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Do Deaf Children Delay in Their Executive Functioning Due to Their Delayed Language Abilities?

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Language use during daily interactions plays a key role in executive functioning. Given that increasingly sophisticated language is required for effective executive functioning as an individual matures, it is likely that children with delayed language skills will have difficulties in performing tasks which are related to executive functioning. The aim of this study was to investigate the relationship between language ability and executive functioning in a group of deaf students who communicate using spoken Turkish, as measured by their performance on WSCT (Wisconsin Card Sorting Test). For that purpose, 82 children who are deaf were tested by means of their language skills and executive functioning abilities. Results show that, language skills have significant impact on the executive functioning of the children. Gender was found to be another factor affecting the executive functions. Results were discussed with the relevant literature.

Keywords: Hearing Impairment, Children Who Are Deaf, Executive Functions, Language Development

Introduction

Spoken language development in severely or profoundly deaf children is generally delayed compared with their hearing peers (Baker-Hawkins & Easterbrooks, 1994). Regarding to their delay in typical development, children who are deaf experience difficulties when communicating with their families, hearing peers, and the wider society (Meadow-Orlans & Erting, 2000; Hindley, 2000). As language is the main component of social communication, it also has key importance for cognitive processing of individuals.

The key component of how an individual processes social and cognitive input learning to solve problems and to behave intelligently is through the use of language (Ylvisaker & De Bonis, 2000). Language provides individuals with the capacity to think, learn, and behave through understanding and interacting through shared symbols. The process of recognition, coding, storing, and recalling of any social or cognitive information create links necessary for future processing. Language enables the storing and recalling of information that is already known and reasoning about what an individual does or does not know. While using language in that way, individuals are in fact communicating with themselves about how to solve a problem and to learn (Barkley, 1997). From this point of view, how language skills are developed and used appropriately is a complex process requiring the correct functioning of many different cognitive processes. These processes, or executive functions, enable effortful and flexible organization of information and the incorporation of strategic and goal-orientated behavior (Borkowski & Muthukrishna, 1992). Simply, such executive functions enable intelligent thought, problem solving, and learning to take place.

The construct of executive function (EF) encompasses the organizational and self-regulatory skills required for goal-directed, non-automatic behavior. It has been variously described as including planning, initiating, monitoring, and flexibly correcting actions according to feedback; sustaining and shifting attention; controlling impulses and inhibiting pre-potent but maladaptive responses; selecting goals and performing actions that may not lead to an immediate reward, with a view to reaching a longer term objective; holding information in mind whilst performing a task (working memory); and creatively reacting to novel situations with non-habitual responses (Hughes & Graham, 2002; Shallice & Burgess, 1991; Welsh & Pennington, 1988). Recent theoretical conceptualizations of EF suggest that it is not a unitary function, but encompasses a range of dissociable skills, such that it is possible for an individual to fail on some executive tasks whilst succeeding on others (Baddeley, 1998; Garavan, Ross, Murphy, Roche, & Stein, 2002; Miyake et al., 2000). Different EF skills may follow independent developmental pathways, some of which may be more strongly associated with language (and thus more affected by the consequences of deafness) than others.

Language deficits in deaf children, which typically reflect delayed rather than disordered functioning, are potentially useful in clarifying the relationship between language and EF because these children's difficulties are secondary to a peripheral cause. Electroencephalogram evidence (Wolff, Kammerer, Gradner, & Thatcher, 1989; Wolff & Thatcher, 1990) has shown differences in the neural organization of the bilateral frontal cortex (closely linked to EF abilities) and the left temporofrontal area (involved in expressive language) of deaf and hearing children. A weaker development of these cortical areas might be reflected in both poorer language and poorer EF in deaf children. No studies have examined EF comprehensively in deaf children, although a number have included tests that assess some EF components as part of wider investigations. There is some evidence for impaired attention in deaf children compared to their hearing peers (Khan, Edwards, & Langdon, 2005; Mitchell & Quittner, 1996). Planning and problem solving have also been found to be poorer in deaf children when compared with hearing children (Das & Ojile, 1995; Marschark & Everhart, 1999). Further, there are numerous studies reporting on the intelligence and problem-solving abilities of deaf children, but there are relatively few that are specific to higher level cognitive processing and particularly to EF. In fact, since

1994, only three studies have reported specifically on the EF abilities of school-aged deaf children (Luckner & McNeill, 1994; Marschark & Everhart, 1999; Surowiecki et al., 2002). Two of these studies have assessed EF using different versions of Tower tests (Luckner & McNeill, 1994; Surowiecki et al., 2002), whereas one has used 20 Questions (Marschark & Everhart, 1999).

