Parenting stress in parents of children with cochlear implants: Relationships between parent stress, child language, and unilateral versus bilateral implants

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Abstract

Little attention has been focused on stress levels of parents of children with cochlear implants (CIs). This study examined the stress experience of 70 parents of children with CIs by comparing stress levels in this group of parents to those in parents of children without disabilities, identifying primary stressors, examining the relationship between parent stress and child language, and comparing stress in parents of children with bilateral and unilateral CIs. Parents completed a parent stress questionnaire, and the receptive vocabulary and language abilities of the children were evaluated. Results indicated that these parents had a higher incidence of stress than the normative population. Parent stress levels and child language outcomes were negatively correlated. Child behaviour and lack of spousal and social support were the prime causes of parent stress. Parents of children with bilateral CIs were significantly less stressed than were parents of children with unilateral cochlear implants.

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Parent stress in families of children with hearing loss

The diagnosis of hearing loss in a child is often a very difficult time for parents with normal hearing (Burger, Spahn, Richter, Eiselle, Lohle & Bengel, 2005). The grieving process undergone by parents of children with hearing loss has been described as being continuous, with trigger events reminding parents of the discrepancies between their expectations for their child and their child's actual performance contributing to ongoing emotional stress (Kurtzer-White & Luterman, 2003). Parents also face ongoing practical challenges, including an increased number of specialist medical and audiological appointments, appointments with other professionals, and that of managing the hardware of hearing aids and/or cochlear implants. When children are old enough to attend preschool and school, there may be educational challenges, both in terms of the child's rate of progress, and also with regard to access to appropriate services, particularly for country children for whom there may not be an ideal school setting or professional support readily available. Parents also have the ongoing experience of having a child who is 'different,' and need to be their child's advocate, explaining to others their child's hearing loss and associated needs.

The literature shows mixed findings regarding whether there are higher stress levels in parents of children with hearing loss compared to those of children with normal hearing. In critically evaluating these reports, it is useful to compare the results of studies conducted prior to early identification of hearing loss and those conducted after early identification, as this has changed age at diagnosis and age at access to early intervention for children, both of which have significant effects on the experience of parents. Prior to the introduction of early identification, three studies compared parent stress in families of children with hearing loss to that experienced by families of children with normal hearing. The first of these studies evaluated parent stress for matched pairs of nine-month-olds and found no significant difference in stress levels between the groups (Meadow-Orlans, 1994), while both of the

other studies reported increased parent stress in families of children with hearing loss (Quittner, Steck, & Rouiller, 1991; Quittner, Glueckauf, & Jackson, 1990). Of the three studies conducted after the introduction of early identification, two reported no significant difference in stress levels between parents of children with and without hearing loss (Lederberg & Golbach, 2002; Pipp-Siegel, Sedey, & Yoshinaga-Itano, 2002), and the third found higher stress levels in parents of children with hearing loss (Spahn, Richter, Burger, Löhle, & Wirsching, 2003). Only one of the six studies included children over the age of five years (Spahn et al., 2003), so little is known about parent stress in parents of older children who have benefitted from early identification, compared to stress in parents of children with normal hearing. The contradictory results in the literature have been ascribed to differences between studies in sample size, child age, degree of hearing loss, age at diagnosis, the different tools used to assess parent stress and also to the amount of support provided to parents (Pipp-Siegel et al., 2002; Quittner et al., 2010). Some parents whose children are diagnosed early and who receive good support report stress levels within the normative range (Lederberg & Golbach, 2002), while for other families, factors such as socioeconomic status, spousal relationships and personal problems are thought to influence parent stress more than does having a child with hearing loss (Hanson & Hanline, 1990). It is clear that the experience of having a child with a hearing loss can have varying effects on the coping ability of families.

Parent stress and child language development

A strong link between parent stress and child language development has been demonstrated in children with normal hearing (Gallagher, 1999). However, only one study has directly examined the relationship between parent stress and child language development outcomes in children with hearing loss (Quittner et al., 2010). Quittner and colleagues examined parent

stress and early language outcomes in children aged under 5 years, using the short form of the PSI (Abidin, 1995a) as a measure of general parent stress, and The Family Stress Scale (Quittner et al., 1990) as a measure of context-specific parenting stress. The study found that, although parents of children with hearing loss reported higher levels of context-specific parenting stress, their general stress levels were not elevated when compared with those of parents of children with normal hearing. Parents in this study listed communication difficulties, educational concerns, maintaining hearing aids and having to teach their children language as being high on their list of stressors. The children in this study showed higher rates of behaviour problems than did children with normal hearing, which appeared to be related to language delays. The authors postulated that language delays influenced parent stress through child behaviour problems. Children with significant language delays were thought to have difficulty with emotion regulation, attention and behaviour; however this was not directly tested. It was also suggested that children with language difficulties who struggled to express their needs would be more likely to become frustrated and behave badly, and may also struggle to understand instructions given by their parents. All of these factors could lead to increased communication difficulties. The finding of Barker and colleagues that language delays lead to increased behaviour problems in young children supports this theory (Barker et al., 2009).

Factors that affect stress in parents of children with hearing loss

Some of the child-related factors that may increase stress for parents of children with hearing loss that have been examined to date and that will also be considered in this study include child age, age at diagnosis, degree of hearing loss, social support, maternal education and income.

Regarding child age, although there is compelling evidence in families of children with normal hearing that parent stress often increases as children grow older and peaks in adolescence (Pasley & Gecas, 1984; Seginer & Somech, 2000), the limited literature on families of children with hearing loss is conflicting. Some studies report that as children age, parent stress increases (Hagborg, 1989; Konstantareas & Lampropoulou, 1995) and others show no effect of child age (Åsberg, Vogel, & Bowers, 2008; Holt, Beer, Kronenberger, Pisoni, & Lalonde, 2012). Most of this research has been focused on mothers in early childhood (e.g., Lederberg & Golbach, 2002; Meadow-Orlans, 1994; Quittner et al., 1990), with those studies that have included older children often reporting a wide age range and a relatively small number of older participants (e.g., Åsberg et al., 2008; Quittner et al., 1991; Zaidman-Zait, 2008). Given reports that parents of children with normal hearing often become more stressed as their child's age increases, it is possible that this could be exacerbated for parents of children with hearing loss, due to the increased communication, social, educational, and cognitive demands placed on children as they mature, and also the fact that the communication gap between children and their parents often becomes more obvious as communication expectations increase with increasing child age (Konstantareas & Lampropoulou, 1995; Lederberg & Mobley, 1990; Meadow-Orlans, 1994). An as yet unanswered question is whether mothers of older children feel more stressed than do mothers of younger children (Pipp-Siegel et al., 2002; Zaidman-Zait, 2008).

The effect of age at diagnosis on longer term stress is also unclear. Diagnosis before the age of 18 months has been linked to higher parent stress (Konstantareas & Lampropoulou, 1995), and this finding fits well with the theory that early diagnosis disrupts parent-child bonding and subsequent parent behaviour (Bess & Paradise, 1994). However, later diagnosis also contributes to poorer language development (Ali & O'Connell, 2007; Nicholas & Geers, 2007; Yoshinaga-Itano, Sedey, Coulter, & Mehl, 1998), which is a well-established cause of

ongoing parent stress (Chaffee et al., 1990; Quittner et al., 2010). Many studies have reported increased stress levels for parents of children with delayed language development, regardless of mode of communication (eg. Chaffee, Cunningham, Secord-Gilbert, Elbard, & et al., 1990; Hintermair, 2006; Pipp-Siegel et al., 2002; Zaidman-Zait, 2008). Further, Zaidman-Zait (2008) found that parents of older children with language delays appeared to be more stressed than did parents of younger children, due to communication difficulties.

