and the development of low birth weight infants. In a study of 40 preterm infants and their mothers, the infants were assessed for cognitive, motor, social emotional, neurological, and medical problems. Mothers were asked to complete the Knowledge of Infant Development Inventory (KIDI) that measures parent knowledge of child rearing practices, developmental processes, and infant norms. They were also asked to complete the Catalog of Previous Experience with Infants (COPE) that measures a parent’s exposure to babies and their overall opinion regarding how much they think they know about babies. Their findings indicated that there was little difference in parent’s knowledge of infant development between parents of preterm infants and parents of full term infants. Furthermore, their results support Glascoe and MacLean’s (1990) findings that many parents rely on socio-cultural indicators to tell them if their child is not developing normally. That is, they compare against other children in the community to assess their child’s development.

Therefore, it seems parents with limited knowledge of child development, those who have high risk children, or those come from high risk populations can recognize atypical development when they compare their children against others either favorably or unfavorably.
Literature supports parents as part of the developmental screening process, but neither of these studies addresses characteristics that may influence their accuracy on reporting.

Henderson and Meisels (1994) also investigated parental input in the screening process. They argued that developmental screening tools must address the multiple risk factors that influence development of a child, as children are exposed to multiple risk factors influencing their development. They hypothesized that parents hold the key to understanding multiple risk factors. They studied the predictive value of a developmental screening instrument when a parent questionnaire was added to the assessment. They hypothesized that "by combining parental input with direct assessment it would be possible to improve accuracy of the developmental screening process and to reduce the likelihood of classification errors that are associated with single sources of screening data" (p. 143). The study used the Early Screening Inventory (ESI; Meisels et al., 1992), which is completed by a professional and not by parents, either alone or along with a parent questionnaire developed by the researchers. They then compared both results with the results from the McCarthy Scales of Children's Abilities (MSCA; McCarthy, 1972). Although this study was conducted solely with parents of preschool aged children, their results showed that adding a parent questionnaire did help decrease false positive results on the ESI.

Results from this study showed that a parent questionnaire helped guide practitioners to more accurate screening with the ESI. However, this study does not provide evidence that characteristics of parents have influence over the accuracy, just that taking parent information about their child's development helped researchers with accuracy on the screening instrument. Therefore, it may be that developmental screening instruments are inherently inaccurate, while parents may be more accurate than once thought.
**Parent reporting of development.** Parents can play an important role in the early screening and detection of developmental delays for their children (Lagerberg, 2005). There is evidence that parents who are assisted in parent-completed screening tools are successful in identifying developmental delays (Glascoe, 1999; Glascoe & Dworkin, 1995; Montgomery, 1999; Squires, 1996). Investigations examining parents’ abilities to correctly identify developmental problems in their children have shown that parental concerns regarding fine motor skills, overall functioning, or speech and language development tend to more accurately predict actual delays than when concerns centered around social and self-help skills or gross motor development (Glascoe & Dworkin, 1995).

Parent reports can be completed in a number of different settings (e.g., over the telephone, in the waiting room, during an interview with the pediatrician, etc.), and have been demonstrated to be highly accurate when parents are asked to report on observable child behavior in a systematic, structured format (Glascoe & Dworkin, 1995; Rydz, Shevell, Majnemer, & Oskoui, 2005; Squires, Potter, Bricker, & Lamorey, 1998). In addition, reliability and validity of parent-screening questionnaires are highest when questions are well structured and well worded, detailed, pertain to specific behaviors, and focus on descriptions of current child achievements (Glascoe & Dworkin, 1995; Rydz et al. 2005).

Glascoe (1997) found that the discrepancy between accurate and inaccurate results on the PEDS was the result of parent language barriers. In other words, parents for whom English was their second language were not as accurate as parents for whom English was their first language. In addition, a different kind of language barrier has also hindered the screening process. Terminology differences concerning child development between parents and health care can be very different (Glascoe, 1999). Summarizing studies about parent knowledge of development
and health care provider ability to elicit this parental knowledge, Glascoe concluded that the questions were more of a problem than the parents who were answering them. Parents may not have the language needed to describe their concern to the healthcare provider. The disconnect in language may account for some discrepancies found between healthcare provider results and parent results on developmental screening tools. Parents may need assistance with completing the screening tool because the language used may not be familiar to them. Providing parents with a screening tool that elicits observable child behaviors may decrease the likelihood that terminology will hinder the process (1999).

**Parent Characteristics**

The Bio-ecological Model (Bronfenbrenner & Morris, 1998) provides a framework for the selection of family and child characteristics that may potentially influence parent accuracy and agreement with developmental screening instruments. The Bio-ecological Model includes two defining propositions relevant to this study. The first is that human development takes place through processes of progressively more complex reciprocal interaction between an active, evolving bio-psychological human organism and the persons, objects, and symbols in its immediate external environment. Interaction must occur on a fairly regular basis over extended periods of time with one or more persons with whom the child develops a strong, mutual, irrational attachment, and who are committed to that child's development, preferably for life. To do this, the availability and active involvement of another adult who assists, encourages, spells off, gives status to, and expresses admiration and affection for the person caring for and engaging in joint activity with the child (quality of relationships in the family) is necessary. Enduring interactions are the primary engines of development. This proposition guides the selection of family structure. The parent would provide the active involvement of another adult.
The second proposition dictates that the form, content, and direction of the processes affecting development may vary systematically as a joint function of the characteristics of the developing person; of the environment; of the nature of the developmental outcomes under consideration; and of the social continuities and changes occurring over time through the life course. This second proposition guides the selection of child characteristics particularly health, age, and gender and the family characteristics of age, education, and income.

Although Bronfenbrenner and Morris (1998) articulate six bio-psychological constructs to consider in their model, three of them are directly pertinent to this study: (a) family resources that constitute bio-psychological liabilities and assets such as maternal education, family income, partner support, and child health; (b) maternal age; (c) and child gender (See Figure 1). Again, this model is merely to help decide which characteristics of parents and children are important to investigate when questioning the accuracy of parent reporting of child development.

Figure 1.1: Bio-Ecological Model Guiding Study Concepts (adapted from Bronfenbrenner & Morris, 1998)
Investigators who have conducted studies on parents and their communities provide evidence that characteristics of parents and children play a role in the development of a child. The characteristics that serve as the focus of the present study are reviewed here and include maternal education, family income, family structure, maternal age and child gender, age, and health status.

**Maternal education**

Similar to family income level, maternal education and the contribution education makes to a parent’s ability to accurately report developmental status is disputed in the literature. Investigators (Bowman, 1992; Dichdeltelmiller et al., 1992; Henderson & Meisels, 1994) provide evidence that children with mothers who have less than a high school diploma are at greater risk for developmental delays. Researchers surmise that mothers with low levels of education are not familiar with child development or possess few parenting skills (Bowman, 1992). According to Bronfenbrenner (1998), educational attainment of the parent is one of the variables that is unaffected by family processes because educational attainment happens before the formation of the family, yet has significant effects on the family if attainment is low. Parent educational attainment is typically linked to whether or not the family lives in poverty. Poverty, in turn, creates an unstable and poor environment for consistent and positive parent child interaction (Bronfenbrenner, 1998).

Stanton-Chapman, Chapman, and Scott (2001) measured individual and population-based risk factors for children with learning disabilities. Maternal education level was one of the highest risk factors at the individual-level for a learning disability later in life, and was one of the highest population-level risk factors for a learning disability. This study focused on the behaviors often associated with mothers who attained an education level of less than high school.
Mothers with a less than high school education were found to be more likely to smoke and engage in more risk behaviors pre and post-natal than their better-educated counterparts. Although Stanton-Chapman et al. (2001) do not provide evidence that mothers with a less than high school educational attainment are inaccurate in reporting their child’s developmental progress, they do document that women with a less than high school education may not understand the implications their own behaviors have for their children’s health and development. This lack of understanding may limit their ability to observe signs their children may have developmental delays. It should be noted that this study did not mention whether the mothers themselves had learning disabilities, which would also influence their ability to understand development and ultimately report on their child’s development.

It is important to consider maternal education as a characteristic that may influence a parent’s ability to accurately report developmental delay as it is an important characteristic for parents in predicting other developmental accomplishments in children. Glascoe and Dworkin (1995) summarized studies from the 1960s and 1970s regarding parental education attainment. They found that there are discrepancies within the literature. It was reported that early studies found that parents with higher levels of education made more accurate reports of their child’s development than did parents with less than high school education. In the Glascoe and MacLean (1990) study, they found that maternal education did not affect the ability to make accurate appraisals, however, they call for more research to investigate maternal education as influential in accuracy for reporting on development of a child. Regardless, none of these studies actually investigated the accuracy of parents report according to the developmental status of the child (i.e., if the child was reported to be delayed or not delayed both on a parent completed
developmental screening instrument and on a developmental assessment), a focus of the present study.

**Family income**

In the literature, it has been widely disputed as to whether or not family socioeconomic status plays a role in accurate reporting of a child's development (Glascoe 1995; Squires, Potter, Bricker, & Lamorey, 1998). Much of the dispute is a result of new advancements in the screening instruments; as the screening instruments have become stronger psychometrically, researchers have found that parental characteristics like socioeconomic status have less influence on the accuracy of the results (Glascoe, 1999). Although screening instruments have become increasingly valid and reliable, partially because of parent report of developmental milestones, socioeconomic status may continue to play a role in parent accuracy in reporting.

Family income/socio-economic status (SES) is widely researched and connected to many outcomes for child development. It is clear that demographic and environmental characteristics contribute to child development. For instance, children who come from disadvantaged backgrounds have an increased chance of being developmentally delayed. Not only is there evidence that children from low income or disadvantaged families are at risk, but also that neighborhoods, such as highly stressful and dangerous areas impact a child’s development (Bowman, 1992).

Although some investigators have demonstrated certain characteristics put children at risk for developmental delays, others’ findings have been contradictory regarding these same characteristics of parents and the influence they have on the parent’s ability to detect and report a developmental delay. Bowman (1992) and Hamilton (2006) reported that parents of high socioeconomic status provide a better and more developmentally stimulating environment for
their young children. However, understanding the influence of socioeconomic status on a parent’s ability to report on their child’s development is less clear.

According to a study by Squires, Potter, Bricker, and Lamorey (1998), parents, using the ASQ, were able to accurately report their child’s development regardless of parent income status. These investigators focused on the ability of parents from low and middle-income levels to accurately understand and report their child’s development. The researchers were aiming to validate the use of the ASQ with low-income parents by reporting that there was no statistically significant difference in ability of parents from either income category to accurately report on their child’s development compared to results on the professionally administered Bayley Scales of Infant Development (Squires, Potter, Bricker, & Lamorey, 1998).

These results are often interpreted to mean that parents of all income levels have the ability to read and understand the questions on the ASQ and therefore are accurately able report on their child’s development. Although similar findings are established in the literature (Glascoe 2005, 1999, 1997; Squires & Bricker, 1991), there is an inherent bias in the Squire et al (1998) study. The authors’ may have over interpreted the statistical results. For example, the study did not find enough children with delays to calculate sensitivity percentages, much less conclude that low-income parents were as able as middle-income parents to accurately complete the ASQ.