The development of language and that of EF is considered to closely linked. Given the wealth of research examining the impact of deafness on the language acquisition of deaf children, it is surprising that limited research has been carried out deaf children's EF, and that there are such few studies explicitly examining the relationship between language skills and EF in deaf children. Many of the existing studies have examined deaf children's performance on only a few of the EF subcomponents. Therefore, the aim of this study was to investigate the relationship between language ability and executive functioning in a group of deaf students who communicated using spoken Turkish, as measured by their performance on a standardized test of executive function: WCST. It was hypothesized that, language ability would relate to performance on the measures of executive functioning. For that purpose, we tested 82 children who are deaf in order to assess their EF and language abilities. We did not include a comparison sample in our study because it is already well documented in literature that normally developing children have better executive functioning than their hearing impaired counterparts. Thus, we compared hearing impaired children according to their language abilities and we grouped children into two groups as; with and without preschool special education experience. The rationale for this grouping is the well documented positive effect of early special education on the language skills of children who are deaf. As it is previously reported children with language impairments present lower EF compared to children with typical language development, comparing children who are deaf with different language abilities will provide precious/vital/ novel information on the relationship between language skills and EF of children who are deaf.

Method

Participants

The present study was conducted in the metropolitan area of Ankara, the capital city of Turkey. All segregated schools for the deaf in Ankara were contacted for participation. The purpose of the study was explained and discussed with the Principals of these schools. However, one of the schools refused to participate in the study due to the busy schedule. In total 82 children between 10 - 14 ages were recruited into the study. Of these participants 42 children were boys and 40 were girls with a mean age of 11.91 (s = 1.44) All the children had bilateral, sensory-neural (S/N), severe hearing loss (71 - 95 dB) as they were all attending classes in segregated schools for the deaf. 39 of the children (47.6%) had early special education history whereas 43 of them (52.4%) not. Children with a secondary disability were excluded from this study.

Instruments

Demographic information form: A demographic information form was used to gather information about the family, child, child's education and child's communicative behaviors.

Peabody Picture Vocabulary Test (*PPVT*): PPVT as developed by Dunn in 1959 (as cited in American Guidance Services, AGS, 2005) was utilized to assess the vocabulary knowledge of children as well as their receptive language. The PPVT is an individual language performance test, orally administered in less than 20 minutes. No reading is required by the subject, and scoring is rapid and objective. Item responses are made by pointing or multiple choice selections, dependent upon the subject's age. Although desirable, no special training is required to properly administer and score the PPVT. The PPVT provides an estimate of the subject's verbal performance and can be administered to groups with reading or speech problems, mental retardation, or if emotionally withdrawn. For its administration, the examiner presents a series of pictures to each subject. There are four pictures to a page, and each is numbered. The examiner states a word describing one of the pictures and asks the client to point to or say the number of the picture that the word describes. PPVT was standardized for Turkish language by Katz and colleagues in 1974 (as cited in Oner, 1997). For Turkish standardization, 1440 children (2 - 12 years) living in urban, suburban and rural areas were tested and norm tables were listed according to the scores. Reliability of Turkish standardization of PPVT was found to have range of .71 - .81.

Wisconsin Card Sorting Test (*WCST*): WCST is developed by Berg (1948), and revised by Heaton (1981) to assess executive functions in terms of planning, organizing, abstract thinking, conceptualization, maintaining and adapting cognitive constructs and inhibiting impulsive responses (Lezak, 1995; Spreen & Strauss, 1998). WCST measures 13 different executive functioning abilities; number of total responses, number of total errors, number of total correct responses, number of categories completed, number of perseverative responses, number of total perseverative errors, number of nonperseverative errors, percentage of perseverative errors, number of responses to complete the set, number of conceptual level of responses, percentage of conceptual level of responses, failure to maintain a set and learning to learn. Turkish standardization and validation of WCST for adults was reported by Karakas, Eski and Basar (1996) and for children between 6 - 15 ages (75 - 182 months) by Erol et al. (2006).