Degree of hearing loss appears to be a relatively poor predictor of parent stress, with several studies showing no direct relationship between degree of hearing loss and parent stress levels (Åsberg et al., 2008; Calderon & Greenberg, 1999; Konstantareas & Lampropoulou, 1995; Spahn et al., 2003) and one study suggesting that hearing loss, mediated by language delay, increases the frequency of dysfunctional parent-child interactions and therefore increases parent stress (Quittner et al., 2010).

In terms of parent perceptions and characteristics, there is strong evidence that external and personal resources reduce stress for parents of children with hearing loss, with increased social support reducing stress in families (Åsberg et al., 2008; Calderon & Greenberg, 1999; Hintermair, 2004; Lederberg & Golbach, 2002; Meadow-Orlans, 1994; Pipp-Siegel et al., 2002). It has been reported that the effect of social support for mothers is so significant that the amount of support received contributes significantly to the quality of mother-child interactions (MacTurk, Meadow-Orlans, Koester, & Spencer, 1993). However, Quittner and colleagues (1990), who examined social support and parent stress in 96 mothers of children with hearing loss, found that although social support may act as a buffer at times of acute stress, it has less effect in situations of chronic stress, such as that of parenting a child with hearing loss. A further form of social support is spousal support; lower spousal support has been found to increase parent stress levels in families of children with normal hearing (Deater-Deckard & Scarr, 1996; Holden & Ritchie, 1991). Although increased stress related

to decreased spousal support in mothers of children with hearing loss has been reported (Hanson & Hanline, 1990), little attention has been focused on how much this factor contributes to overall parent stress levels.

Family factors such as parental income and maternal education have also been found to affect stress levels in parents of children with normal hearing, with decreased income and lower levels of maternal education increasing parental stress (Deater-Deckard & Scarr, 1996; Hoff, 2003; Sohr-Preston & Scaramella, 2006; Webster-Stratton, 1990). The literature on the effect of these demographic factors is equivocal, with these findings replicated in some studies (Holt et al., 2012; Pipp-Siegel et al., 2002; Zaidman-Zait, 2008), but not in others (Åsberg et al., 2008; Pipp-Siegel et al., 2002).

Children with Cochlear Implants

Less attention has been focused on parent stress in parents of children with cochlear implants (CIs), and it has been suggested that a closer examination of the effect of CIs on the parental stress experience be undertaken (Hintermair, 2006). Of the few studies undertaken to date, two studies examining stress in this group of parents reported elevated stress levels for these parents compared to those of children with normal hearing, including increased symptoms of depression and anxiety (Quittner et al., 1991; Spahn, Richter, Zschocke, Löhle, & Wirsching, 2001). However, a further study reported no difference in stress levels between parents of children with cochlear implants and parents of children with normal hearing (Horsch, Weber, & Detrois, 1997). A further finding of this latter study was that parents of implanted children reported lower stress than did parents of children with hearing loss who used hearing aids. More recent studies comparing the stress levels of parents of children with CIs and those of children with hearing aids provide conflicting information, Spahn and colleagues (2003) reported parents of implanted children to be more highly stressed and their families less

functional, while a further study found no difference in stress levels between the two groups (Åsberg et al., 2008). Although it is generally accepted that parent stress is highest immediately pre- and post-implant, there is no consensus as to whether parent stress levels in this population decrease over time post-operatively (Zaidman-Zait, 2008).

Bilateral cochlear implantation

A further factor that has not been examined to date is bilateral implantation. Bilateral CIs have been shown to improve many children's ability to perceive speech in quiet and noisy listening conditions and to localize sound (Galvin, Mok, Dowell, & Briggs, 2008; Johnston, Durieux-Smith, Angus, O'Connor, & Fitzpatrick, 2011; Lovett, Kitterick, Hewitt, & Summerfield, 2010; Scherf et al., 2007). Parents have identified other communication benefits of bilateral CIs such as reduced listening effort, improved communication within the family, reduced frustration and a more positive attitude (Fitzpatrick, Jacques, & Neuss, 2009; Scherf, Van Deun, van Wieringen, Wouters, Desloovere, Dhooge et al., 2009). Given that a great deal of the stress experienced by parents appears to be due to communication difficulties with their children (Quittner et al., 2010; Quittner et al., 1991; Zaidman-Zait, 2008), it is possible that improvements in children's communication abilities that may result from bilateral implantation might reduce parent stress levels.

Purpose of Study

As discussed earlier, little attention has been focused on the stress experience of parents of children with CIs. There is no consensus as to whether or not parents of children with CIs are more stressed than are parents of children in the general population. The relationship between parent stress and language outcomes has not yet been examined for school-aged children with early diagnosis and CIs, with only one study so far exploring this area in young

children (Quittner et al., 2010). There is also conflict in the literature regarding the influence of some factors on parent stress, such as child age. Whether parents of children with bilateral CIs have a different stress experience to those of children with unilateral CIs has also not yet been explored.

The following questions were addressed:

1. How do the stress levels of parents of school-aged children with cochlear implants compare to those of parents of children with normal hearing?
2. Is there a relationship between parent stress levels and child language development?
3. What are the highest reported stressors for parents of children in this age group with cochlear implants?
4. What factors influence parent stress?
5. Is there a difference in stress levels between parents of children with unilateral and bilateral cochlear implants?

Methods

Participants

Seventy parents and their children were recruited from three cochlear implant clinics and three early intervention centers in four states of the country, accounting for most of the country's pediatric CI-related service organisations and major intervention centers. Eighty-four percent of the country's population is located in the area from which the study sample was recruited. Of the eligible children in this area, 51.6% were recruited to the study. This figure is consistent with reported recruitment rates in the last decade for epidemiological studies (Galea & Tracy, 2007). Since December 2010, all babies born in Australia have been screened for hearing loss at birth under the Australian Government's Universal Newborn

Hearing Screening program. In Australia, 20 children per 10,000 live births are born with a congenital sensorineural hearing impairment. Those who receive a "refer" result from their screening (or who are detected later) attend a diagnostic service. If a hearing loss is diagnosed, children attend Australian Hearing for hearing aid provision and/or a CI service. Diagnostic and hearing aid services are funded by state and federal governments. Funding for at least one CI is provided in most states, and in all of the states from which participants for this study were recruited. Private health insurance covers the cost of a second CI, but in most states these are also government-funded, although there is awaiting list. For families who cannot afford private health insurance, community service clubs often raise money to assist with the cost of a second CI. All children with hearing loss are entitled to annual funding for early intervention through the federal government's "Better Start for children with disability initiative." The funding can be used to pay for early intervention services provided by a range of early intervention professionals who are members of the Better Start Early Intervention Service Provider Panel, and families can choose the services they access. Families who live in outer regional or remote areas are also eligible for a once-only additional payment, to cover additional expenses associated with accessing early intervention services.

Table 1 provides demographic information about the participants. The children were identified and implanted early (first CI by age 3.5 years and second CI (if bilaterally implanted) by age 6 years), came from a range of socioeconomic backgrounds, were aged 5 to 8 years, and had normal cognitive ability. The communication mode for all families was either spoken language only (n = 62) or primarily spoken language, with some sign used occasionally (n = 8). Forty-five children were aged five years and 25 were aged eight years of age at the time of assessment.