Furthermore, in taking a closer look at the statistical analysis, the creation of a “total agreement” category (encompassing all of the specificity and sensitivity numbers) creates a false interpretation of the results. The number of parents that accurately identified a delay when there was in fact a delay was only seven (sensitivity). As the authors stated, this number is too small to have any sort of power in a statistical analysis. However, the number of parents that were able to accurately identify children who did not have delays was large (N = 260), and therefore creates
the best scenario for statistical analysis. The number of false positive screens in this study was twenty-nine and false negative screens were four.

It is difficult to report that a screen is sensitive in detecting developmental delays when there were not many children with delays in that particular population. In addition, for the small number of children who did in fact have a developmental delay, the results show that only half were detected in one age group and only one third were detected in another age group, all within the low-income parent child dyad. Therefore, it cannot be concluded that parents of low and high socioeconomic status have the same ability to detect developmental delays in their children.

In a literature review by McLoyd (1990), parents of low income and low socioeconomic status were demonstrated to have a decreased capacity to cue into their children's social-emotional needs, and less likely to provide a supportive, caring and consistent environment for their children. More evidence is needed to understand the role of socioeconomic status in influencing accurate parent reporting.

**Family structure**

Jackson, Brooks-Gunn, Huang, and Glassman (2000) explored single motherhood and its implications on children's preschool outcomes. Results provide evidence to support the biocological model. They found that maternal educational attainment, together with the financial stress of being a single mother with only one income, was related to maternal depression. Financial stress coupled with low educational attainment and maternal depression lead to decreased parenting quality and poor child outcomes in behavior and cognitive development (Jackson et al, 2000). While these studies are important in explaining reasons for investigating these characteristics in the literature, none offer any evidence relevant to the question of whether single parenthood influence parents' abilities to accurately report on their child's development.
Validation studies of developmental screening tools include demographic data that include characteristics such as single motherhood. None has found a significant effect on the accuracy of parent reporting (Glascoe, 2000; 1999; 1995; Squires, Potter, Bricker & Lamorey, 1998). As stated earlier, high risk populations are not always well represented in these studies, and therefore, investigating single motherhood as a characteristic that could influence accuracy on developmental screening tools is worthwhile (Dichdeltelmiller et al, 1992; Henderson & Meisels, 1994; Tervo, 2005).

Maternal age

Children of teen mothers are at risk for developmental delays. Furstenberg, Brooks-Gunn, and Morgan (1987) summarized the results of the famous Baltimore study, a longitudinal study following over 300 teenage mothers in the United States. Adolescent motherhood, like educational attainment, co-varies with other characteristics for its negative influence on children. Mothers who bare children as teenagers have a likelihood of additional risk factors such as dropping out of school, low income levels, and less marital stability (Bronfenbrenner, 1998; Furstenberg, Brooks-Gunn, & Morgan, 1987). In addition, as study by Tamis-LeMonda et al. (2002) studied maternal knowledge of development when mothers were less than 18-years of age. Sixty adolescent mothers (ranging in age from 13-18-years-old) were asked to estimate ages infants met developmental milestones. These mothers were able to name the order of milestones, but were much less likely to know when (i.e., timing) the milestones should take place for the infant. Overall, the mothers were observed as expecting developmental milestones to happen much earlier and in less time that developmental milestones occur in general. Although this study provided evidence that young mothers were inaccurate at estimating the onset of developmental milestones, the connection was not made to accuracy of reporting on
observable developmental milestones. Therefore, the literature is lacking evidence that young mothers can be accurate in reporting development, even if they were shown to be inaccurate at estimating timing of developmental milestones.

Many studies investigating the accuracy of parents as reporters include adolescent mothers in the demographic description. However few, if any, studies actually investigate whether this particular characteristic influences accuracy of reporting on developmental screening tools. Many validation studies completed on developmental screening tools fail to include large numbers of teenage mothers, and therefore it is unlikely that current research is sufficient in this area (Dichdeltelmiller et al, 1992; Henderson & Meisels, 1994).

**Child Characteristics**

Child characteristics cannot be ignored when considering parent accuracy in reporting on their child’s development. Research on the validity of developmental screening tools provides some of the best evidence of the influence of child characteristics on the ability of parents to accurately report on the child’s development. Child age, gender, and health status have been examined to better understand their influence on parent report accuracy.

**Child age**

As children increase in age they progress through developmental milestones. A greater number of older children have developmental delays because they have gone through more development (Glascoe, 1990). Therefore, it is logical that parents would have greater accuracy when reporting on older children. Diamond and Squires (1993) summarize studies that are contradictory in explaining the equivocal relationship between child age and maternal report. They reported that some studies provided evidence of greater accuracy of maternal report with preschool aged children than with infants. Some studies suggested that there was greater
accuracy in maternal reports when the developmental level of the child was lower, while others found no difference in accuracy and the age and the developmental level of children.

In the study by Glascoe and MacLean (1990) investigating parent’s appraisals of child development, they found that parents with concerns about their child’s development had children that were significantly older than parents who did not have concerns. However, in this study there was not a criterion measure for accuracy. The study, as described previously was conducted to understand how parents appraise their child’s development. Glascoe (2003) conducted another study where parent’s concerns were used to help predict children’s performance on the Eyeberg Child Behavior Inventory (ECBI; Eyeberg, 2000), and the Possible Problems Checklist, which is part of the Child Development Inventory (CDI; Ireton, 1994). Parents who reported concerns about their child’s behavior successfully predicted mental health problems. Results were significant for children under the age of 4 years, 5 months, indicating that parents’ concerns can be accurate for children less than five years (Glascoe, 2003).

Tervo’s (2006) research suggested that parents of younger children are less likely to have concerns as parents of older children. His research also suggested that age of the child has not been widely investigated in terms of predicting child outcomes from parental concerns. Understanding how age relates to parent ability to accurately report development will certainly better inform research in developmental screening tools.

Child gender

Gender is important to investigate, especially with young children because rates of development vary widely by gender (Dahinten & Ford, 2004; Frankenburg, 1994). Few studies focused upon investigating child gender effects on parent accuracy in reporting developmental delays. However, there are numerous studies providing evidence of discrepancy in referral rates
of boys and girls because parents rate boys higher in behavioral problems than they do girls. A study by Tervo (2006) found parents of boys reported more problems with attention and behavior than parents of girls. In a study investigating the utility of CHILDSERV a community-based developmental screening service, more boys than girls were referred for services (McKay, Shannon, Vater & Dwokin, 2006). The question must be raised as to whether the parent’s expectations for the child is influenced by their gender. It is also important to consider that parent accuracy is influenced by inherent bias in the creation of developmental screening instruments. Therefore, investigating the effect of the child’s gender on a parent’s ability to accurately report on their child’s development is important.

Child health status

Parents who rate their children as having poor health or chronic health problems may have a more unique perspective on their child’s development. In a study by Tervo (2006), some parents who initially had health concerns about their child, in fact had confused developmental concerns with health concerns.

In a study examining parents’ consideration of their child’s development when parents provided concerns about their child’s development, almost one third of parents with inaccurate reports based their rating on prior health concerns (Glascoe, 1999; 1990). Therefore, health of the child seems to hold a unique status in parents’ opinion about development. Some hypothesized that lower income parents actually don’t consider developmental problems to be developmental in nature; rather they view the problems they observe as health problems. This may be why some children’s problems go unnoticed or are inaccurately recognized and diagnosed.
Summary

This chapter summarized what is known through published studies about the parent's role in developmental screening and the contribution of selected parent and child characteristics in the accuracy of their assessment. The Bio-Ecological Model was proposed as a framework to organize the family and child characteristics of interest. It can be concluded, from the literature, that the parent's accuracy in completing developmental screens can be influenced by (a) the screens themselves; (b) by education, income, family structure, and age; and (c) by their child's age, gender, and health status. The exact nature of parent and child characteristics lacks clarity because the literature is limited by a chronic under representation of parents of low educational attainment, low income, young age, and single parent homes. This study contributes some clarity to the field because of the diversity of its participants. The literature is somewhat more congruent regarding child characteristics in that the older the child, the more likely the parent is to be accurate on the screen. It remains unclear whether child gender influences accuracy.

Developmental delay, when observed by parents, may be considered a health condition. Taken together, the literature indicates there is a gap in the field's knowledge about parental accuracy in reporting child developmental delays. This study has potential to reduce the gap in this knowledge.
Chapter Three: Methodology

This study's purpose was to examine child and parent characteristics that may influence agreement between parent report of developmental delay using the Nippising District Developmental Screen (NDDS) and in-depth assessments of child development by a professional. In this chapter, the methods for the study are explained. The participants, measures, and procedures for data collection and analysis are described.

Research Questions

The following research questions are proposed:


**Hypothesis.** It was hypothesized that higher rates of True Positive results and True negative results would be obtained for older children (preschool age), females, and children with no health concerns.

2. To what extent do family demographic or socio-economic characteristics (maternal educational attainment, family income, family structure, and maternal age) predict agreement between parent report on the NDDS and developmental assessment of the child using the SB5, the PPVT-III and the BSID-2?

**Hypothesis.** It was hypothesized that older maternal age (age 23 or older at the birth of the first child), higher maternal education (greater than high school), mothers in two-
parent families, and those with a family income greater than LICO would be associated with higher levels of agreement.

3. What set of child and family characteristics best accounts for agreement between parent report on the NDDS and developmental assessment of the child using the SB5, the PPVT-III, and the BSID-2?

Hypothesis. It was hypothesized that both child and family characteristics associated with lower risk factors would best account for agreement between the developmental assessments and the developmental screening instrument. Those child and family characteristics were; females, preschool age children, children with no health concerns, mothers with greater than high school education, families above LICO, two-parent families, and mothers whose first child was born after age 22.

Participants

A secondary data source was analyzed to answer the research questions. The participants in this study were part of a larger validity study conducted on the Nipissing District Developmental Screen. The sample was comprised of 395 children who were 4, 18, 24, or 36 months old. Families were recruited from a two smaller communities outside a large urban centre in southwestern British Columbia through newspaper advertising and by direct advertising at the public health immunization clinic, a community development centre, and child health fairs. Recruitment posters were also distributed to physician’s offices, day care centres, preschools, supermarkets, recreation centres, and the library. Eligibility criteria required only that the responding parent and child speak English (Dahinten & Ford, 2004). The sample was approximately evenly divided by gender with 53% female children. The sample was also evenly divided by age group, with 51% of the children in the ‘preschool’ group (i.e., the 36-month olds),
and 49% in the infant/toddler group (i.e., 4, 18 or 24 months olds, with 81, 73, and 39 children, respectively). Five percent of the children lived in one-parent families and 27% had been born to mothers who began childbearing prior to 23 years of age. Twenty-one percent of the mothers reported having high school education or less, and 17% reported having a family income below the low-income cut-off point.

Data Collection

Trained graduate student research assistants from the University of British Columbia completed the individualized developmental assessment battery. The research assistants conducted individual developmental assessments with the child and assisted the parents in completing the parent questionnaire and the NDDS. Children were assessed at the community health unit or in their homes. The NDDS was completed by the parent, either over the phone, prior to the visit, or at the time of the assessment. This study draws on data from the following developmental assessments: the Bayley Infant Developmental Instrument: Second Edition, the Stanford Binet Intelligence Scale: Fifth Edition, and the Peabody Picture Vocabulary Test: Third Edition.