Procedure:

The procedure was applied at the schools during day time under the supervision of the teachers. Children were informed about the purpose of the study and the voluntary nature of participation was explained. None of the children refused to participate in the study. School records were used for grouping children with and without special education background. Children with early special education background formed Group 1 and children without early special education background formed Group 2. Even though Group 1 was expected to have better language performance, both groups were tested with PPVT by authors in order to assess their language performance before the study procedure was applied. Thus, the data gathered from Group 1 also points the group with "better language performance". EF of the children were tested with WCST in the test rooms of the schools where are silent rooms with minimum materials which minimize the distraction of children. Children were given stickers of stars and smiley faces to reward their efforts and sustain motivation. The same numbers of stickers were offered to each child, across the two groups. Care was taken to give instructions with maximum clarity, making sure that children could see the tester's lip movements, and that their attention was appropriately focused. The same instructions

were given to all participants. Tests were always administered in the same order, to ensure that potential test-order effects would be constant across groups. Test materials were four stimulus cards (from left to right; a red triangle, two green stars, three yellow crosses and four blue circles) and the response cards. Response cards were placed in an order as described in the test manual. The researcher picked one of the response cards and gave it to the child in order to match the correct stimulus card. For each correct match, the child was prompted as "correct" and for each false match the child was prompted as "false". First turn of matching was based on color, second turn was based on shape and third turn was based on quantity. As soon as the child successfully completed the first turn (matching 10 cards according to their colors), matching criterion was changed to "shape". Similar to the first turn, for each correct match the child was prompted as "correct" and for each false match the child was prompted as "false". Each session included six turns as; color, shape, quantity, color, shape, quantity. WCST sessions ended when the children successfully matched the cards (10 for every category) in six matching categories (color, shape, quantity, color, shape, quantity) or when the cards ran out. Sessions took around 20 - 25 minutes for the children participating in the study.

Preliminary analyses of the participants are shown in Table 1. Table 2 provides the descriptive statistics for each group of children on the language test. As hypothesized, a significant effect of group emerged on children's raw score on the PPVT ($F[2, 65] = 29.89$, $p < .001$) Follow-up ANOVA with Bonferroni corrections revealed that, as expected, Group 1 scored significantly higher than Group 2 ($F[1, 41] = 50.93$, $p < .001$)

Table 1.
Preliminary analysis of the participants in the study.

Variable	N	%	S	M
Age				
10	19	% 23.2		
11	16	% 19.5		
12	15	% 18.3	1.44	11.91
13	17	% 20.7		
14	15	% 18.3		
Gender				
Girl	40	% 48.8		
Boy	42	% 51.2		
Early special education background				
Had early special ed.	39	% 47.6		
Did not have early special ed.	43	% 52.4		
Duration of early special education				
Never	43	% 52.4		
Less than 1 year	10	% 12.2		
1-2 years	5	% 6.2		
2-3 years	2	% 2.4		
More than 3 years	22	% 26.8		
Communication choices with family				
Sign language	16	% 19.5		
Oral language	16	% 19.5		
Both	50	% 50		
Reactions to communication barriers				
Repeatedly tries to express	63	% 76.8		
Gets angry	10	% 12.2		
Gives up	6	% 7.3		
Other	3	% 3.7		

Table 2.
Children's performance on peabody picture vocabulary test.

Group	n	*PPVT raw scores*		*PPVT standard scores*	
		M	SD	M	SD
Group 1[a]	39	56.3	14.4	67.2	11.7
Group 2[b]	43	50.1	12.7	48.4	14.3

Note. Standard scores based on a population M = 100, SD = 13. a. with early special education background; b. without early special education background.

Correlations of WCST scores with language ability, gender and age are presented in Table 3. Pre-analyses of data distribution showed that some of the WCST scores presented abnormal distribution. Therefore, WCST scores which showed abnormal distribution were analyzed with Mann-Whitney U and Wilcoxon W tests and normally distributing scores were analyzed with T test. Results showed that WCST scores 1, 2, 3, 4, 5, 6, 8, 11, 13 are significantly effected by language ability ($p < .05$). Gender was found to have impact on all WCST scores but WCST 7 and 10. Besides, age showed difference for only WCST 7 ($p = .005$). Tukey's post-hoc was applied for better understanding the difference between ages. Results showed that ages 10 and 14 differ for WCST 7 (mean scores difference = 7, 80, $S = 2.84$, $p = .05$).