Eight of the participating children were singletons and 12 had three or more siblings. Seven families also included at least one other child with a hearing loss, or other diagnosis. The average age of parents was 37.5 years (*SD* = 4.4 years). Information about the paid occupation of the primary caregivers was coded using the Australian and New Zealand Standard Classification of Occupations (Cat. No. 1220.0 ANZSCO, First Edition Revision 1). This information was used as a proxy for socio-economic status (SES).

Procedure

The children in this study were participating in a wider project examining outcomes for children with cochlear implants. In keeping with the protocol of the wider project, assessment points were at five and eight years of age. Therefore, parent stress and child language development were assessed when the children were aged five and eight years. To ensure that children were entered into the analyses only once, the most recently collected data for each child was entered. The primary caregiver (68 mothers, 2 fathers) completed the Parenting Stress Index (Abidin, 1995a). All children were assessed using the Peabody Picture Vocabulary Test-4 (PPVT-4; (Dunn & Dunn, 2007). Language development for five-year-old children was assessed using the Preschool Language Scale-4 (PLS-4; Zimmerman, Steiner, & Pond, 2002) and for eight-year-olds, the Clinical Evaluation of Language Fundamentals (CELF Version 4, Australian Edition; Semel, Wiig, & Secord, 2006). The cognitive ability of all children was assessed using the Wechsler Non-Verbal Scale of Ability (WNV) (Wechsler & Naglieri, 2006). Family involvement in children's intervention program was assessed using the Moeller's Family Rating Scale (MFRS) (Moeller, 2000). Results from these two measures were used as covariates in the analyses of outcomes.

Instruments

*Parenting Stress Index – Third Edition (PSI).*The PSI is widely used, and has been shown to be a reliable measure of both general parent stress and stress specific to parenting a particular child (Hintermair, 2006; Lederberg & Golbach, 2002; Meadow-Orlans, 1994). Studies of reliability and validity for the PSI yielded coefficient alphas of 0.91 for the Total Stress score, and a test-re-test reliability of 0.84 (Abidin, 1995b). The PSI consists of 151 questions on 14 individual scales across the Child and Parent domains, with Life Stress as an optional 19-item scale. High, or clinically significant, scores on the PSI indicate that the area being measured is a source of significant stress. It is important to note that scores for individual parents reflect their perceptions of particular areas, and do not provide factual information about these areas. For example, some parents with few friends may feel they receive adequate social support, and this will not be an area of stress for them, whereas others may feel isolated and very stressed when receiving this level of support.

Subscales in the Child domain are: Adaptability (how well does a child handle change and transitions?), Acceptability (do the child's physical, intellectual and emotional characteristics meet the parent's expectations?), Demandingness (how demanding of attention, aggressive, intrusive and defiant is the child?), Mood (does the child engage in excessive crying, withdrawal or appear depressed?), Distractibility (is the child overactive, restless, and unable to concentrate?) and Reinforcement (does the parent-child interaction result in a positive affective response in the parent?).

Subscales in the Parent domain are: Depression (is the parent depressed?), Attachment (does the parent feel emotionally close to the child, and do they have the ability to perceive the child's needs accurately?), Role Restriction (does the parent view the parental role as overly restrictive on their freedom and identity?), Competence (does the parent feel they have the necessary skills to parent the child?), Isolation (does the parent feel socially and emotionally supported in their parenting role?), Spouse (does the parent feel they have the

emotional and physical support of their spouse in parenting their child? Is there significant conflict in the spousal relationship?) and Health (is the parent's physical health impacting on their ability to meet the demands of parenting?). The Life Stress subscale provides an index of the amount of stress outside the parent-child relationship the parent is experiencing, but scores on this subscale are not included in the calculation of Total Stress. The PSI also provides a Defensive Responding score which, if in the clinically significant range, indicates that the parent may have responded in a defensive manner (i.e. 'faking good'). Caution, and examination of the pattern of responses, is advised when interpreting the scores of a parent whose Defensive Responding score is clinically significant.

Peabody Picture Vocabulary Test – Fourth Edition (PPVT-4; Australian Standardised Edition. The PPVT-4 (Dunn & Dunn, 2007) is a norm-referenced, closed-set test of receptive vocabulary in which the child is required to point to one of four pictures that best represents the meaning of a verbally presented stimulus word. In this study, children's scores were compared to normative data using standard scores. The average reliability coefficient for this test, based on the normative sample, is 0.89. The normative sample very closely matched U.S. population characteristics, with each age group within 1% of equal numbers of males and females, and socioeconomic status, education level, educational placement, race and ethnicity reflecting the distribution of these characteristics in the general population.

Preschool Language Scale – 4 (PLS-4; Australian Language Adaptation). The PLS-4 (Zimmerman et al., 2002) was used to assess general, receptive and expressive language development in children aged five years. The PLS-4 is a norm-referenced test of receptive and expressive language ability in children. Colored pictures and manipulative toys are used to elicit responses from children. The test gives two core subscale scores; Auditory

Comprehension (AC) and Expressive Communication (EC), as well as a Total Language (TL) score. In this study, children's scores were compared to normative data using standard scores. The reliability coefficients for this test, based on the normative sample, range from 0.81-0.95. The normative sample of 1564 children represented a sample stratified (based on the 2000 census of population in the U.S.) for gender, racial distribution, and primary caregiver education.

Clinical Evaluation of Language Fundamentals, Fourth Edition (CELF-4; Australian Standardised Edition). The CELF-4 (Semel et al., 2006) was used to assess general, receptive and expressive language development in children aged eight years. The CELF-4 is a comprehensive measure of language ability of children aged 5 to 18 years. Four of the subtests give a measure of global language ability; the Core Language standard score, which is based on an age-based norm sample. Reliability coefficients, based on the normative sample, are 0.69-0.91 for subtest items, and 0.87-0.95 for composite scores. Participants in the normative sample represented a sample stratified for age, gender, parental education level, geographic region and type of schooling according to the 2001 census data collected by the Australian Bureau of Statistics.

Wechsler Non-Verbal Scale of Ability (WNV). Non-verbal cognitive ability was assessed using the WNV (Wechsler & Naglieri, 2006). The WNV uses pictorial directions to eliminate the need for language-based instructions, thereby eliminating any potential disadvantage to children with hearing loss, either through perceptual difficulties or language delay. The WNV is suitable for administration with children aged 4 years through to 21 years, 11 months, and provides a norm-referenced standard score measure of non-verbal cognitive ability. It has a full-scale score reliability of 0.91.

Moeller's Family Rating Scale (MFRS). The Moeller's Family Rating Scale (Moeller, 2000) was used to characterise the quality of participation in children's intervention and educational programs. Two interventionists or other professionals (e.g., early intervention specialists, school teachers, teachers of the deaf) who had worked closely with the family prior to the time of assessment were asked to independently rate family involvement in the child's program over the course of the previous year. Each family was rated on a scale of one to five (1 = limited participation through to 5 = ideal participation), with raters choosing from specific descriptions of characteristics that represented each participation category. Raters also estimated their confidence in their ratings as questionable, okay, or good. No ratings were reported as questionable. Raters' scores were averaged to give an overall rating. If the raters specified different confidence levels, a weighted average was calculated, as specified by Moeller (2000).