Measures

The Nippising District Developmental Screen (NDDS). The NDDS is a parent-completed screening instrument that measures children's development in the following areas: vision, hearing, speech-language, gross motor, fine motor, cognitive, social-emotional, and self-help skills. Parents answer “yes or no” to questions about their child’s development across all seven domains. The NDDS can be used to screen children from 1 month to six years of age and has 13 different versions according to the age of the child. An answer of “yes” on the screen indicates that the parent has observed the child doing the behavior in question. An answer of
“no” (referred to as a ‘flagged’ item) on the screen indicates that the parent has not yet observed the behavior in question. The score on the NDDS consists of the total number of “no” answers or flagged items. The developers created “flag rules” that indicate when the child should be referred for further assessment. The one flag rule means that the child will be referred if the parent selects one or more “no” answers. The two flag rule means the child will be referred if the parent selects two or more “no” answers (Dahinten & Ford, 2004). For the purpose of this study, one or more flags on the Nipissing District Developmental Screen were considered to be a positive screening result. The one flag rule was chosen because it encompassed the children with mild to moderate delays, while the two-flag rule is more widely accepted as identifying the more severe delays while under-identifying children with mild to moderate delays (Dahinten and Ford, 2004), and therefore the sample size was greater when using the one-flag rule.

Few studies have been completed to assess the reliability and validity of the NDDS. In 2001, an evaluation of the NDDS was conducted as part of the Ontario Healthy Babies/ Healthy Children study (HBHC, Nagy, Ryan, & Robinson, 2002). The study provided evidence of interrater reliability (71%) between the parent and caregiver other than the parent (for example a daycare worker), and overall agreement rates for 12 month-olds on the NDDS when compared to the 12 month-old ASQ (78% for 1 flag rule, 93% for 2 flag rule). The HBHC validation study only looked at the 12 month NDDS and relied on one criterion measure (ASQ). Therefore, Dahinten and Ford (2004) conducted a validation study of the NDDS for children ages 4, 18 and 24 months. In this study, concurrent validity was assessed by comparing results from the NDDS to results of the Mental Development Index on the BSID-2. They found that sensitivity rates ranged from 44% to 100% depending on which flag-rule was used and whether they used a 2 standard deviation cut-off or 2.5 standard deviation cut-off on the BSID-2. Specificity rates
ranged from 68% to 86%. Currently there are no other studies investigating the NDDS using more advanced statistical analyses (i.e., factor analysis) or additional studies investigating concurrent validity.

The Stanford-Binet Intelligence Scales- Fifth Edition (SB5). The SB5 is an individually administered test of intelligence designed for ages 2.5 years to 85 years, measuring cognitive ability using five major factor indices: Fluid Reasoning, Visual-Spatial Processing, Knowledge, Quantitative Reasoning, and Working Memory. The measurement of these specific cognitive domains is supported by Cattell-Horn-Carroll (CHC) theory (Roid, 2003). The SB5 provides an overall composite Intelligence Quotient (IQ) with the Full Scale IQ (FSIQ), as well as a Nonverbal IQ (NVIQ) and a Verbal IQ (VIQ). The five factor indices also generate factor scores specific to each individual domain (i.e. Visual-Spatial Processing Factor). The SB5 yields standard scores with a mean of 100 and standard deviation of 15 (Roid, 2003).

The SB5 is a well-respected, reliable and valid measurement of cognitive ability at the 36 month-old age range. For children aged 2 to 7 years, the reliability coefficients ranged from mid-.70s to mid-.90s for the five Nonverbal and five Verbal subtests. These coefficients for the broader IQ indexes (FSIQ, NVIQ, and VIQ) using the norms for children ages 2 to 7 years consistently ranged from the middle to high .90 range. Specifically, scores have yielded median reliability coefficients of .98, .96, and .96 respectively for the 3-year-old age range. Reliability coefficients for the factor index scores were also acceptable for preschool-aged children, ranging from .84 to .95 range (Roid, 2003).

Criterion-related validity was demonstrated by the moderate to high correlations (ranging from .40 to .90) found between examinees' scores on the SB5 and their scores on the SB1V and other measures of cognitive ability (e.g., Wechsler Preschool and Primary Scale of Intelligence-
Revised, Wechsler Intelligence Scale for Children-Third Edition, and the Woodcock-Johnson III Tests of Cognitive Abilities). Predictive validity was demonstrated by correlating SB5 scores with measures of academic achievement (e.g., Woodcock-Johnson III Tests of Achievement, and the Wechsler Individual Achievement Test-II), yielding coefficients in the moderate to high range (ranging from .33 to .84) (Roid, 2003).

The Bayley Scales of Infant Development-Second Edition (BSID-2). The BSID-2 is one of the most widely used measures of development of infants and toddlers in both research and clinical practice. Validation studies of the Mental Development Index (MDI) have yielded median reliability coefficients of .88, .92, and .92 for children ages 4, 18, and 24 months of age respectively, with a median reliability of .88 among all ages and test retest reliability of .87. The stability coefficient for the MDI has been found to be .83 for the 1-to 12-month age range and .91 for the 24 to 36-month range (Bayley, 1993.) The construct validity evidence consists of intercorrelation data for the MDI, and intercorrelations of MDI scores with other measures of preschool cognitive functioning. The MDI tends to correlate highly with other measures of preschool cognitive functioning (Weschler Preschool and Primary Scales of Intelligence-Revised (WPPSI-R), McCarthy Scales of Children’s Abilities (MSCA), and the Differential Abilities Scale (DAS)). The moderate correlations between the MDI, WPPSI-R (.73), and MSCA (.79) provide evidence of concurrent validity for children at the older age range (36 to 42 months) of the BSID-2. The correlations for the preschool age range is not relevant to this study as the BSID-2 was only used with 4, 18, and 24 month-olds in this study, but does provide evidence of its strong reliability as a criterion measure. The BSID-II was chosen because of the psychometric properties and history, as well as its appropriateness for children 4 to 24 months of age. Like the SB5, the BSID-2 yields standard scores with a mean of 100 and a standard
deviation of 15 (Bayley, 1993). The MDI is currently the only outcome measure for intelligence on the Bayley-2. This is different from the SB5, which yields scores for verbal and nonverbal intelligence as well as scores for the factor indices.

The Peabody Picture Vocabulary Test, Third Edition (PPVT-III). The PPVT-III is an individually administered test of receptive vocabulary designed for ages 2.6 to 90 years. The PPVT-III was chosen because of its strong psychometric properties, and utility with young children. A receptive vocabulary test like the PPVT-III is also useful because it does not require any verbal answers from the child; he or she may just point to the answers. The reliability coefficients for the PPVT-III range from .88 to .96 for the preschool age. The criterion-related validity evidence is also good. Correlations with the Wechsler Intelligence Scale for Children, Third Edition (WISC-III) are .91 and .92. Lower correlations were found with the nonverbal subtests, which is to be expected as they require less language and measure different abilities than the PPVT-III. Concurrent validity again, was correlated higher with the verbal subtests on the WISC-III than the performance subtests, highly correlated with the crystallized intelligence on the Kaufman Adolescent and Adult Intelligence Test, and with the vocabulary subtest more than with matrices subtest on the Kaufman Brief Intelligence Test (Dunn, Dunn, Williams, & Wang, 1997).

Explanatory Variables

Child characteristics. Three child characteristics of interest are gender, age group, and health status. Age group was defined as infant/toddler (i.e., 4, 18, or 24 months old) or preschool (i.e., 36 months old). Health status was measured by a single item on the parent questionnaire asking the parent to describe their child’s health as poor, fair, good or excellent. This variable was later recoded as ‘excellent’ and ‘less than excellent’. Although this cutoff is at ‘excellent’
and not 'good,' global self-evaluations of health are an often-used measure of health status that has been shown, within the adult population, to be reflective of physical and mental health, physical functioning, and health behaviours (Krause & Jay, 1994; Vingilis, Wade, & Adlaf, 1998). Therefore, there is reason to believe that parental self-reports of children's health (using a single item or global evaluation of health) may also be predictive of children's developmental outcomes. The responses of poor, fair, good, and excellent were divided into excellent vs. less than excellent for two reasons, one pragmatic and more theoretical: 1) because 71% of children were identified as being in excellent health vs. 27% in good health and 2% in poor health, and 2) because it was hypothesized that excellent meant no concerns at all, whereas 'good' allows for some concerns about the child's health.

**Family characteristics.** Four family demographic and socio-economic characteristics are included in the analysis: maternal educational attainment, family income, family structure, and maternal age at first childbearing. Each of these were measured on the parent questionnaire and later recoded as follows: Maternal educational attainment was recoded as "greater than high school education" or "less than or equal to a high school education." Family income was later recoded as "above LICO," or "below LICO." Family structure was recoded as "two parent family" or "one parent family." Although the family structure variable did not allow for any other family structure (e.g., extended family, same-sex couples, or additional help for the mother like living with her parents) the question on the parent questionnaire limited the mother to answer if she was married or not. Therefore, it was logical to recode the variables as one-parent or two-parent family. Lastly, maternal age at first childbearing was later recoded as "greater than 23 years" or "less than or equal to 22 years." Research investigating the effects of young maternal age on children's developmental outcomes has been inconsistent across studies with
respect to whether maternal age at first birth or maternal age at the target child's birth is used as a predictor, and mixed results, even for the few studies that have used both ages (Moore et al., 1997 and Turley, 2003). Thus, given that there is some evidence of residual effects of age at first childbirth for subsequent children born when the mother is older, maternal age at first childbirth was chosen as the variable of interest for this study.

Analysis of Data

The primary aim of this study is to identify the set of child and family characteristics that best accounts for agreement between parent report on the NDDS and cognitive assessment of the child. Correspondence between the screening results and developmental assessments also provides the basis for assessing the sensitivity and specificity rates for the NDDS.

Agreement Status and the Calculation of Sensitivity and Specificity Rates.

Sensitivity and specificity rates are calculated based on the agreement between the parent report on the NDDS and the results of the professionally administered direct child assessment. A true positive result refers to a positive screen for a child who was assessed as having a developmental delay (i.e., the parent-reported screening results are consistent with the results obtained on the professionally administered direct assessment). For the purpose of this study, a developmental delay is considered a standard score of one standard deviation below the mean on one of the developmental assessments (Mean=100, SD=15; therefore, delay = a score of < 85). A false positive refers to a positive screen for a delay for a child who was assessed as not having a delay. A false negative refers to a negative screen for a delay for a child who has a delay. A true negative refers to a negative screen for a delay for a child who does not have a delay. Thus, the true positives and true negatives represent cases where there is agreement between the parent-reports and the direct assessments, whereas false positives and false negatives represent disagreement.
Finally, sensitivity refers to proportion of the true positives among children with delays and specificity refers to the proportion of true negatives among children without delays.

**Bivariate Analysis.** Research questions one and two were analyzed using a bivariate analysis. Chi-squared statistics were completed to test the following hypotheses generated based on the literature review provided in chapter two. (Two-way tables with chi-square statistics were used because each of the variables were measured at the nominal level, each with two categories.) It was hypothesized that certain parent and child characteristics would predict higher levels of agreement between the results of the NDDS and the child assessments. Separate analyses were completed for children with delays and for children without delays in both the bivariate and multivariate analyses.