Distribution of the mean scores gathered from WCST was shown in Figure 1 for better understanding the WCST performances of children in the study. There is a decreasing trend in the mean scores which show that children in the study were facing difficulties in most of the main WCST tasks such as number of categories completed (WCST 4), number of nonperseverative errors (WCST 7), number of responses to complete the first set (WCST 9), learning to learn (WCST 13) and maintaining a set (WCST 12). Conceptual level of responses in both numbers and percentages were found relatively average (WCST 10 and 11).

Discussion

High level cognitive processing abilities, also known as key executive functions, include planning and organizational abili-

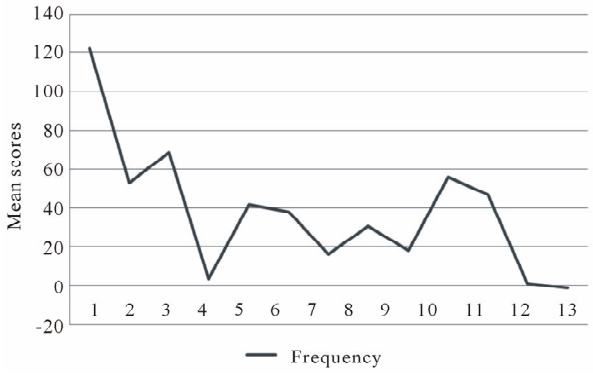

Figure 1.
Distribution of mean scores for each WCST subtest.

Table 3.
Analysis of language ability, age and gender compared to WCST scores.

WCST	*Language ability*					*Gender*						*Age*	
	Mann Whitney U	*Wilcoxon W*	*F*	*t*	*p*	*Mann Whitney U*	*Wilcoxon W*	*F*	*t*	*p*	X^2	*F*	*p*
WCST 1						566.0	1386.0			.002*	2.43		.657
WCST 2			23.52	–6.01	.003*	486.5	1306.5			.001*		1.417	.236
WCST 3			58.90	3.46	.001*			11.15	2.52	.014*		1.130	.348
WCST 4	.005	946.0			.007*			.12	4.15	.023*		.244	.913
WCST 5			42.68	6.48	.009*	469.0	1289.0			.001*	3.55		.469
WCST 6			42.63	–6.48	.001*	460.0	1280.0			.004*	4.09		.393
WCST 7			4.69	.335	.738			2.73	–.77	.441		4.018	.005*
WCST 8			46.88	–6.06	.013*	549.5	1369.5			.007*	4.72		.396
WCST 9			1.12	–1.23	.221			.67	–2.49	.015*		1.126	.351
WCST 10	678.5	1458.5			.965	664.0	1259.0			.862		2.107	.089
WCST 11	379.0	1009.0			.001*	462.5	1057.5			.018*		2.399	.058
WCST 12	513.5	1293.5			.853	299.5	734.5			.001*	4.97		.290
WCST 13			2.56	13.97	.037*			.59	2.37	.021*		1.207	.318

Note: *p < .05 significance level.

ties. abstract thinking, formulation of effective strategies, establishment and maintenance of cognitive sets, and refraining from impulsive trial-and error responses. Such executive functioning requires the ability to draw upon existing knowledge and strategies which are then applied to problem solving involving the flow of information back and forth between cognitive and metacognitive levels of processing (Butterfield et al., 1995). Some researchers have suggested that the observed EF Table 3. deficits of children with language delay or impairment imply that language ability may play a significant role in executive functioning (Singer & Bashir, 1999; Ylvisaker & De Bonis, 2000). The main hypothesis of this study was that language ability would relate to performance on measures of executive functioning differentially. The findings, in general, provide support for this hypothesis.

Results of language ability were found to impact on executive functions. The findings illustrate that WCST 2, 3, 4, 5, 6, 8, 11 and 13 were significantly affected by language ability and the group (1) with higher language skills was found to possess higher levels of executive functioning. This finding links/correlates with previous studies on executive functions and language problems (Marlowe, 2000; Singer & Bashir, 1999; Landa & Goldberg, 2005; Hooper et al., 2002). Hooper et al. (2002) studied language skills and reported that impairments in language results in impairments in executive functions. The parallel finding in our study echoes the early studies and reveals that children who are deaf have delays in executive functions and better language abilities have a boosting effect in developing executive functions. Besides, results show that WCST 7, 9, 10 and 12 had no significant affect on language abilities in our sample. This finding is quite surprising as WCST 9 and 12 points out working memory which is highly related to language skills. Such a result indicates that there may be some other factors affecting working memory than the language.