Results

Overall stress in parents of children with cochlear implants

Overall stress (Total Stress scores) was examined for the group of 70 parents. Clinically significant scores on the PSI are considered to be scores that are at or above the 85th percentile. Twenty percent of parents in this group obtained clinically significant Total Stress scores, with 14% of these parents scoring at or above the 90th percentile. Forty-three percent of the 70 parents achieved clinically significant scores on three or more sub-domains of the PSI, indicating that these areas were sources of significant stress. The incidence of clinically significant scores for the group was compared to that expected for the population on which this instrument was normed using Chi-Square Goodness of Fit tests. The incidence of Total

Stress scores that were clinically significant was not significantly different to that expected for the normal population (χ^2 (1, n= 70) = 1.37, p = 0.24).

Prior to interpreting the content scores of the PSI, the PSI manual advises that the Defensive Responding scores and patterns of scores on particular subscales for each respondent are examined (Abidin, 1995b). Twenty percent of parents in this study obtained a clinically significant Defensive Responding score. According to Abidin (1995b), a clinically significant Defensive Responding score indicates that the parent is responding in a defensive manner (or "faking good"), and that scores on the PSI should not be taken at face value. To explore the effect on the overall result of these parents potentially downplaying their stress, their data was removed from the dataset, and the incidence of clinically significant Total Stress scores was examined again for the remaining 56 parents. Chi Square Goodness of Fit tests showed that the incidence of clinically significant Total Stress scores for this reduced group was significantly higher than for the normative population (χ^2 (1, n = 56) = 4.39, p = 0.04).

Parent stress and child receptive vocabulary.

Figure 1 shows results for all of the language assessments; PPVT-4, PLS-4 and CELF-4. As is common in children with cochlear implants, there was great variability in vocabulary outcomes between individual children. Although the data were distributed normally, it can be seen in the figure that mean standard scores across all tests are depressed, and are either in the low average range or just outside the normal range of scores for typically developing children.

Performance on the PPVT-4 ranged from up to 2 *SD*s (139) above the mean through to 2*SD*s below the mean (59), with almost two thirds of the children scoring within or above the mean range of scores (or within one standard deviation of the mean) for typically developing

children. However, when compared with the normal distribution of expected scores, instead of around 16% of children's standard scores falling one standard deviation or more below the mean, almost 39% of children scored in this range. Whereas, for typically developing children, it would be expected that approximately 16% of children would score higher than one standard deviation above the mean, less than five percent of the children scored in this range. The receptive vocabulary abilities of the group were therefore on average significantly below the normative sample means for typically developing children for children assessed at age five years (M = 91.10, SD = 17.70; $t(158) = 2.73$, $p = 0.01$), and at age eight years (M = 91.0, SD = 13.30; $t(220) = 2.67$, $p = 0.01$) but were significantly higher than for the normative sample of children with cochlear implants (M = 90.58, $t(x) = 5.51$, $p = 0.00$).

A negative correlation between parent Total Stress and child PPVT scores for the 70 children fell just short of significance ($r(68) = -0.23$, $p = 0.06$), but there was a significant, although low, correlation between parent Life Stress and child vocabulary outcomes ($r(68) = -0.27$, $p = 0.03$). Other factors that were significantly and moderately negatively correlated with vocabulary outcomes for all children were child behaviour characteristics measured by the PSI such as demandingness, adaptability and distractibility ($r(68) = -0.32$, p=0.01; r(68) = -0.33, p=0.01; $r(68) = -0.33$, p=0.01). Age at diagnosis, age at activation and parent education were also significantly and moderately negatively correlated with vocabulary outcomes. Parent involvement and child cognitive ability were positively and moderately correlated with vocabulary outcomes. Higher parent involvement was also significantly correlated with increased child cognitive ability.

Parent stress and child language.

Figure 1 shows the mean standard scores on the three subscales of the PLS-4 and the CELF-4 Core Language. Mean standard scores for children assessed at age 5 years on the PLS-4 were

also in the low average range. The data were distributed normally, with a maximum standard score of 135 and a minimum standard score of 50. Fifty-three percent of children scored within or above the mean range of scores for typically developing children. As for the vocabulary results, a large proportion of children scored greater than one standard deviation below the mean (47%), whereas only 16% of typically developing children are expected to score in this range. When compared with the normative sample, standard scores for this group of children were significantly below the normative means for typically developing children of the same age across all three scores yielded by the test (PLS-4 Auditory Comprehension (M =87.06, SD = 19.03, $t(151) = 5.33$, $p = 0.00$; PLS-4 Expressive Communication (M =84.44, SD = 19.80, $t(151) = 6.20$, $p = 0.00$; PLS-4 Total Language (M =84.83), $t(122) = 4.67$, $p = 0.00$).

CELF-4 Core Language standard scores for the children assessed at eight years were distributed normally, with performance ranging from up to two *SD*s above the mean (132) through to three *SD*s below the mean (40). Seventy-four percent of children scored within or above the mean range of scores for typically developing children, but 26% still scored greater than one standard deviation below the mean. When compared with the normative sample, Core Language scores for this group of children were still significantly below the normative sample means for typically developing children of the same age (M =92.60, SD = 22.0, $t(70) = 2.47$, $p = 0.02$).

In order to determine whether there was a relationship between parent stress and language outcomes for the whole group of children, standard scores for PLS-4 Total Language and CELF-4 Core Language were combined. A negative correlation between parent Total Stress levels and language outcomes indicated that children of parents who were less stressed had better language outcomes ($r(68) = -0.32$, $p = 0.01$). Outcomes on these tests

were again negatively correlated with the same personality attributes as for the vocabulary results ($r(68) = -0.43$, $p = 0.00$; $r(68) = -0.31$, $p = 0.01$; $r(68) = -0.32$, $p = 0.01$).

Increased age at diagnosis and activation were also associated with poorer language outcomes ($r(68) = -0.26$, $p = 0.02$; $r(68) = -0.39$, $p = 0.01$). Increased parent involvement in children's intervention was associated with better child language outcomes ($r(68) = 0.43$, $p = 0.00$).

In order to examine the relationships between parent stress, child language, and child behaviour more closely, the parent cohort was divided into two groups according to whether children had age-appropriate or delayed language abilities relative to their typically developing peers. There were no significant differences between the groups with regard to age at diagnosis, age at test, or number of CIs, although children in the delayed language group had been implanted significantly later (1.9 versus 1.3 years; $t(68)=2.77$, $p = 0.01$). The delayed language group included the three children in the study with disabilities, although one of the disabilities (mild cerebral palsy) should not have affected language development. The delayed group included 28 children, and the group with age-appropriate language included 40 children. Parent stress levels were significantly higher for parents of children with delayed language ($t(68) = 2.94$, $p = 0.01$). Scores on the Demandingness and Adaptability child domains of the PSI were also significantly higher for parents of children with delayed language abilities ($t(68) = 4.36$, $p = 0.00$; $t(68) = 2.64$, $p = 0.01$).

Highest Reported Stressors

Results on all sub-scales of the PSI were examined to determine the areas that caused the most stress for parents. Whether the incidence of clinically significant scores on specific sub-scales was higher than for the general population was examined using Chi-Square Goodness of Fit tests. Table 2 shows a summary of results. The PSI Child sub-scale on which the

highest number of parents achieved a clinically significant score was the Demandingness sub-scale. The incidence of clinically significant scores was significantly higher than that expected for the normative population, with 37% of parents achieving clinically significant scores on this sub-scale. A Pearson Product moment correlation showed that Demandingness was highly and significantly correlated with parent Total Stress scores. There was also a higher than expected incidence of clinically significant scores on the Acceptability (24%) and Mood (24%) sub-scales, and both of these were moderately and significantly correlated with Total Stress scores (see Table 2).