**Multivariate Analysis.** The third research question was analyzed using a binary logistic regression to investigate the child and parent characteristics that best predict agreement between parent report on the NDDS and developmental assessment of the child using the Stanford-Binet: Fifth Edition (SB5) and the Bayley Scales of Infant Development: Second Edition (BSID-2). The dependent variable was measured as 1 = True Positive for children who were assessed as delayed, and 0 = False Negative. For children who were assessed as not delayed, 1 = True Negative, and 0 = False Positive. The predictor variables were the parent and child characteristics supported by the bivariate analysis. Assumptions involved in logistic regression are similar to that of linear regression. Specification of Error and Collinearity are discussed. Specification of Error refers to the adequacy of the model. Does the model incorporate all the relevant independent variables and exclude irrelevant independent variables? This study was limited because it was conducted on a secondary data set. In logistic regression tests for “goodness of fit” are based on the log likelihood. “The concern is less with the overall fit of the
model and more with the accuracy with which the model predicts actual category membership on
the dependent variable” (Menard, 2002, p. 41). The Hosmer-Lemeshow Test is the test for the
goodness of fit statistic. “A non-significant result indicates that the model fits; a significant result
indicates that it does not fit” (Munro, 2005, p. 311). The specific tests used to examine the
accuracy of category membership were the Cox and Snell R Square and the Negelkerke R
Square tests. They assessed the percentage of variance explained by each of the variables in the
model (Munro, 2005).

Collinearity is the correlation of independent variables. In this study it was expected the
family socio-economic status variables would be correlated. Thus after controlling for the one
family characteristic, a significant result may not be found. Therefore sub-analyses using a
series of logistic regression were run where relevant family characteristics were entered one at a
time.
Chapter Four: Results

Chapter Four presents the analysis and results of the study. First, sample characteristics are described. Then, the overall results for sensitivity and specificity analysis are described. Next the hypothesized associations between screening results on the NDDS and child characteristics (gender, age, and health status) and family characteristics (maternal education, family income, family structure, and maternal age) were tested using two-way tables and Pearson chi-square statistics. Finally, binary logistic regression analyses were conducted to identify family characteristics and child characteristics that predict agreement between parent-completed screening result and the developmental assessments. Discussion and implications of the findings are presented in Chapter Five.

Description of the Sample

Initial descriptive analyses were used to describe the sample used in this study. Of the total sample (N = 395), the majority were children with no delays (n = 343, 86.8%, per the results of the developmental assessment) whereas children with delays (n = 52) accounted for 13.2% of the sample. For both groups (children with delays and children without delays), the sample represents males and females, and the infant/toddler and preschool age groups evenly. Child health status is less evenly distributed in both groups. Of the family characteristics, family income and maternal age at first childbearing are not well distributed across the sample. Notably, characteristics that are generally considered to put children at risk for developmental delays, young maternal age and low family income, were more common among the children who were assessed as having delays. See Table 4.1.
Table 4.1
Demographic Characteristics of the Sample

<table>
<thead>
<tr>
<th>Child Characteristics</th>
<th>Total Sample (N = 395)</th>
<th>Children With Delays (n = 52)</th>
<th>Children Without Delays (n = 343)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>Gender</td>
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<td></td>
</tr>
<tr>
<td>Male</td>
<td>184</td>
<td>46.6</td>
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<tr>
<td>Female</td>
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<td>53.4</td>
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</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
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<tr>
<td>Infant/Toddlers</td>
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<td>48.9</td>
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<tr>
<td>Preschoolers</td>
<td>202</td>
<td>51.1</td>
<td>29</td>
</tr>
<tr>
<td>Health Status</td>
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<tr>
<td>Excellent</td>
<td>278</td>
<td>70.7</td>
<td>34</td>
</tr>
<tr>
<td>Less than Excellent</td>
<td>115</td>
<td>29.1</td>
<td>18</td>
</tr>
<tr>
<td>Family Characteristics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maternal Education</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤ High School</td>
<td>81</td>
<td>20.8</td>
<td>11</td>
</tr>
<tr>
<td>&gt; High School</td>
<td>308</td>
<td>79.2</td>
<td>41</td>
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<tr>
<td>Family Income</td>
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<tr>
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<tr>
<td>Above LICO</td>
<td>320</td>
<td>83.1</td>
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<td>Family Structure</td>
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<tr>
<td>One-parent</td>
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<tr>
<td>Two-parent</td>
<td>374</td>
<td>94.7</td>
<td>49</td>
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<tr>
<td>Maternal Age</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤ 22 years</td>
<td>106</td>
<td>27.2</td>
<td>22</td>
</tr>
<tr>
<td>&gt; 22 years</td>
<td>283</td>
<td>72.8</td>
<td>30</td>
</tr>
</tbody>
</table>
Overall Sensitivity and Specificity Rates

Table 4.2 shows the correspondence between the parent-reported screening results and the developmental assessments. As described in Chapter 2, the true positives and true negatives represent cases where there is agreement between the parent-reports and the developmental assessments, whereas false positives and false negatives represent disagreement. Sensitivity refers to proportion of the true positives among children with delays and specificity refers to the proportion of true negatives among children without delays. Therefore, in this sample, the sensitivity rate for the NDDS was 37% (19/52) and the specificity rate was 82% (282/343).

Table 4.2
Analysis of Sensitivity and Specificity

| Assessment Results |
|-------------------|-----------------|-----------------|-----------------|
| NDDS Results      | Delayed         | Not Delayed     | Total           |
| Positive          | 19              | 61              | 80              |
| True Positives    | False Positives |                 |                 |
| Negative          | 33              | 282             | 315             |
| False Negatives   | True Negatives  |                 |                 |
| Total             | 52              | 343             | 395             |

Separate analyses were conducted for children with and without delays in both the bivariate and multivariate analyses. For children with delays, agreement is represented by a True Positive screening result; among children with delays, agreement is represented by a True Negative screening result.

Research Question One
Research question one. To what extent do child characteristics (gender, age, and health status) predict agreement between parent report on the NDDS and developmental assessment of the child using the SB5, the PPVT-III, and the BSID-2?

Bivariate analyses, using two-way tables with chi-square statistics, were conducted to determine the relationship between child characteristics and agreement between parent report on the NDDS and professional assessment of the child for children with and without delays. First, bivariate results are described for children with delays. Second, bivariate results are described for children without delays.

Children with delays. For children with delays, there were significant associations between each of the three child characteristics under investigation and the agreement status between parent reports and direct assessment (i.e., True Positive vs False Negative results). Parents of males were significantly more likely than parents of females to report delays ($\chi^2 = 5.68, df = 1, p = .017$). Approximately 50% of the male children with delays were identified by their parents as delayed, compared with only 20% of the female children with delays. Parents of infants and toddlers were significantly more likely than parents of preschoolers to report true positives ($\chi^2 = 10.53, df = 1, p = .001$). Less than one-fifth of the preschoolers with delays were identified by their parents as delayed. There was also a significant association between child health status and parent report of delay. Parents who reported their children’s health as less than excellent were significantly more likely to report a delay than parents of children with excellent health ($\chi^2 = 4.29, df = 1, p = .038$). Only one-quarter of the children with excellent health were identified by their parents as delayed, compared with approximately half of the children with less than excellent health. Thus, among the sub-sample of children who were assessed as delayed, true positive screening results were more likely to occur for male children, younger children (4,
18, and 24 months), and those perceived by the parents to have less than excellent health. See Table 4.3.

Table 4.3
Association Between Child Characteristics and Parent-Reported Screening Results for Children with Delays (n = 52)

<table>
<thead>
<tr>
<th>Child Characteristic</th>
<th>Marginal Probabilities</th>
<th>True Positives</th>
<th>χ²</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>27</td>
<td>51.9</td>
<td>14</td>
<td>51.9</td>
</tr>
<tr>
<td>Female</td>
<td>25</td>
<td>48.1</td>
<td>5</td>
<td>20.0</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Infant/Toddlers</td>
<td>23</td>
<td>44.2</td>
<td>14</td>
<td>60.9</td>
</tr>
<tr>
<td>Preschoolers</td>
<td>29</td>
<td>55.8</td>
<td>5</td>
<td>17.2</td>
</tr>
<tr>
<td>Health Status</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excellent</td>
<td>34</td>
<td>65.4</td>
<td>9</td>
<td>26.5</td>
</tr>
<tr>
<td>Less than excellent</td>
<td>18</td>
<td>34.6</td>
<td>10</td>
<td>55.6</td>
</tr>
</tbody>
</table>

Children without delays. For children without delays, there were significant associations between two of the three child characteristics and parent reports of delay (i.e., True Negative vs False Positive results). There was a significant association between child gender and parent report of delay. Parents of females were more likely to correctly report their child as non-delayed than parents of males (χ² = 5.243, df = 1, p = .022). There was also a significant association between child age and agreement status (χ² = 37.79, df = 1, p = .000). Parents of preschool children were more likely to report true negative results compared with parents of infants and toddlers. There was not a significant association between parent-reported child health status and parent report of delay (χ² = 3.129, df = 1, p = .077).
Table 4.4
Associations Between Child Characteristics and Parent-Reported Screening Results for Children Without Delays (n = 343)

<table>
<thead>
<tr>
<th>Child Characteristic</th>
<th>Marginal Probabilities</th>
<th>True Negatives</th>
<th>$\chi^2$</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$n$</td>
<td>%</td>
<td>$n$</td>
<td>%</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>157</td>
<td>45.8</td>
<td>121</td>
<td>77.1</td>
</tr>
<tr>
<td>Female</td>
<td>186</td>
<td>54.2</td>
<td>161</td>
<td>86.6</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Infant/Toddlers</td>
<td>170</td>
<td>49.6</td>
<td>118</td>
<td>69.4</td>
</tr>
<tr>
<td>Preschoolers</td>
<td>173</td>
<td>50.4</td>
<td>164</td>
<td>94.8</td>
</tr>
<tr>
<td>Health Status</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excellent</td>
<td>244</td>
<td>71.1</td>
<td>206</td>
<td>84.4</td>
</tr>
<tr>
<td>Less than Excellent</td>
<td>97</td>
<td>28.4</td>
<td>74</td>
<td>76.3</td>
</tr>
</tbody>
</table>

To summarize the analyses of the child characteristics, bivariate analyses provided evidence of significant associations between child characteristics and parent report of delay both when children had delays and when they did not have delays. Parents were more likely to identify a true positive for males in the delayed group, and more likely to identify true negatives for females in the group without delays. In addition, parents were more likely to identify true positives among younger children in the delayed group and more likely to identify true negatives among older preschool children in the group without delays. Child health status had a significant association with parent report only in the delayed group. Parents in the sub-sample of delayed children, with less than excellent health, were more likely to report true positives than parents of children with excellent health.

Research Question Two

**Research question two.** To what extent do parent demographic characteristics (maternal education, family income, family structure, and maternal age) predict agreement between parent
reports on the NDDS and developmental assessment of the child using the SB5, the PPVT-III, and the BSID-2? Bivariate analyses, using two-way tables with chi-square statistics, were conducted to determine the associations between family characteristics with agreement between parent report on the NDDS and developmental assessment of the child for children with and without delays. The analyses were conducted for children with delays first, followed by analyses for children without delays.