Surprisingly, the findings on WCST and gender presented were at odds to those already cited in the literature (Surowiecki et al., 2002; Miyake et al., 2000; Erol et al., 2006). All WCST scores with the exception of WCST 7 and 10 were found to be significantly affected by gender. Heaton (1993), Roselli and Ardilla (1993) and Shu, Tien, Lung et al. (2000) reported that gender has no significant affect on executive functioning. Moreover, Erol et al. (2006), in the standardization of WCST for Turkish children reported that gender has no effect on any WCST scores. In our study, boys were found to have higher executive skills compared to girls which show that girls have poor perseveration skills. Such a finding may be an artifact of the sampling process. In our study, we assessed a highly specific sample which may lead to biased findings because of the characteristics of the participants. However, this result is strongly considered by the authors as necessary to be assessed in further studies.

Frontal lobes are well-known to be the latest developing body structures both anatomically and in functionality and therefore, their activities increase with age and reach their Zenith during adolescence (Karakas, 2004; Kilic, 2002). Thus, adolescents are expected to have higher levels of executive functioning and positive WCST scores relative to school age children/pre adolescents. In this study, only WCST 7 (number of nonperseverative errors) was found to be affected by age which shows that nonperseverative errors of children who are deaf decrease with age and which is in keeping with previously published studies (Heaton, 1993; Roselli & Ardilla, 1993; Erol et al., 2006). This finding highlights the importance of developmental features. During normal development children achieve their highest level of executive functioning around 11 age, children who are deaf display delays in the development of this executive functioning and only possess the EF of a 10 years old child when they are between 12 - 14 ages. Such a difference

highlights the importance of language skills on the development of EF. As children learn to control their behaviors and flexibly correct their actions with social feedbacks (Hughes & Graham, 2002), thus the lack of receiving insufficient feedback due to low language skills affects their ability to learn to control their responses. As a result one can say that "lack of practicing" self regulatory skills lead to delays in the development of EF.

Conclusion

Findings of our study presents that language ability has impact on executive functions of children who are deaf. From a theoretical perspective, the findings support the interdependence of language and executive functions but also suggest that executive functions themselves may be dissociable. Therefore, one can say that early language skills have positive effects on cognitive development of children who are deaf.

Besides, it is argued that the behavioral manifestations of executive function delays observable in deaf children are unlikely to be the consequences of deafness itself but rather result from the language delays that are the consequences of the deafness. The finding that deaf children experience deficits in executive functions has both clinical and educational implications. Clinical assessment of deaf children should take into account their potential difficulties with executive functions and the ways in which this might interfere with their performance in other areas, including both the cognitive and social domains. Deficits in executive functions may manifest in difficulties in organizing thoughts for writing tasks, organizing materials for lessons or homework, organizing time, and implementing lengthy verbal instructions. Poor executive functioning may also show behaviorally through difficulties in social situations, such as expressing the self and peer interactions. Behavioral management and classroom teaching may be facilitated by using learning strategies that emphasize visual cues and place minimal demands on language, so that deaf children's executive functioning can be maximized. In addition, enhancing particular aspects of language use, such as teaching deaf children to practice and implement self talk strategies for planning and problem solving, may help them make better use of their existing executive functioning and develop them more fully.

Limitations and Implications for Further Studies

This study was an attempt to assess the executive functions of children who are deaf and to clarify the linking to their language abilities. As some of the findings echo the earlier research, present study poses several questions which will require further research and evaluation.

The limited number of participants in the study has the risk of presenting biased results as well as decreasing weighting of the findings. Of the small sample size (82 children) means that the findings may reflect the characteristics of the participants, their cultural background or the structure of their social environment. A further study with a larger sample may present more accurate results.

Children with disabilities differ within their groups as they may have different levels of severity in their disability. Particularly for children who are deaf, there are numerous educational options according to their hearing and language abilities that support their development. As different educational backgrounds may cause differences in their developmental pace, including a particular group (only with severe hearing loss or only profound hearing loss) in a study may result in limited findings which are not comparable. Therefore, a future study including children who are deaf from different levels of hearing loss would provide deeper understanding of their executive functioning.