On the Parent Domain, the sub-scale with the highest incidence of clinically significant scores was Health (26%). Despite a higher than expected incidence of clinically significant scores on this sub-scale, there was no correlation between Health and Total Stress scores, or between Health and any other factor measured in this study. Given the higher than expected incidence of clinically significant scores on the Acceptability sub-domain, scores on the Attachment sub-domain were also examined. It was interesting to note that although many parents struggled with acceptance of their child, only four of the 70 parents achieved clinically significant scores on this sub-domain, indicating that while many parents found it difficult to accept their child's characteristics, this did not significantly affect their bond with their child.

Correlations among Variables

All data were checked for normality of distribution and outliers. Nominal data, such as whether children did or did not have or had additional disabilities, were living with one or two parents, were attending preschool or school, and were female or male, were coded as 1 and 2 respectively. Parent education levels were coded 1-6, and parent occupations were

coded 1-9. Inter-correlations were calculated among test sub-scales on which clinically significant scores were obtained, and also between test domains, language results and demographic variables (see Table 3). When one or both of the variables were interval or ordinal, a Pearson product-moment correlation was calculated, and when both variables were nominal, the phi coefficient was used. Variables which were found not to be significantly correlated with any other variable were excluded from this table. Excluded variables included child age, parent health, number of siblings, pre-implant pure tone average (PTA; better ear), the presence of additional disabilities, and parent age, which was positively related only to the degree of parent involvement in children's intervention ($r(68) = 0.29$, $p = 0.02$). As the parent occupation categories were categorical, multiple linear regression was used to determine whether there was a relationship between parent occupation and stress.

There was no relationship found between child age, gender, degree of hearing loss (PTA), the presence of additional disabilities, age at diagnosis, age at first CI activation, parent occupation, parent education, and parent stress levels for the families in this study.

Social Support. Support for the primary caregiver, both external to and within the parent relationship was measured by the PSI Isolation and Spouse domains respectively. The amount of support parents felt they received from sources outside the family was moderately correlated with overall parent stress levels ($r(68) = 0.57$, $p = 0.00$), with parents who felt they received more support feeling less stressed. There was also a significant relationship between how supported parents felt by their spouse and parent stress, with a high correlation between the amount of spousal support received and overall stress levels ($r(68) = 0.76$, $p = 0.00$).

Life Stress and Total Stress. The relationship between Life Stress and Total Stress scores was examined, as it was presumed that the number of stressful events in parents' lives that were unrelated to parenting their child would also impact on their overall stress levels, and that this would need to be taken into account when interpreting the results. There was a higher than

expected incidence of clinically significant scores on this sub-domain ($\chi^2(1, n = 70) = 4.73$, $p = 0.030$), however, Total Stress and Life Stress scores were not significantly correlated ($r(68) = 0.17$, $p = 0.15$).

Stress in parents of children with unilateral versus bilateral cochlear implants

It was hypothesized that parents of children with bilateral CIs may be less stressed than parents of children with unilateral CIs. Linear regression analyses (controlling for combinations of for child age at CI and CI2, age at diagnosis, language outcomes [PPVT, PLS-4/CELF], parent participation, number of siblings, spousal support, social isolation, parent education and occupation) were conducted to compare total parent stress between the two parent groups. The Akaike Information Criterion (AIC) was used to select the preferred regression model (Akaike, 1974; Claeskens & Hjort, 2008). The AIC is a bias-corrected estimator of the Kullback-Leibler divergence between a regression model and the true distribution of the data. It takes the form of a penalised log-likelihood function AIC = □2 log L + 2k, where log L is the maximised log-likelihood of the model and k is the number of parameters estimated. The preferred regression model, among a set of candidate models, is the one with the smallest AIC. The final model explained 73.3% of the variance in scores, and showed that bilateral CI predicted significantly reduced stress in parents (p=0.03). Having the second CI at a younger age was also a significant predictor of reduced stress, with a bilateral CI age of two years, for example, predicting a reduction in parent total stress raw scores of approximately 20 points.

Discussion

Overall Stress

The whole-group result for this study suggested that the incidence of clinically significant Total Stress scores for parents of school-aged children with CIs in this study was not significantly higher than for the normative population. As mentioned previously, several studies (including those involving children with CIs) have also reported no difference in stress levels between parents of children with hearing loss and those with normal hearing, some having used the same measure of stress as the current study (Asberg et al., 2008; Horsch et al., 1997; Meadow-Orlans, 1994; Pipp-Siegel et al., 2002: Quittner et al., 2010). Research with parents of children with disabilities other than hearing loss has also shown that parenting a child with a disability does not always result in atypical stress levels, particularly in middle-class families, many of whom cope adequately (Keller & Honig, 2004).

However, the further analysis of results, which excluded those of parents with significant Defensive Responding scores, showed a significantly higher incidence of overall parent stress than is seen in the normative population. It seems plausible that this result could accurately reflect the characteristics of this cohort of parents, and that more parents are experiencing stress at clinically significant levels than the overall data imply. Other previous studies have reported significantly increased stress for parents of children with hearing loss (Quittner et al., 2002; Spahn et al., 2001), and not all families are well-resourced and economically advantaged. It seems reasonable that many parents of children with cochlear implants could be experiencing more daily hassles in everyday life with their children as a result of numerous appointments with professionals, maintenance and troubleshooting of their child's cochlear implant/s (Sach & Whynes, 2005), and particularly with increased difficulties with communication, which have been reported to contribute significantly to parent stress (Quittner et al., 1991; Zaidman-Zait, 2008). Anxiety about children's educational performance and future is also experienced by many parents of school-aged children with hearing loss (Lederberg & Mobley, 1990). It is clear, both from the results of this study and

previous studies, that many children with CIs have decreased language ability, which has also been shown to increase parent stress (Chaffee et al., 1990; Hintermair, 2006; Quittner et al., 2010). Furthermore, it has been reported recently that some children with cochlear implants exhibit more problem behaviours related to inhibition, working memory and executive function than do their peers without disabilities (Holt et al., 2012).

As has been suggested previously, it seems that a combination of specific stress factors related to each child's characteristics and/or caregiving needs interacts with parent resources such as social support, financial security, education, and the spousal relationship to influence parents' perceptions of both their families and their own experience of stress. It is interesting that the degree of a child's disability does not necessarily explain the observed variability between families in terms of stress and coping (Frey, Greenberg, & Fewell, 1989). Depending on the combination of factors, stress can range from within normal limits for some families to distress for others.

Although previous studies have shown that some parents of children with hearing loss do not have elevated levels of general parenting stress (as measured by the Total Stress scale of the PSI), these same studies have shown elevated levels of stress specific to parenting a child with hearing loss when a context-specific measure of stress is used (Lederberg & Golbach, 2002; Quittner et al., 1990; 1991). After finding increased context-specific stress in a longitudinal study of parents of children with hearing loss, Quittner and colleagues conducted a further assessment of the same parents using a more general measure of stress (the PSI), which showed no difference in stress levels between this group and the normative population (Quittner et al., 2010). The authors suggested that context-specific measures could be more sensitive measures of the stresses and challenges faced by these parents than the PSI. It would be interesting to examine the PSI data of future studies after removing the data for parents with clinically significant Defensive Responding scores to determine whether the

Total Stress score is still a less sensitive measure of parent stress than other context-specific tests.