**Children with delays.** For children with delays, the findings are mixed in that only two of the four parent characteristics were associated with agreement status between parent-report screening results and developmental assessments (i.e., True Positive vs. False Negative results). No significant association was found for maternal age at first childbearing or family structure and parent report of delay, but maternal education and family income showed significant associations with parent report of delay. Mothers with a high school education or less were almost three times more likely than mothers with education beyond high school to report True Positive screening results ($\chi^2 = 7.88, df = 1, p = .005$). Families with household income below the Low Income Cutoff (LICO) were also much more likely to report delays (i.e., True Positives) than parents with incomes above LICO ($\chi^2 = 5.357, df = 1, p = .021$).
Table 4.5
Associations Between Family Characteristics and Parent-Reported Screening Results for Children with Delays (n = 52)

<table>
<thead>
<tr>
<th>Family Characteristic</th>
<th>Marginal Probabilities</th>
<th>True Positives</th>
<th>$\chi^2$</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>Maternal Education</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤ High School</td>
<td>11</td>
<td>21.2</td>
<td>8</td>
<td>72.7</td>
</tr>
<tr>
<td>&gt; High School</td>
<td>41</td>
<td>78.8</td>
<td>11</td>
<td>28.6</td>
</tr>
<tr>
<td>Family Income</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Below LICO</td>
<td>15</td>
<td>30.0</td>
<td>9</td>
<td>60.0</td>
</tr>
<tr>
<td>Above LICO</td>
<td>35</td>
<td>70.0</td>
<td>9</td>
<td>25.7</td>
</tr>
<tr>
<td>Family Structure</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>One-parent</td>
<td>3</td>
<td>5.8</td>
<td>2</td>
<td>66.7</td>
</tr>
<tr>
<td>Two-parent</td>
<td>49</td>
<td>94.2</td>
<td>17</td>
<td>34.7</td>
</tr>
<tr>
<td>Maternal Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤ 22 years</td>
<td>22</td>
<td>42.3</td>
<td>9</td>
<td>40.9</td>
</tr>
<tr>
<td>&gt; 22 years</td>
<td>30</td>
<td>57.7</td>
<td>10</td>
<td>33.3</td>
</tr>
</tbody>
</table>

**Children without delays.** For children without delays, two of the four parent characteristics were associated with agreement status between parent-reported screening results and developmental assessments (i.e., True Negatives vs False Positives), although these are not the same as for children with delays. Family income, and maternal age at first childbearing were found to be significantly associated with agreement status, but maternal education and family structure were not. Mothers with family income above LICO were more likely to identify true negatives than mothers with family income below LICO ($\chi^2 = 4.069$, $df = 1$, $p = .044$). Mothers who were age 23 or older when their first child was born were more likely to correctly report True Negatives than mothers who were age 22 or less ($\chi^2 = 7.012$, $df = 1$, $p = .008$).
Table 4.6
Associations Between Family Characteristics and Parent-Reported Screening Results for Children without Delays (n = 343)

<table>
<thead>
<tr>
<th>Family Characteristic</th>
<th>Marginal Probabilities</th>
<th>True Negatives</th>
<th>$\chi^2$</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$n$</td>
<td>%</td>
<td>$n$</td>
<td>%</td>
</tr>
<tr>
<td>Maternal Education</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\leq$ High School</td>
<td>70</td>
<td>20.8</td>
<td>52</td>
<td>74.3</td>
</tr>
<tr>
<td>$&gt;$ High School</td>
<td>267</td>
<td>79.2</td>
<td>225</td>
<td>84.3</td>
</tr>
<tr>
<td>Family Income</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Below LICO</td>
<td>50</td>
<td>14.9</td>
<td>36</td>
<td>72.0</td>
</tr>
<tr>
<td>Above LICO</td>
<td>285</td>
<td>85.1</td>
<td>239</td>
<td>83.9</td>
</tr>
<tr>
<td>Family Structure</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>One-parent</td>
<td>17</td>
<td>5.0</td>
<td>11</td>
<td>64.7</td>
</tr>
<tr>
<td>Two-parent</td>
<td>325</td>
<td>95.0</td>
<td>270</td>
<td>83.1</td>
</tr>
<tr>
<td>Maternal Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\leq$ 22 years</td>
<td>84</td>
<td>24.9</td>
<td>61</td>
<td>72.6</td>
</tr>
<tr>
<td>$&gt;$ 22 years</td>
<td>253</td>
<td>75.1</td>
<td>216</td>
<td>85.4</td>
</tr>
</tbody>
</table>

In summary, family characteristics had several significant associations for parent report of delays for children with delays and children without delays. In the sub-sample of children with delays, mothers with lower educational attainment were more likely to identify true positives, while in the sub-sample of children without delays, maternal education was not significant. In both groups family income was significant. In the delayed group, families below LICO were likely to identify true positives, and in the group of children without delays families above LICO were likely to identify true negatives. For both children with delays and children without delays, family structure had no significant association with parent report. Lastly, the analysis of the association between maternal age and parent report of delay resulted in mixed findings. In the group of children with delays, maternal age was not significant, whereas in the group of children
without delays, mothers who began childbearing after age 22 were more likely to identify true
negatives than younger mothers.

Research Question Three

**Research question three.** What set of child and family characteristics best accounts for
agreement between parent report on the NDDS and cognitive assessment of the child using the
SB5, the PPVT-III, and the BSID-2?

Multivariate analyses using logistic regression were conducted to determine the set of
child and family characteristics that best accounts for agreement between parent report on the
NDDS and professional assessment of the child using the SB5, the PPVT-III, and the BSID-2 for
children with and without delays. As with the bivariate analyses, the analyses and findings are
described for children with delays followed by the analyses and findings for children without
delays. Results for sub-analyses by child gender and child age group are also presented.

**Children with delays.** The first binary logistic regression analysis was conducted with
children identified as having a delay by developmental assessment. All three of the child
variables were included in the model, but only the two family characteristics (maternal education
and family income) that were found to be statistically significant in the bivariate analyses were
included in the model. Two of the three child characteristics were found to be statistically
significant in this multivariate analysis, but neither of the family characteristics were found to be
significant.

Both child gender and child age were statistically significant in association with
agreement status. Child gender for the group of delayed children was shown to be associated
with agreement status (i.e., True Positive vs False Negative results) (OR = .118, df = 1, p = .027).
Table 4.7 indicates that females were only about 1/8th as likely as males to be reported as delayed
when in fact they were delayed. Child age was also predictive of agreement (OR = .129, df = 1, p = .011). Again, consistent with the bivariate analysis, children in the preschool group were only about 1/8th as likely as infants/toddlers to be accurately identified by their parents as delayed. Child health status was not found to be a statistically significant predictor of agreement in the sample of children with delays.

According to the Cox and Snell and Nagelkerke estimates, between 37% and 50% of the variance in agreement is accounted for by this model. The Hosmer and Lemeshow Test also supports the fit of the model (p = .887). However, given the strong association found in the bivariate analysis for maternal education and family income with agreement status, but the non-significant results in the logistic regression above (coupled with the strong association between maternal education and family income, $\chi^2 = 21.429, df = 1, p = .000$), two other models were run for the children with delays, each including only one of the two family variables. Including maternal education with the three child variables did not yield a significant result for maternal education, but when family income was included in the model, it was found to be significant. Thus, children from families with low incomes were seven times more likely to be identified as delayed (true positives) than children from families with incomes above the LICO, even after accounting for child characteristics. See Table 4.8.
Table 4.7
Results from the Logistic Regression Analyses: Child and Family Characteristics that Predict Agreement between the NDDS and the SB5, BSID-2, and the PPVT-III in Children with Delays (n = 52)

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>B</th>
<th>SE</th>
<th>Wald</th>
<th>df</th>
<th>OR</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Child Characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender (1 = Female, 0 = Male)</td>
<td>-2.136</td>
<td>.968</td>
<td>4.868</td>
<td>1</td>
<td>.118</td>
<td>.027</td>
</tr>
<tr>
<td>Age (1 = Preschool, 0 = Infants/Toddlers)</td>
<td>-2.044</td>
<td>.800</td>
<td>6.522</td>
<td>1</td>
<td>.129</td>
<td>.011</td>
</tr>
<tr>
<td>Health Status (1 = less than excellent, 0 = excellent)</td>
<td>-22.652</td>
<td>40192.991</td>
<td>.000</td>
<td>1</td>
<td>.000</td>
<td>1.000</td>
</tr>
<tr>
<td><strong>Family Characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maternal Education (1 = ≤ HS, 0 = HS+)</td>
<td>.058</td>
<td>1.313</td>
<td>.002</td>
<td>1</td>
<td>1.059</td>
<td>.965</td>
</tr>
<tr>
<td>Family Income (1 = ≤ LICO, 0 = ≥ LICO)</td>
<td>1.954</td>
<td>1.291</td>
<td>2.292</td>
<td>1</td>
<td>7.079</td>
<td>.130</td>
</tr>
</tbody>
</table>
Table 4.8.
Results from the Logistic Regression Analyses: Child and Family Characteristics that Predict Agreement between the NDDS and the SB5, BSID-2, and the PPVT-III in Children with Delays (n = 52)

<table>
<thead>
<tr>
<th></th>
<th>B</th>
<th>SE</th>
<th>Wald</th>
<th>df</th>
<th>OR</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Child Characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender (1 = Female, 0 = Male)</td>
<td>-2.147</td>
<td>.937</td>
<td>5.253</td>
<td>1</td>
<td>.117</td>
<td>.022</td>
</tr>
<tr>
<td>Age (1 = Preschool, 0 = Infants/Toddlers)</td>
<td>-2.043</td>
<td>.800</td>
<td>6.529</td>
<td>1</td>
<td>.130</td>
<td>.011</td>
</tr>
<tr>
<td>Health Status (1 = less than excellent, 0 = excellent)</td>
<td>-22.707</td>
<td>40192.991</td>
<td>.000</td>
<td>1</td>
<td>.000</td>
<td>1.00</td>
</tr>
<tr>
<td><strong>Family Characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Family Income (1 = ≤ LICO, 0 = ≥ LICO)</td>
<td>1.994</td>
<td>.919</td>
<td>4.709</td>
<td>1</td>
<td>7.346</td>
<td>.030</td>
</tr>
</tbody>
</table>
**Children without delays.** The second binary logistic regression analysis was conducted with the group of children without delays. In this analysis only two of the three child characteristics were included (gender and age) because child health status did not have a significant association with agreement in the bivariate analysis. In addition, only two of the four family characteristics that were found statistically significant in the bivariate analyses were included in the model (family income and maternal age). Both child characteristics were significant. Child gender for the group of children without delays was shown to be associated with agreement status (OR = 2.277, df = 1, p = .009). Table 4.9 indicates that females were twice as likely to be correctly identified as non-delayed (True Negatives) than males. Likewise, child age was significant in predicting agreement between parent rating and developmental assessment (OR = .154, df = 1, p = .000). Children in the preschool group were seven times more likely to be accurately reported on by their parents than the infant toddler children. According to Cox and Snell and Nagelkerke estimates, between 12.6% and 20.8% of the variance in agreement is accounted for by this model, however the Hosmer and Lemeshow Test supports the fit of the model (p = .237). As with children with delays, two further models were run, including only one of the family variables in each, but the family variables were not found to be significant after accounting for child characteristics.