Our study provides information on the development of executive functioning of children who are deaf. However, our findings are limited to a small range of age group. A further study including a wide range of age group (i.e. 6 - 12 ages) may provide clearer results on the development of the executive functions of children who are deaf. Besides, a comparison group would provide precious information on their developmental pathways in terms of executive functioning.

References

American Guidance Services Publishing (2005). Peabody picture vocabulary test (3rd ed.). URL (last checked 11 September 2008) http://www.agsnet.com/group.asp?nGroupInfoID=a12010

Baddeley, A. (1998). The central executive: A concept and some misconceptions. *Journal of the International Neuropsychological Society, 4,* 523-526. doi:10.1017/S135561779800513X

Baker-Hawkins, S. & Easterbrooks, S. (1994). *Deaf and hard of hearing students: Educational service delivery guidelines.* Alexandria, VA: National Association of State Directors of Special Education.

Barkley, R. A. (1997). Behavioral inhibition, sustained attention, and executive functions: Constructing a unifying theory of ADHD. *Psychological Bulletin, 121,* 65-94. doi:10.1037/0033-2909.121.1.65

Berg, E. A. (1948). A simple objective technique for measuring flexibility in thinking. *Journal of General Psychology, 39,* 15-22. doi:10.1080/00221309.1948.9918159

Borkowski, J. G., & Muthukrishna, N. (1992). Moving metacognition into the classroom: Working models and effective strategy teaching. In M. Pressley, K. R. Harris, & J. T. Guthrie (Eds.), *Promoting academic competency and literacy in schools* (pp. 477-501). San Diego, CA: Academic Press, Inc.

Das, J. P., & Ojile, E. (1995). Cognitive processing of students with and without hearing loss. *Journal of Special Education, 29,* 323-336. doi:10.1177/002246699502900305

Erol, N., Akcakın, M., Akozel-Sahin, A., Dikmeer-Altınoglu, I. & Irak, M. (2006). *Standardization of neuropsychological tests used for assessing executive functions for Turkish school age children.* Proje no: 20040809183. Ankara: Ankara Üniversitesi Bilimsel Araştırma Projeleri.

Garavan, H., Ross, T. J., Murphy, K., Roche, R. A. P., & Stein, E. A. (2002). Dissociable executive functions in the dynamic control of behavior: Inhibition, error detection and correction. *Neuroimage, 17,* 1820-1829. doi:10.1006/nimg.2002.1326

Heaton, R. K. (1981). *Wisconsin card sorting test manual*. Odessa, FL: Psychological Assessment Resources.

Heaton, R. K. (1993). *Wisconsin card sorting test computer version* 2.0. Odessa, FL: Psychological Assessment Resources.

Hooper, S. R., Swartz, C. W., Wakely, M. B., DeKruif, R. E. L., & Montgomery, J. W. (2002). Executive functions in elementary school children with and without problems in written expression. *Journal of Learning Disabilities, 35,* 57-68. doi:10.1177/002221940203500105

Hughes, C., & Graham, A. (2002). Measuring executive functions in childhood: Problems and solutions? *Child and Adolescent Mental Health, 7,* 131-142. doi:10.1111/1475-3588.00024

Karakas, S. (2004). Handbook of bilnot battery: Research and development studies of neuropsychological tests. Ankara: Dizayn Ofset.

Karakas, S., Eski, R., & Basar, E. (1996). Bilnot battery: The group of neuropsychological tests which were standardized for Turkish culture. *32.* Ufuk Matbaasi: Ulusal Nöroloji Kongresi Kitabi.

Khan, S., Edwards, L., & Langdon, D. (2005). The cognition and behavior of children with cochlear implants, children with hearing aids and their hearing peers: A comparison. *Audiology and Neuro-Otology, 10,* 117-126. doi:10.1159/000083367

Kilic, B. G. (2002). Theoretical models for executive functions and attention processes and neuroanatomy. *Turkish Journal of Clinical*