Parent stress and child language development

Language outcomes for the children in this study were similar to those reported in the more recent literature, with mean scores significantly below the normative means for typically developing children (Holt et al., 2012; Nikolopoulos, Dyar, Archbold, & O'Donoghue, 2004; Sarant, Holt, Dowell, Rickards, & Blamey, 2009; Spencer, Barker, & Tomblin, 2003). As is also common, variability in language development between children was high, with some children scoring well above the average range, and others scoring well below it. Better language outcomes were associated with lower age at diagnosis of hearing loss, earlier age at activation and increased parent participation in educational intervention. Overall, children in this study whose parents were less stressed achieved better language outcomes.

Alternatively, it could be said that parents of children with better language were less stressed. In the only other study of the relationship between parent stress and language development in children with hearing loss, Quittner & colleagues (2010) also reported high rates of behaviour problems in younger children with hearing loss, and showed that oral language delays influenced parent stress levels through child behaviour problems. Despite the children in the present study being older, demanding child behaviour was still significantly correlated with receptive vocabulary and spoken language ability, and was the major cause of stress for parents in this study.

When parent stress scores were examined more closely, it was found that parents of children whose language skills were delayed were more stressed than were parents whose children had developed age-appropriate language. Furthermore, scores on the child demandingness and adaptability subscales of the PSI were significantly higher for parents of

children with delayed language, supporting the suggestions of others that spoken language abilities may explain an increased incidence of behaviour problems in children with delayed language (Barker et al., 2009; Quittner et al., 2010).

Highest reported stressors

In addition to the incidence of general stress (Total Stress) being significantly higher than in the normative population for a subset of parents in this study, the incidence of clinically significant scores on several subscales of the PSI was also significantly higher. There are other reports in the literature of high stress on various sub-domains of the PSI coincident with non-significant overall stress scores (Horsch et al., 1997; Quittner et al., 2010). Negative child behaviour was the major cause of stress for the parents in this study, as has been reported previously (Horsch et al., 1997; Keller & Honig, 2004; Quittner et al, 1990; Zaidman-Zait, 2008). In families of children without disabilities, child behaviour, or difficult temperament, has also been cited as the most significant cause of stress for parents of children with normal hearing (Seginer, Vermulst, & Gerris, 2002). Demanding child behaviour, which was highly correlated with overall parent stress scores, was the area with the highest number of clinically significant scores. Almost 40% of parents struggled with frequent demanding behaviours such as whining and dependent behaviour, minor problem behaviours, and/or frequent requests for help. Children in this study were also seen by many parents as being excessively moody, which was a major cause of stress for almost a quarter of parents. High scores on this sub-domain indicated that these parents experienced their children as unhappy and depressed, with frequent crying. Horsch and colleagues (1997) also found that, although overall stress levels for parents of children with hearing loss did not differ significantly to levels in the normative population, significantly elevated stress was reported with regard to demanding and moody child behaviour. In the present study, the third

area of highest incidence of clinically significant scores was parent difficulty with acceptance of their children's characteristics. It is known that children who do not fulfil their parents' expectations are at risk of poor attachment (bonding) or rejection, but despite many parents in the present study reporting significant difficulties with acceptance of their children, it is interesting that the number of parents who felt low levels of attachment to their children was minimal (6%). This finding is similar to that of Beckman (1991), in whose study 27 parents of children with disabilities reported greater stress on the PSI than did 27 parents of children without disabilities, except on the attachment scale. Although it has been reported that fathers have more difficulty with acceptance of, and attachment to, their children with disabilities (Keller & Honig, 2004), in this group of mostly mothers, acceptability and attachment did not seem to be related.

When parent characteristics that contributed to stress in this cohort were examined, it was found that over a quarter of parents had significant health issues, but that despite this, physical health was not correlated with parents' overall stress levels. In a study of 54 families of children with and without disabilities, Beckman also reported that mothers of children with disabilities had a higher incidence of health problems than did mothers of children without disabilities (Beckman, 1991). A further study of 59 families of preschool children with disabilities including deafness again reported similar findings (Oelofsen & Richardson, 2006). Increased risk of impaired physical health has also been reported for mothers, but not fathers, of children with Asperger Syndrome (Allik, Larsson & Smedje, 2006) and also for caregivers of children with intellectual disability, cerebral palsy and mental health disabilities (Brehaut, Kohen, Raina, Walter, Russell, Swinton et al., 2004; Emerson, 2003; Seltzer, Greenberg, Floyd, Pettee & Hong, 2001). Interestingly, in accordance with the results of the present study, Allik and colleagues (2006) also did not find a link between physical and mental health for parents in their study. In explanation of these

findings, it has been noted previously that psychosomatic problems are common manifestations of stress related to caregiving in parents of children with disabilities (Weiss, 1991). Further, physical symptoms such as physical fatigue and lack of energy could also simply be due to the demands of parenting children with whom daily communication is often laborious and who require additional time and assistance with activities such as homework and being taken to after-school professional appointments.

Twenty percent of parents in the present study also reported clinically significant scores for depression. Although this number did not exceed the expected incidence in the normative population, other studies have reported significantly higher levels of depression in parents of children using cochlear implants (Quittner et al., 1991) and hearing aids (Spahn et al., 2001). There was also a significant association between stress and depression for parents in this study, also shown in previous research on parenting stress levels and aspects of psychological functioning such as depression and anxiety (Quittner et al., 1990; 1991). Also in the present study, almost the same number of parents felt they lacked adequate support from their spouse. Through the mechanisms of emotional support, favourable evaluation of the mother's conduct of her parenting role, and acceptance of the fathering role, husband supportiveness can significantly moderate maternal parenting stress (Abidin, 1995b). The results of this study strongly support this theory, with a high correlation between scores on the Spouse sub-domain and overall parent stress scores. Some researchers have reported that the greatest correlate of parenting stress in all families is spousal support, with parents in unhappy marriages reporting the greatest distress (Deater-Deckard & Scarr, 1996). It has also been suggested that marital discord can lead to negative and inconsistent parenting practices, which in turn are a suspected cause of child behaviour problems (Deater-Deckard & Scarr, 1996; Holden & Ritchie, 1991). This would seem to be supported by the significant correlations found in the present study between scores on the Spouse subscale and scores on

the Difficult Behaviour subscales. Of parents with significant scores on the Spouse sub-domain, just over half scored significantly for depression. However, it has also been suggested by Lederberg et al. (2002) that a very high degree of stress on the Child Domain scale may be so overwhelming that other factors, such as spousal or social support, may not affect maternal mental health.

The significantly higher stress scores found on several domains of the PSI in this study may at least partially reflect the fact that almost all respondents were mothers, as mothers have been shown to report more stress as a result of parenting children with disabilities than do fathers (Beckman, 1991; Webster-Stratton, 1990). Mothers are reported to be more likely than fathers to feel depressed and affected in terms of their spousal relationship and physical health. These outcomes for mothers fit with the normative approach to child-rearing stress: that it is role-related and that parents with higher care-giving loads usually experience greater stress (Beckman, 1991; Seginer, 2002). While fathers of children with CIs usually remain in their professions, mothers often give up or restrict their work for at least some period of time in order to care for their child, shouldering more of the responsibility for parenting (Spahn et al., 2001). Almost 36% of mothers in this study were not working, and many others had returned to work (mostly part-time) after periods of being at home to care for their child.