Results from the logistic regression analyses indicate that, for children without delays, agreement status (i.e., the rate of True Negatives, or specificity) was largely influenced by child gender and age group; none of the four family variables were found to be significant after accounting for child characteristics although there was an indication of some association from the bivariate analyses. Therefore, further sub-analyses were conducted on gender-specific and age-specific sub-samples of the children without delays, in order to further explore possible
relationships between agreement status and family characteristics. Similar sub-analyses could not be completed with the group of children with delays because of the smaller number of children with delays (52 vs. 343).
Table 4.9  
Results from the Logistic Regression Analyses: Child and Family Characteristics that Predict Agreement between the NDDS and the SB5, BSID-2, and the PPVT-III in Children without Delays (n = 343)

<table>
<thead>
<tr>
<th></th>
<th>B</th>
<th>SE</th>
<th>Wald</th>
<th>df</th>
<th>OR</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Child Characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender (1 = Female, 0 = Male)</td>
<td>.823</td>
<td>.313</td>
<td>6.900</td>
<td>1</td>
<td>2.277</td>
<td>.009</td>
</tr>
<tr>
<td>Age (1 = Preschool, 0 = Infants/Toddlers)</td>
<td>1.954</td>
<td>.397</td>
<td>24.236</td>
<td>1</td>
<td>7.059</td>
<td>.000</td>
</tr>
<tr>
<td><strong>Family Characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LICO (1 = ( \leq ) LICO, 0 = ( &gt; ) LICO)</td>
<td>-.165</td>
<td>.410</td>
<td>.161</td>
<td>1</td>
<td>.848</td>
<td>.688</td>
</tr>
<tr>
<td>Maternal Age (1 = ( \leq ) 22 years, 0 = ( &gt; ) 22 years)</td>
<td>-.210</td>
<td>.354</td>
<td>.352</td>
<td>1</td>
<td>.810</td>
<td>.553</td>
</tr>
</tbody>
</table>
Sub-analysis by Gender for Children without delays. Maternal age predicted agreement when analyzing the sub-sample of females without delays (OR = .293, df = 1, p = .022). For the sub-sample of females without delays, mothers who began childbearing prior to 23 years were only 29.3 % as likely to correctly identify their children as not delayed (True Negatives) as older mothers. However, for the sub-sample of males without delays, none of the family characteristics were significantly associated with agreement status (i.e., True Negatives). Refer to tables 4.10 and 4.11 for details.
Table 4.10
Family Characteristics that Predict Agreement between the NDDS and the SB5, BSID-2 and the PPVT-III in Female Children who are not Delayed (n = 179)

<table>
<thead>
<tr>
<th>Family Characteristics</th>
<th>B</th>
<th>SE</th>
<th>Wald</th>
<th>df</th>
<th>OR</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maternal Education (1 = ≤ HS, 0 = HS +)</td>
<td>-.125</td>
<td>.597</td>
<td>.044</td>
<td>1</td>
<td>.883</td>
<td>.834</td>
</tr>
<tr>
<td>Family Income (1 = ≤ LICO, 0 = ≥ LICO)</td>
<td>-.558</td>
<td>.635</td>
<td>.773</td>
<td>1</td>
<td>.572</td>
<td>.379</td>
</tr>
<tr>
<td>Family Structure (1 = one-parent, 0 = two-parent)</td>
<td>-.848</td>
<td>1.00</td>
<td>.719</td>
<td>1</td>
<td>.428</td>
<td>.396</td>
</tr>
<tr>
<td>Maternal Age (1 = ≤ 22 years, 0 = &gt; 22 years)</td>
<td>-1.227</td>
<td>.537</td>
<td>5.219</td>
<td>1</td>
<td>.293</td>
<td>.022</td>
</tr>
</tbody>
</table>

Table 4.11
Family Characteristics that Predict Agreement between the NDDS and the SB5, BSID-2 and the PPVT-III in Male Children who are not Delayed (n = 148)

<table>
<thead>
<tr>
<th>Family Characteristics</th>
<th>B</th>
<th>SE</th>
<th>Wald</th>
<th>df</th>
<th>OR</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maternal Education (1 = ≤ HS, 0 = HS +)</td>
<td>-.351</td>
<td>.530</td>
<td>.439</td>
<td>1</td>
<td>.704</td>
<td>.508</td>
</tr>
<tr>
<td>Family Income (1 = ≤ LICO, 0 = ≥ LICO)</td>
<td>-.346</td>
<td>.662</td>
<td>.273</td>
<td>1</td>
<td>.707</td>
<td>.601</td>
</tr>
<tr>
<td>Family Structure (1 = one-parent, 0 = two-parent)</td>
<td>.033</td>
<td>.947</td>
<td>.001</td>
<td>1</td>
<td>1.033</td>
<td>.972</td>
</tr>
<tr>
<td>Maternal Age (1 = ≤ 22 years, 0 = &gt; 22 years)</td>
<td>.028</td>
<td>.490</td>
<td>.003</td>
<td>1</td>
<td>1.029</td>
<td>.954</td>
</tr>
</tbody>
</table>
Sub-analysis by Age Group for Children without delays. When the sub-sample of children in the preschool age group was analyzed, maternal age was the only family characteristic found to be statistically significant (OR = .164, df = 1, p = .020). Younger mothers are only 16.4% as likely as older mothers to accurately report True Negatives (non-delays) for 36-month old children. Therefore, younger mothers were less likely to identify True Negatives than older mothers for preschool children. None of the family characteristics were found to be statistically significant for the infant/toddler group (ages 4, 18 or 24 months old). Refer to tables 4.12 and 4.13 for detail.
Table 4.12
Family Characteristics that Predict Agreement between the NDDS and the SB5, BSID-2 and the PPVT-III in Preschool Children who are not Delayed (n = 161)

<table>
<thead>
<tr>
<th>Family Characteristics</th>
<th>B</th>
<th>SE</th>
<th>Wald</th>
<th>df</th>
<th>OR</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maternal Education (1 = ≤ HS, 0 = HS +)</td>
<td>19.000</td>
<td>9229.035</td>
<td>.000</td>
<td>1</td>
<td>1.8E+008</td>
<td>.998</td>
</tr>
<tr>
<td>Family Income (1 = ≤ LICO, 0 = ≥ LICO)</td>
<td>18.427</td>
<td>15896.799</td>
<td>.000</td>
<td>1</td>
<td>1.0E+008</td>
<td>.999</td>
</tr>
<tr>
<td>Family Structure (1 = one-parent, 0 = two-parent)</td>
<td>-1.659</td>
<td>25342.850</td>
<td>.000</td>
<td>1</td>
<td>.190</td>
<td>1.000</td>
</tr>
<tr>
<td>Maternal Age (1 = ≤ 22 years, 0 = &gt; 22 years)</td>
<td>-1.808</td>
<td>.780</td>
<td>5.376</td>
<td>1</td>
<td>.164</td>
<td>.020</td>
</tr>
</tbody>
</table>

Table 4.13
Family Characteristics that Predict Agreement between the NDDS and the SB5, BSID-2 and the PPVT-III in Infant/Toddler Children who are not Delayed (n = 166)

<table>
<thead>
<tr>
<th>Family Characteristics</th>
<th>B</th>
<th>SE</th>
<th>Wald</th>
<th>df</th>
<th>OR</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maternal Education (1 = ≤ HS, 0 = HS +)</td>
<td>-.235</td>
<td>.412</td>
<td>.324</td>
<td>1</td>
<td>.791</td>
<td>.569</td>
</tr>
<tr>
<td>Family Income (1 = ≤ LICO, 0 = ≥ LICO)</td>
<td>-.124</td>
<td>.463</td>
<td>.072</td>
<td>1</td>
<td>.883</td>
<td>.788</td>
</tr>
<tr>
<td>Family Structure (1 = one-parent, 0 = two-parent)</td>
<td>-.252</td>
<td>.690</td>
<td>.133</td>
<td>1</td>
<td>.778</td>
<td>.715</td>
</tr>
<tr>
<td>Maternal Age (1 = ≤ 22 years, 0 = &gt; 22 years)</td>
<td>-.039</td>
<td>.378</td>
<td>.010</td>
<td>1</td>
<td>.961</td>
<td>.919</td>
</tr>
</tbody>
</table>
To summarize the analyses for research question three, statistically significant predictors were present for child characteristics in both sub-samples of children with delays and those without delays. In the sub-sample of children with delays, male gender and younger child age lead more often to the identification of True Positives, but child health was not predictive of agreement between the NDDS and the developmental assessment. For the sub-sample of children without delays, child gender and age were also predictive of agreement. Female gender lead more often to true positives while the preschool age group lead more often to True Negatives. When only a single family characteristic was included in the model, low family income was found to be associated with higher rates of agreement for children with delays, but no family characteristics were found to be statistically significant for the non-delayed group after accounting for child characteristics.

The sub-analyses by child gender and child age in children without delays, provided further information about the influence of family characteristics on agreement status. When all four family characteristics were included in the logistic regression model, young maternal age at first childbearing was found to be associated with agreement status for female children who are not delayed and preschool children who are not delayed. That is, younger mothers were less likely than older mothers to correctly identify their female children as not delayed and less likely to identify their preschool children as not delayed (i.e., lower rates of True Negative results, or lower specificity).

Summary

In Chapter Four, the statistical analyses and findings for three research questions were reported. Bivariate analyses, using the Chi-Square statistic to examine associations among child and family characteristics and parent report of delays, were conducted on data from children with
delays and then on data from children without delays. Child gender and child age were associated with agreement status for both children with delays and children without delays; but child health was associated with agreement status only for children with delays. Regarding family characteristics, maternal education and family income were found to be associated with agreement status for children with delays, whereas family income and maternal age were associated with agreement status for children without delays. Family Structure was not related to agreement status for either group of children. In summary, True Positive results were more likely to be found for male children and infants and toddlers, children in less than excellent health, children whose mothers have not completed any education beyond high school, and those who live in families with incomes below LICO. True Negative results were more likely to be found for female children and preschoolers, children whose mothers began childbearing at after 22 years of age, and those who live in families with incomes above LICO.

A multivariate analyses, using binary logistic regression, was conducted to examine the best predictors of accurate parent report were conducted on sub-samples of children with delays, and children without delays. For both groups of children, child gender and age were significantly associated with agreement status, and in the same direction as with the bivariate analysis. No family characteristics were found to be statistically significant for the sub-sample of children without delays after accounting for child characteristics. However, low family income was found to be associated with a greater likelihood of agreement (True Positives) for the sub-sample of children with delays, even after accounting for child characteristics, but only when it was the only family variable entered into the model. Children of families with incomes lower than LICO were more likely to be identified as delayed than children of families with incomes above LICO.
Lastly, separate sub-analyses were run, using only the sub-sample of children without delays, grouped by gender and child age, to further investigate the potential influence of family characteristics. Maternal age was the only family characteristic found to be significantly associated with agreement status, but only for female children and preschool children. Mothers who began childbearing at an earlier age were less likely than older mothers to correctly identify their female children as not delayed and less likely to identify their preschool children as not delayed (i.e., lower rates of True Negative results, or lower specificity). Thus, in contrast to the results found through bivariate analysis, after accounting for child characteristics, family income was not found to predict agreement status for the children without delays.