Psychiatry, 5, 105-110.
Landa, R. J., & Goldberg, M. C. (2005). Language, social and executive functions in high functioning autism: A continuum of performance. *Journal of Autism and Developmental Disorders, 35,* 557-573. doi:10.1007/s10803-005-0001-1
Lezak, M. D. (1995). *Neuropsychological assessment* (3rd ed.). New York: Oxford University Press.
Luckner, J. L., & McNeill, J. H. (1994). Performance of a group of deaf and hard-of-hearing students and a comparison of hearing students on a series of problem solving tasks. *American Annals of the Deaf, 139,* 371-377.
Marschark, M., & Everhart, V. S. (1999). Problem solving by hearing impaired and hearing children: Twenty questions. *Hearing Impairment and Education International, 1,* 63-79.
Marlowe, W. B. (2000). An intervention for children with disorders of executive functions. *Developmental Neuropsychology, 18,* 445-454. doi:10.1207/S1532694209Marlowe
Meadow-Orlans, K., & Erting, C. (2000). *Mental health and deafness.* London: Whurr Publishers.
Mitchell, T. V., & Quittner, A. L. (1996). Multi method study of attention and behavior problems in hearing impaired children. *Journal of Clinical Child Psychology, 25,* 83-96. doi:10.1207/s15374424jccp2501_10
Miyake, A., Friedman, N. P., Emerson, M. J., Witzki, A. H., Howerter, A., & Wager, T. D. (2000). The unity and diversity of executive functions and their contribution to complex "frontal lobe" tasks: A latent variable analysis. *Cognitive Psychology, 41,* 49-100. doi:10.1006/cogp.1999.0734
Oner, N. (1997). Psychological tests used in Turkey: A source for researchers. Istanbul: Bogazici Üniversitesi Matbaası.
Roselli, M., & Ardilla, A. (1993). Developmental norms for the Wisconsin Card Sorting Test in 5- to 12-year old children. *Clinical Neuropsychology, 7,* 145-154. doi:10.1080/13854049308401516
Shallice, T., & Burgess, P. W. (1991). *Higher cognitive impairments and frontal lobe lesions in man.* In H. S. Levin, H. M. Eisenberg, & A. Benton (Eds.), *Frontal lobe function and dysfunction* (pp. 125-138). Oxford: Oxford University Press.
Shu, B.C., Tien, A.Y., Lung, F. W. et al. (2000). Norms for the Wisconsin Card Sorting Test in 6 - 11 year old children in Taiwan. *Clinical Neuropsychology,* 14, 275-286
Singer, B. D., & Bashir, A. S. (1999). What are executive functions and self-regulation and what do they have to do with language disorders? *Language, Speech, and Hearing Services in Schools, 30,* 265.
Spielberger, C. D., Reheiser, E. C., & Sydeman, S. J. (1995). Measuring the experience, expression, and control of anger. In H. Kassinove (Ed.), *Anger disorders: Definitions, diagnosis, and treatment* (pp. 49-67). Washington, DC: Taylor & Francis.
Spreen, O., & Strauss, E. (1998). *A compendium of neuropsychological tests: Administration, norms and commentary* (2nd ed.), New York: Oxford University Press.
Surowiecki, V. N., Sarant, J., Maruff, P., Blamey, P. J., Busby, P. A., & Clark, G. M. (2002). Cognitive processing in children using cochlear implants: The relationship between visual memory, attention and executive functions and developing language skills. *The Annals of Otology, Rhinology and Laryngology, 111,* 119-126.
Taylor, S. E., Pham, L. B., Rivkin, I. D., & Armor, D. A. (1998). Harnessing the imagination: Mental simulation, self regulation and coping. *American Psychologist, 53,* 429-439. doi:10.1037/0003-066X.53.4.429
Taylor, S. E., Peplau, L. A., & Sears, O. D. (2000). *Social psychology* (10th ed.). Upper Saddle River, NJ: Prentice-Hall Inc.
Welsh, M. C., & Pennington, B. F. (1988). Assessing frontal lobe functioning in children: Views from developmental psychology. *Developmental Neuropsychology, 4,* 199-230. doi:10.1080/87565648809540405
Wolff, A. B., Kammerer, B. L., Gradner, J. K., & Thatcher, R. W. (1989). Brain-behavior relationships in hearing impaired children: The Gallaudet Neurobehavioural Project. *Journal of the American Hearing Impairment and Rehabilitation Association, 23,* 19-33.
Wolff, A. B., & Thatcher, R. W. (1990). Cortical reorganization in hearing impaired children. *Journal of Clinical and Experimental Neuropsychology, 12,* 209-221. doi:10.1080/01688639008400968
Ylvisaker, M., & De Bonis, D. (2000). Executive function impairment in adolescence: TBI and ADHD. *Topics in Language Disorders, 20,* 29-57. doi:10.1097/00011363-200020020-00005