Correlations among variables

Support. In addition to child behaviour, degree of spousal support, and child acceptability, social support outside the spousal relationship (as measured by the PSI Isolation sub-domain) had a significant positive effect on overall parent stress levels for parents in this study. As mentioned previously, social support has been found by others to play a key role in mediating

parent stress, with many studies of parent stress in families with disabled children reporting that social support has a strong effect on parent well-being (Lederberg & Golbach, 2002; Meadow-Orlans, 1994; Oelofsen & Richardson, 2006; Pipp-Siegel et al., 2002). Even the parental perception of support, whether or not it was particularly effective, has been sufficient to lower stress levels (Åsberg et al., 2008; Quittner et al., 1990). Although it has also been found that support received by mothers contributes significantly to the quality of mother-child interaction (MacTurk et al., 1993), and that this has been shown to lead to better language outcomes in children of preschool age (Pressman, Pipp-Siegel, Yoshinaga-Itano, & Deas, 1999), the present study found no direct relationship between child language outcomes and social support. This may be due to the fact that the children in this study were older and were attending school, therefore maternal input was no longer the primary medium through which the children learned language.

Competence. Parents' sense of competence in their parenting role was also found to be associated with their overall stress levels, as was their degree of attachment to their child. Feelings about competence as a parent have previously been reported to be one of the most important predictors of life satisfaction (Lederberg & Golbach, 2002), with perceived competence usually resulting in competent parenting practices (Bogenschneider, Small & Tsay, 1997). Previous research has also shown competence to be related to parent stress and depression (Webster-Stratton, 1990), with increased parent stress negatively correlated with competence (Dempsey, Keen, Pennell, O'Reilly, & Neilands, 2009). There was also a moderate and significant positive relationship between competence and attachment, although only a very small number of parents reported difficulties with attachment to their child.

Child Age. It was expected that stress for many of these parents of older children, 66% of whom who were attending primary/elementary school, might be increased due to a heightening awareness of delays in their children's development that often occurs when there is a mismatch between their children's skills and the increasing expectations and demands placed on them at school. Assessment measures used in this study (and reported to parents) gave results in terms of standard scores, which compared individual children's development with that of their same-age peers with normal hearing. Given this, all parents in this study were in a position to make a direct comparison of their child's progress with that of their peers. Concern, or even pessimism, regarding children's futures, was also hypothesized to be a possible factor that could have contributed to significantly raised overall stress, as was concern about a more obvious communication gap between parents and their children. However, child age was not found to be correlated with parent stress levels, or indeed with any of the other dependent variables, although a negative relationship between child age and child acceptability was found. As mentioned previously, a number of other studies of families of children with hearing loss have also found no correlation between child age and parent stress (Åsberg et al., 2008; Beckman, 1991; Holt et al., 2012). In the current study, this result may have been influenced by a number of factors related to the age range of the children. Firstly, this cohort comprised children of two discrete ages, rather than a wider range of ages. Further, child age is reported to become a more influential factor from when children are aged nine years and older, with parent stress peaking between 14-18 years (Bristol & Schopler, 1984; Seginer et al., 2002). Lastly, some other studies have shown that there is actually a decrease in parenting stress when children are aged between six and nine years, due to a decrease in the amount of physical care required, and the fact that the stressful adolescent processes related to an increasing need for independence and the emotional distancing of children from their parents have not yet begun (Pasley & Gecas, 1984). After

consideration of previous research findings, the age limitations of this cohort of children, and the fact many of the children in this study were progressing well in their language development, it is perhaps unsurprising that no relationship between child age and parent stress levels was found.

Stress in parents of children with unilateral versus bilateral cochlear implants.

Given many anecdotal parent reports that children with two CIs are easier to communicate with (Fitzpatrick, Jacques & Neuss, 2011; Scherf et al., 2009), and taking into account the additional benefit many children with bilateral CIs receive in quiet and noisy listening situations (Galvin et al., 2008; Johnston et al., 2009; Scherf et al., 2007), it was hypothesized that parents of children with bilateral CIs may be less stressed than parents of children with unilateral CIs. Accordingly, when child language ability and demographic factors were controlled for, the average stress scores of parents of children with unilateral CIs were found to be significantly higher than those for parents of children with bilateral CIs. As far as the authors are aware, this is the first report of such a finding. Given the additional finding that parents of children in this study who had better language outcomes were less stressed, it seems logical that having a bilateral CI, facilitating easier listening and communication, helps improve child language development. This in turn reduces parent stress. A comparison of language outcomes between children with bilateral and unilateral CIs for a larger cohort of children participating in the study from which this group is derived is planned to investigate this further.

Study limitations

This study was cross-sectional in design, and therefore the results may not apply to the whole population of parents and children with cochlear implants. However, given the fact that the study cohort was recruited from 84% of the country's population, with a recruitment rate similar to recently reported recruitment rates for epidemiological studies, these results can be considered to be reasonably representative of Australian children with cochlear implants. The study also assessed spoken language outcomes only, because this is still the main outcome for most children born to parents with normal hearing in Australia. It may be argued that a limitation of this study was that almost all respondents were mothers. However, in all cases the respondents were the primary care givers, and were therefore the people who were the most directly affected by the demands of parenting their child. In addition, mothers' reports of children's characteristics as measured by the Child Domain of the PSI are deemed to be more accurate than those of fathers (Abidin, 1995b). Further, the age range of the children in this study was limited to a three-year span, which made it difficult to study the effect of child age on parent stress. It is also unknown whether the PSI norming sample included the responses of parents with clinically significant Defensive Responding scores. Future research could include a matched sample of hearing children in order to further compare parent stress in families of children with cochlear implants with that in families of children with normal hearing. A final limitation of this study was the imbalance in numbers between the unilateral and bilateral groups, and therefore the more limited representation of families with children who had unilateral CIs. This is difficult to address, as the trend in this country has been for bilateral implantation for some time. It is hoped that ongoing recruitment of children in the future may help to address this issue.

Conclusion

This study suggests that parents of children with CIs, and particularly parents of children with delayed language, may experience greater stress than do parents of children with normal hearing. These results are in agreement with those of three other studies showing increased stress in parents of children with CIs (Purdy et al., 1995; Quittner et al., 1991; Spahn et al., 2001), and contradict those of two studies which reported no difference in stress between parents in this population and in the general population (Asberg et al., 2008; Horsch et al., 1997). Given the equivocal nature of the literature, the relatively small number of parents of children with CIs who participated in each study (81 parents is the highest N to date) and the small number of studies in this area, it may be hasty at this time to draw a firm conclusion about the severity of the stress experience for these parents, although the evidence does appear to be suggesting that parenting children with CIs is more stressful.

The results of this study offer a new insight into the relationship between parent stress and children's language development that has not previously been examined for school-aged children. For this cohort of parents and school-aged children, which is representative of the countries' population of children with CIs, better child language outcomes were associated with significantly lower parent stress levels. This study also provides evidence in addition to that of Quittner and colleagues (2010) that spoken language abilities may explain an increased incidence of behaviour problems in school-aged children with delayed language, in that child behaviour perceived by parents as demanding was significantly correlated with receptive vocabulary and spoken language ability.

A further novel finding of this study is that parent stress was lower in parents of children with bilateral CIs than in parents of children with unilateral CIs. This finding fits with reports in the literature that parents find communication with children who have bilateral CIs easier, and that the effort required in communication for these children is reduced. Given the close and well-documented relationship between parent stress, or psychological state, and

child development in many areas, this is important information to consider when decisions about unilateral versus bilateral implantation are being made.

Childhood deafness presents ongoing challenges for parents in terms of communication, time demands, discipline and concern for children's futures. Parent stress plays a critical role in child development, and can be ameliorated by the provision of appropriate family support and child intervention. We still need to understand more about the experience of parenting children with cochlear implants, and also about parent stress and its effects on the parent-child relationship in order to determine the most effective methods of facilitating change in the family environment to maximise children's chances of successful outcomes. Preventing parent stress from reaching critical levels through a thorough understanding of protective factors and the provision of appropriate support is of the utmost importance.