In conclusion, hypotheses were partially supported. It was hypothesized that for the child characteristics higher rates of True Positive and True Negative results would be obtained for the older children (preschool age), females, and children with no health concerns. The results from the bivariate analyses support hypotheses for gender and age for children without delays (True Negatives). However, for the children with delays (True Positives), results were opposite to the hypotheses for gender and age. For the family characteristics it was hypothesized that older maternal age (age 23 or older at the birth of the first child); higher maternal education (greater than high school), mothers in two-parent families, and those with a family income greater than LICO would be associated with higher levels of agreement. Again, the hypothesized True Negatives were supported by the results for family income and maternal age, but not the hypotheses (True Positives) for the group with delays.

These findings indicate the sensitivity and specificity rates for the NDDS vary largely by child gender and age, but that some family characteristics (specifically, family income and maternal age) also were associated with the likelihood of achieving True Positive and True
Negative results. Implications of these results are investigated in Chapter Five, where further expansion of these results to the field of research are discussed. In addition, limitations to the study will also be discussed.
Chapter Five: Discussion

This study provided information about family and child characteristics which may influence the outcomes of parent reported developmental screening instruments. In this chapter, an expansion of the findings in Chapter Four is discussed according to each research question. Implications of these conclusions as they relate to clinical and research issues will be explored, and limitations and strengths of this study will be discussed. Directions for future research will be outlined and important contributions to the field will also be discussed.

Overall, hypotheses were partially supported. Findings from bivariate analyses indicated that the hypotheses did not hold for the sub-groups of children with delays for either child or family characteristics; indeed, significant but contrary relationships were found for gender, child health status, maternal education, and family income. However, for the sub-group of children without delays, the hypotheses were supported for child gender, age, family income, and maternal age. Child gender and child age were also found to be significant in the binary logistic regression analyses both for children with delays and children without delays. However, after accounting for child gender and age, only family income was significant in the group of children with delays. Finally, in the sub-analysis for children without delays, maternal age was significant but for only females and preschool children.

Research Question One

The first research question explored the associations between parent report on the NDDS and child characteristics using chi-squared statistics. Results indicated several significant relationships both in the sub-sample of children with delays and the sub-sample of children with no delays.
**Child gender.** Results from the bivariate analysis also provided significant associations for child gender and accuracy of parent report on the NDDS. In the sub-sample of children with delays, parents reported more True Positives for males than for females, while in the sub-sample of children without delays parents reported more True Negatives for females than for males. While there are few studies on the influence of child gender on parent report of development, some researchers have found that males are referred more than females in a variety of settings (McKay, Shannon, Vater, & Dwokin, 2006; Tervo, 2006). This is consistent with both the higher rates of True Positives and the lower rate of True Negatives found in this study. On the other hand, it is unclear why there is such a low rate of True Positive results for female children. It is possible that questions on the NDDS are more suitable to recognizing male delays because they are based on observable behavior that is more typical among male children.

**Child age.** Parents were more likely to report True Positive screens for infants and toddlers than for preschool children and more likely to report True Negative screens for preschoolers. Thus, both True Positive and False Positive screening results are more common among younger children. Diamond and Squires (1993) conducted a review of studies focusing on maternal report and the equivocal relationship with child age. Their findings were mixed; providing evidence that some mothers had greater accuracy with older children, some with younger children, and that some studies provided evidence of no link to child age. However, in their validation study for the Ages and Stages Questionnaire (ASQ), Squires et al. (1999) provided evidence of lower sensitivity for younger children. Earlier research by Glascoe and MacLean (1990) also contradicts findings from the present study. Findings from their study investigating parent appraisals showed that parent concerns were more frequently found for older rather than younger children. Tervo (2006) also found that parents of older children had more
concerns than parents of younger children. Although in the current study parents of preschool children without delays were accurate at reporting their child’s development, parents of preschool children with delays were less accurate in their reports than parents of infants and toddlers. It seems surprising that parents of preschool children would be less accurate in identifying delays. As Glascoe (1990) pointed out, children are more likely to be identified when they are older because there are more developmental milestones to be assessed than for younger children.

Limitations of the NDDS as a screening instrument at the preschool age level can not be ignored. The number of preschool children accurately identified by their parents is surprisingly low which suggests concerns regarding the screening instrument for use in that age group. In the literature, lower sensitivity rates are usually found for younger children. For example, the Denver Developmental Screening Test, 2nd edition, and the Ages and Stages Questionnaire have limited items for the infant and toddler age groups, therefore making the domains of development less clear and more complicated to interpret at this age (Dahinten & Ford, 2004; Frankenburg, 1994; Squires et al., 1999).

**Child health status.** Results for child health found that children with delays, whose parents reported their health as ‘less than excellent’ were more likely to be reported as true positives than children who were considered to be in excellent health. Children with excellent health were significantly under-identified as True Positives. Once more, there is limited research into the influence of child health status and its relationship to parent accuracy in reporting on development. However, Glascoe (1990) found that many parents who were inaccurate in their report on development tended to have children with prior health concerns. Therefore, the results have led some to believe that parents who have health concerns for their child may be less
accurate in reporting on development because they mistake developmental concerns for health concerns, which leads to lower rates of True Negatives. Tervo's findings (2006) also suggested that parents tend to mistake developmental problems for health problems leading to under-identification (False Negatives vs True Positives). Thus, the limited research findings in previous literature are inconsistent with the findings of the present study. In the current study, parents who had health concerns for their children were actually more accurate in reporting on delays. However, in the sub-sample of children without delays there was no significant association between health status and parent accuracy. It seems that in this sample, health concerns may have aided parents in reporting accurately when children were developmentally delayed.

Research Question Two

The second research question explored the associations between parent report on the NDDS and family characteristics using chi-squared statistics. Results showed several significant relationships both in the sub-sample of children with delays and the sub-sample without delays.

Maternal education. Results from the bivariate analyses provide evidence of a significant association between maternal education attainment and parent accuracy on the NDDS in the sub-group of children with delays only. Mothers who had a high school education or less were more likely to report True Positives than mothers with higher levels of education, although they were less likely to report True Negative results. This result for the sub-sample of children with delays was surprising. Although there has been little investigation of maternal educational attainment having influence on the accuracy of parent reporting, early studies provided by Glascoe and Dworkin (2005) showed that mothers with higher levels of education were more accurate in their reports of child development.
Results from the current study for the sub-sample of delayed children contradict Glascoe and Dworkin’s findings and the hypothesis for this study. It is unknown why mothers with lower levels of education were likely to report True Positives. Research provides evidence that highly educated parents read more about development and seek advice from pediatricians more regularly than lower educated parents, who rely more on social comparisons with other children to assess their child’s development (Glascoe & MacLean 1990). One must ask if these mothers were being socially desirable by not reporting delays they may have noticed. Parenting is a difficult job and no parent wants to suspect or be told that their child may have a developmental delay. Therefore, it is reasonable that these mothers may feel ashamed, scared, or even in denial that their child could have a developmental delay. Weiner (1974) conducted studies involving attribution theory. Mothers who may suspect delays may attribute the problem to them or feel responsible due to any number of reasons (self-serving bias); therefore, it is reasonable to consider that the mothers in this study knew there was something wrong but for any number of reasons did not report their concerns on the screening instrument.

For the sub-group of children without delays (True Negatives), maternal education neared significance, a trend that would be expected from the literature. Again, studies supporting a connection between low levels of education and accuracy on reporting development are scarce and contradictory depending on the decade the studies were completed (Glascoe & Dworkin, 1995). The research cited by Glascoe and Dworkin reported that mothers of low educational attainment tended to miss developmental delays when they are present, not over report them as the mothers did in the current study. However, research supports the idea that mothers with less education may have less knowledge of development (Stanton-Chapman, Chapman, & Scott, 2001), and may use social comparisons more than higher education mothers
(Glascoe and MacLean 1990). Therefore, it is also possible that the mothers from the sub-sample of children with no delays simply were comparing their children to others unfavorably. Furthermore, these mothers, as stated by Bowman (1992), may not understand the processes of development and if comparing to other children, may not be looking for the correct developmental milestones.

**Family income.** Results for family income were similar to that for maternal education. Parents with family incomes below the Low Income Cutoff (LICO) were more likely to report True Positive results than parents above LICO, but less likely to report True Negative results. The former results were surprising. The parents with higher socio-economic status were more likely to be inaccurate at identifying delays than lower SES parents. Research has provided mixed results for this family characteristic as well. McLoyd (1990), provided evidence that parents of low income and low socioeconomic status demonstrated a lower capacity to cue into their children’s social-emotional needs, and were less likely to provide a supportive, caring and consistent environment for their children. Many more recent studies suggest that that SES is no longer as influential on accuracy of parent reported developmental screening instruments because the psychometric characteristics of screeners have improved (Glascoe, 1999). However, as discussed in Chapter 2, there are concerns with the statistical analysis in many of the studies that examine SES. Therefore, drawing conclusions such as, SES has no influence on accuracy, may be incorrect.

Although a statistical association is present, it is difficult to speculate why higher income families would not identify developmental delays for the same reasons as outlined for maternal education: higher SES families have more resources, more stimulating environments (Hamilton, 2006), and are generally better informed about the developmental process than lower SES
families (Bowman, 1992). Therefore, it is puzzling why the higher SES parents in the present study were inaccurate in identifying delays, but accurate in identifying normal development (as the literature predicts). Again, social desirability may be an issue. Interview methods to engage parents with inaccuracies and learn more about why they reported the way they did may provide insight.

**Family structure.** Unlike maternal education and family income, partner status was not found to have a statistically significant association with parent accuracy on the NDDS. Although the literature supports the idea that single mothers might have a more difficult time accurately reporting on child development than partnered mothers, the association was not found in this study among either sub-group. This is not surprising given the small number of single mothers (n = 20) that were in the study. The sub-sample size for single mothers as compared to mothers who were married or had a partner was much smaller and was not large enough for meaningful statistical analysis. High-risk populations are not always well represented in these studies, and therefore, investigating single motherhood as a characteristic that could influence accuracy on developmental screens is still worthwhile (Dichdeltelmiller et al, 1992; Henderson & Meisels, 1994; Tervo, 2005). In the future, it would be beneficial to have a more balanced population of single and married mothers to better understand the influence of family structure on accuracy of parent reporting.

**Maternal age.** The last family characteristic analyzed in the bivariate analyses was maternal age. Results showed for the sub-sample of children with delays there was no significant association between maternal age at first birth and parent accuracy on the NDDS. However, a significant association was found for maternal age in the sub-sample of children without delays. Mothers older than age 23 were more likely to report True Negatives than
younger mothers. This was an interesting result, consistent with the literature, and the research hypothesis. Although the literature is limited in research relating to maternal age and accuracy of parent reporting on development, findings by Tamis-Lemonda, Shannon, and Spellman (2002) indicated that adolescent mothers were more likely to believe that developmental milestones happened earlier than they actually do. This would lead us to expect lower levels of True Negatives among younger mothers, as was found in the present study.

Research Question Three

In the third research question the likelihood that child and family characteristics could predict agreement between the results of the developmental screening instrument (NDDS) and the results from the professional assessment (the SB5, the PPVT-III, and the BSID-2) was examined. A binary logistic regression was used to analyze the sub-sample of children with delays and the sub-sample of children with no delays. Additional sub-analyses were run to investigate the significance of child characteristics for the sub-sample of children without delays (age and gender) focusing on family variables.

For both groups of children, child gender and age were significantly associated with agreement status and in the same direction as with the bivariate analysis. In future studies it would be beneficial to study the response patterns for parents of boys. For example, in terms of the NDDS, did the parent tend to answer "no" to the questions focusing on social emotional development more than questions related to cognition, language, or motor? If so, do these males really have developmental delays or should they be referred for psychological evaluation for mental health problems? For child age, this information will be useful for developers of the NDDS and for the developers of other developmental screening instruments. More response
choices than “yes” or “no” may be useful for this age group as developmental milestones for the very young children seem more difficult to differentiate between accurately.

No family characteristics were found to be statistically significant for the sub-sample of children without delays after accounting for child characteristics. However, low family income was found to be associated with greater likelihood of agreement (True Positives) for the sub-sample of children with delays, even after accounting for child characteristics, but only when it was the only family variable entered into the model. Children and families with incomes lower than LICO were more likely to be identified as delayed than children of families with incomes above LICO. Again, there is a lack of evidence in the literature to support these findings, especially given that many studies for other developmental screening instruments do not divide the groups into children with delays and children without delays, rather they compare families of low income and middle to high income within an overall group of children. The results from this study are unique because even with the small number of children with delays (N = 52), findings provided evidence that low-income families were more accurate at identifying delays. Recent research supports the finding that low income parents are accurate at reporting delays (Glascoe, 1999; Squires et al., 1999). Overall, these findings provide evidence that family income is worth further investigation with other developmental screening instruments.

Sub-analysis for children without delays. The sub-analyses were conducted solely on the sub-sample of children without delays. Further sub-analyses were conducted on gender-specific and age-specific sub-samples of the children without delays, in order to further explore possible relationships between agreement status and family characteristics. Similar sub-analyses could not be completed with the group of children with delays because of the smaller number of children with delays (52 vs. 343). Maternal age was the only family characteristic found to
significantly associated with agreement status, but only for female children and preschool children. Thus, in contrast to the results found through bivariate analysis, after accounting for child characteristics, family income was not found to predict agreement status for children without delays.

What is exciting about these findings is that with greater numbers of children, it may be possible to find significant results among the family characteristics after accounting for child age and gender, which influence sensitivity and specificity. Maternal age is widely researched in the literature. Bronfenbrenner’s (1994) work provides evidence that teenage mothers are at risk for low education levels, single parenthood, and poverty, but this does not provide evidence of inability to accurately report developmental delays. The results from the sub-analyses provide the evidence needed to make the link between maternal age and accuracy on parent completed developmental screening instruments.

Limitations of the Study

The current study had three limitations. First, the sizes of the sub-samples were less than optimal. Second, there are limitations to the NDDS. Third, the extent to which the results can be generalized to other populations is restricted. These limitations are discussed below.

Sample Size

Overall, the sample size for the current study was acceptable. However, for the analyses sub-samples were created to investigate the differences between children with delays and those without. Therefore, the sub-sample of children with delays was small (n = 52). The small sample size resulted in limited ability to detect statistically significant relationships between family characteristics and agreement with the NDDS and professional assessment even when clinically meaningful associations existed. This was not just the case for the family characteristics, but also
for child health status. Although child health status proved valuable in the bivariate analysis, the numbers did not support significant statistical analysis in the multivariate analysis.

Limitations of the NDDS

The current study used the NDDS for the developmental screening instrument and the BSID-2, or the SB5 and the PPVT-III as criterion measures. To date, there has been little validation of the psychometric properties of the NDDS. The study completed in 2002 (Nagy, Ryan, & Robinson, 2002) used the ASQ as the criterion measure and focused on the concurrent validity of only the 12-month version. The study by Dahinten and Ford found that the NDDS performed well for 18-month olds, but that sensitivity rates for other age groups tended to be lower than the 70% used as an acceptable cutoff for sensitivity in the field. Dahinten and Ford (2004) suggested that the NDDS is “effective at identifying children with severe delays, but is less effective at identifying children with milder delays” (pg. 12). Therefore, one might question the role child age actually plays on parent accuracy and what is potentially a more inherent problem within the developmental screening instrument at the infant and toddler age group and at the preschool age group from the findings of the current study. Lastly, the results of this study may not generalize to another developmental screening instrument.

Ability to Generalize to a Larger Population

The current study was conducted using secondary data from three separate validation studies of the NDDS at the 4, 18, 24 and 36 month ages. All the parents and children involved were recruited from two small suburban middle-class communities in Southeastern British Columbia, Canada. The results from the current study may not generalize to large urban environments. In addition, as with much research, the families were self-selected. Although the response rates were satisfactory, it is very possible that the parents who took part in the studies
were different from the parents who chose not to respond and take part in the studies. It is even difficult to generalize results to parents outside the study who have taken part in developmental screening using the NDDS. Some of the families had already completed the part of well child visits. Many communities across southern British Columbia use the NDDS at earlier age groups through local health centres where they were given the NDDS as part of their community-based health. Therefore, potential bias could be implicated because parents may have already been given information about their child's development.

Strengths of the Study

Although three limitations of the study were outlined above, the current study had several strengths. First, the need for this kind of research in the developmental screening will be discussed, the need for further research on the NDDS, and finally, the approach to data analysis.

As stated in the literature review, little is known about how family characteristics influence parent accuracy on developmental screening instruments in general. Many studies use high risk populations in the standardization samples, but do not analyze if these family characteristics actually influence parent accuracy on reporting child development. This study has taken the data from two validation studies on the NDDS and provided evidence that family and child characteristics do influence accuracy on the NDDS.

The NDDS is a relatively new developmental screening instrument; therefore this study has provided more needed research to validate its use with parents. In addition, developers claim that it is parent friendly. This study has provided evidence useful to the developers about high risk populations of parents, and which age groups are likely to elicit the most accuracy from parents.
The current study is novel in that the investigation of parent accuracy was completed without combining both the delayed sub-sample and the non-delayed sub-sample as most other studies have done when investigating accuracy of developmental screening instruments. Often the number of children with delays is small and therefore researchers combine the groups into one “total agreement” category to run analyses. Another approach that has been used in other literature is to focus on whether or not parents have concerns, but without identifying whether or not the children actually have delays. In this study two distinct groups; children with delays, and children without delays were kept separate for all analyses providing new evidence of how family characteristics influence accuracy on the NDDS.

Implications for Further Research

Future research in this area should include the continued investigation of family and child characteristics that may influence parent accuracy on parent reported developmental screening instruments, especially using larger sample sizes to look at these variables. Although the child characteristics (child gender and age) revealed significant results consistent with the literature in the field, child health and the majority of family characteristics were not found to play a significant role in parent accuracy after accounting for variance in sensitivity and specificity by child gender and age. This implies further need for investigation into the advancement of developmental screening instruments, as well as family characteristics in general. It would be advantageous to examine the theoretical underpinnings that drive the study of certain family characteristics such as high-risk parents; for it may not necessarily be the parent that is the problem but rather an inherent problem with the screening instrument itself (Dahinten & Ford, 2004; Dichtelmeier et al., 1992; Frankenburg, 1994). Other family characteristics may be valuable to investigate as well. In this study, maternal depression was only measured in the 36-
month-old group and therefore was not ultimately used in the analysis. However, maternal depression has been found to have effects on the development of children at all ages (Johnson & Flake, 2007). Because little research exists about a depressed mother’s ability to report on her child’s development it would be an additional important characteristic to investigate in future research.

In addition, as stated in the limitations of the study section, the NDDS as well as other developmental screening instruments have low sensitivity numbers for infants and toddlers; therefore, it would be valuable to continue to investigate child age as a factor in all developmental screening instruments. In this study, the preschool age children had very low sensitivity and further investigation of these results would be worthwhile for researchers interested in use of the NDDS with this age group.

As stated previously, it could be beneficial to take a qualitative look at the NDDS data. For example, the chi-squared hypothesis testing provided a significant association between child gender and parent accuracy on the NDDS. Specifically, males were more likely to be reported as delayed (True Positives) and females were more likely to be identified as True Negatives. It would be beneficial to investigate item response by the parent for these children. Recent research provides evidence that males are often referred more for behavior and attention problems more than females are (Tervo, 2006). A study focusing on the social and emotional ratings of parents and gender of the child may help shed light on the gender influence found in the current study.

Building on a qualitative study that investigated item response, it would be interesting to understand why the mothers with higher education and higher income were more likely to be inaccurate for children with delays. For this question, a social psychology theoretical
perspective may be beneficial. For example, as related to Glascoe and MacLean (1990), is social comparison driving these ratings? One might hypothesize that this sub-group of mothers have higher expectations than are reasonable for these children and that is why they are not rating their children as delayed as often as mothers with lower education and lower incomes.

Contributions to the Field

The present study provides several important contributions to the fields of developmental screening, school psychology, and health care. First, this study is unique in that accuracy was investigated according to whether the child was delayed or not delayed. In previous research to date most studies look at overall agreement and do not look at accuracy in sub-groups. Second, results from the current study were that child characteristics (child gender and age) influenced accuracy of parent report on child development. These results will add to the growing research in the development of more accurate, and parent friendly developmental screening instruments. Specifically, researchers now have further evidence that not only are males referred more often for a variety of services (McKay, Shannon, Vater & Dwokin, 2006; Tervo, 2006), but that male gender is likely to influence parental report, especially increasing the chances of True Positive screening results. In addition, the current study lends support to those who claim parents of older children are more accurate in identifying normal development (Glascoe & MacLean, 1990; Tervo, 2006).

Furthermore, the current study lends support to the notion that maternal age is influential in parent accuracy of parent report. Given that many validation studies for developmental screening instruments have data on young mothers, the findings from the current study may incite further investigation into the influence of maternal age on accuracy of parent reporting.
Contributions to other fields are evident as well. For example, the field of school psychology relies heavily on parent report, especially for social and emotional, and behavior rating scales. Therefore, understanding influences on parent accuracy are important for school psychologists to be aware of when conducting psycho-educational assessments. Furthermore, many school psychologists are becoming more involved in early intervention services and therefore will be exposed to the preschool population. School psychologists hold a unique position when it comes to evaluating young children. Unlike developmental screening in general, school psychologists have more of an opportunity to interview the parents and form a more long-term, professional relationship with them to facilitate accuracy on parent completed rating scales. Even so, the increasing number of children being referred for early intervention services will increase the case loads for school psychologists. Therefore, understanding what characteristics may influence parent accuracy will be important for the school psychologist.

Lastly, these findings are valuable for health care providers in general. The results of the current study provide strong evidence for more community-based services to target parents to educate them about child development. Public health nurses and physicians can be prepared to provide more support for parents of young children and young mothers.

Conclusions

In conclusion, parent reported developmental screening instruments are gaining respect and usage across North America, Western Europe, and Australia. Just as professional tests for child development have a margin of error; parents are not always accurate in their report of child development on these developmental screening instruments and developmental screening is expected to be less accurate than diagnostic tests. This study investigated the child and family characteristics that may influence a parent's ability to accurately report child development on the
Nippising District Developmental Screen, a new screening instrument developed in Canada now used throughout North America. Although findings were mixed, many of the results from this study provide evidence that child and family characteristics play a role in the accuracy of a parent to report development. As research continues on the advancement of developmental screening and the role of child and family characteristics it is hoped that results of the current study are used to better inform researchers in the field.
References