Table 1 Demographic information for parent (n = 70) and child (n = 70) variables.

Parent Variables		
Gender	Mothers	68 (97%)
	Fathers	2 (3%)
Hearing status	Hearing	70 (100%)
Educational status	1. Postgraduate degree	6 (8.6%)
	2. Bachelor degree	27 (38.6%)
	3. TAFE diploma or apprenticeship	20 (28.6%)
	4. Completed secondary school	12 (17%)
	5. Senior secondary (year 11)	2 (2.9%)
	6. Junior Secondary (years 7-10)	3 (4.3%)
Occupation	1. Managers	3 (4.3%)
	2. Professionals	25 (35.7%)
	3. Technicians & trades	3 (4.3%)
	4. Community & Personal Service Workers	8 (11.4%)
	5. Clerical & administration	4 (5.7%)
	6. Sales	2 (2.9%)
	7. Machinery operators & drivers	0
	8. Labourers	0
	9. Other (home duties, student, unemployed)	25 (35.7%)
Family composition	Two parents	64 (91%)
	Single parent	6 (9%)
Child Variables		
Age at test (years)	M (SD)	6.6 (1.4)
Pure tone average (better ear)		99.6 (15.2)a
Age at diagnosis (months)		7.5 (7.5)
Age at activation of CI1 (months)		18.6 (9.6)
Duration of CI use (years)		5.0 (1.6)
No. siblings		1.7 (1.2)

Cognitive ability		104.3 (12.3)
Additional disabilities		3 (4.3%)
Onset of hearing loss	1. Congenital	62 (88.6%)
	2. Sudden	3 (4.3%)
	3. Progressive	5 (7.1%)
Gender	Female	34 (49%)
	Male	36 (51%)
Cause of deafness	1. Genetic	28 (40%)
	2. Unknown	33 (47.1%)
	3. Birth complications	3 (4.3%)
	4. Viral	6 (8.6%(
No. CIs	Unilateral	16 (22.9%)
	Bilateral	54 (77.1%)
Educational Status	Preschool	24 (34.3%)
	School	46 (65.7%)

a At the time of writing, unaided audiogram information was available for 36 children.

Table 2 PSI sub-domains with the highest incidences of clinically significant scores on the Child and Parent Domains of the PSI. Correlations with PSI Total Stress scores for each of these domains are reported.

PSI sub-domain	Correlation with Total Stress score *r*	*p*	Incidence at/above 85th percentile	Incidence at/above 90th percentile
Child Domain				
Demandingness	0.784	0.000	χ^2 = 26.92, *p*=0.000	χ^2 = 22.86, *p*=0.000
Acceptability	0.668	0.000	χ^2 = 4.73, *p*=0.030	χ^2 = 10.16, *p*=0.001
Mood	0.560	0.000	χ^2 = 4.73, *p*=0.030	χ^2 = 7.78, *p*=0.005
Parent Domain				
Health	0.104	0.392	χ^2 = 6.30, *p*=0.012	χ^2 = 3.97, *p*=0.046
Depression	0.764	0.000	χ^2 = 1.37, *p*=0.241	χ^2 = 2.54, *p*=0.111
Spouse	0.764	0.000	χ^2 = 0.700, *p*=0.043	χ^2 = 2.54, *p*=0.111

Table 3 Inter-correlations among test and demographic variables

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1. Total Stress	-	.78 [c]	.57 [c]	.67 [c]	.75 [c]	.25 [a]	.17	.76 [c]	.57 [c]	.06	-.19	-.00	-.00	.01	-.15	-.06	-.23	-.32 [b]	-.17	.24
2. Demandingness		-	.51 [c]	.65 [c]	.62 [c]	.14	.08	.51 [c]	.34 [b]	.17	.05	.28 [a]	.4	-.02	-.09	-.06	-.32 [b]	-.43 [c]	-.23	.19
3. Mood			-	.54 [c]	.60 [c]	.06	.05	.31 [b]	.19	.10	-.14	-.13	.01	.09	-.12	-.03	-.17	-.10	-.02	.25 [a]
4. Acceptability				-	.63 [c]	.07	-.01	.28 [a]	.25 [a]	.01	-.08	.07	-.06	-.06	-.12	-.19	-.38 [b]	-.49 [c]	-.29 [a]	.18
5. Adaptability					-	.06	.20	.44 [c]	.17	.09	-.19	-.00	.01	.18	-.22	-.14	-.33 [b]	-.31 [a]	-.21	.22
6. Competence						-	.18	.18	.13	-.08	.04	.14	.12	.05	-.12	.13	-.14	-.13	.05	.00
7. Life Stress							-	.24	.08	.14	-.13	-.09	.12	.32 [b]	-.19	.10	-.27 [a]	-.23	.08	.05
8. Spouse								-	.59 [c]	-.02	-.21	-.03	.03	-.01	-.16	-.03	-.02	-.11	-.01	.23
9. Isolation									-	.04	-.05	-.16	-.04	-.19	-.07	.04	.07	-.06	.01	.16
10. 1 vs 2 parents										-	.28 [a]	.18	-.05	-.11	.02	.06	-.14	-.10	.01	-.01
11. Age @ diagnosis (mths)											-	.55 [c]	.09	.05	-.23	-.15	-.30 [a]	-.26 [a]	-.01	-.22
12. Age @ CI-1 activation (mths)												-	-.01	.01	-.18	-.15	-.42 [c]	-.39 [b]	-.05	-.11
13. Parent education													-	.51 [c]	-.30 [a]	-.18	-.32 [b]	-.16	.01	-.14
14. Parent Occupation														-	-.23	-.04	-.20	-.19	.06	-.08
15. Parent involvement															-	.31 [a]	.48 [c]	.43 [c]	-.07	-.03
16. Cognitive ability																-	.37 [b]	.36 [b]	.25	.01
17. PPVT std score																	-	.82 [c]	.13	-.07
18. PLS-4/CELF TL or Core std score																		-	-.16	-.21
19. School/preschool																			-	.20
20. Gender																				-

[a] $p < 0.05$
[b] $p < 0.01$
[c] $p<0.001$

Table 4. Summary of linear regression analysis of stress in parents of children with unilateral versus bilateral cochlear implants.

Variable	*B*	*SE B*	*p*
C	130.20	32.23	0.00
Bilateral CI	-33.45	14.96	0.03
Age at Diagnosis	-0.51	0.61	0.41
Age at CI1	0.22	0.49	0.65
Age at CI2	7.05	3.23	0.03
Parent Participation	1.16	5.21	0.83
No. siblings	1.03	3.08	0.74
Parent 1 Occupation 1	8.63	19.02	0.65
Parent 1Occupation 2	-11.41	11.03	0.31
Parent 1 Occupation 3	4.37	19.44	0.82
Parent 1 Occupation 4	6.96	13.42	0.61
Parent 1 Occupation 5	-7.36	15.31	0.63
Parent 1 Occupation 6	-11.55	22.49	0.61
Parent 1 Education 1	10.00	24.73	0.69
Parent 1 Education 2	-14.31	20.07	0.48
Parent 1 Education 3	-9.14	20.98	0.67
Parent 1 Education 4	-35.25	21.84	0.11
Parent 1 Education 5	-21.97	21.46	0.31
Parent 1 Education 6	-30.11	27.01	0.27
PSI Spousal Support	4.93	0.86	0.00
PSI Isolation	1.621	1.05	0.13
$R^2 = 0.73$ (<0.05).			

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