The Cognitive Consequences of Early Bilingualism

HANAKO YOSHIDA
University of Houston, Houston, TX

Increasing numbers of immigrant children are entering the U.S. educational system (and the larger culture), often with limited or no knowledge of the English language. One consequence of this phenomenon is increasing linguistic, cultural, ethnic, and religious diversity within our schools. While such diversity may be viewed as a positive consequence from many perspectives, it also presents challenges to teachers and educational systems. Educational and policy decisions about appropriate responses to these challenges require *systematic* research on the role of language, and particularly the use of multiple languages, in cognitive and educational development.

Educators and policymakers often worry that learning and living in two languages will slow immigrant children and have long-term negative effects on their educational achievement and acculturation. However, recent research on bilingual children suggests a quite different view—indeed, cognitive scientists now suspect that learning and using more than one language is an ordinary and common aspect of human cognition, and one with significant positive effects in terms of "cognitive flexibility" or the ability to use information from the environment to spontaneously restructure one's knowledge. Thus, a central issue in developing approaches to bilingualism and its effects on learning may not be the usual question—*one language or two?*—but rather a question of balance and of achieving excellence in both languages. Two specific research questions are generating exciting new conclusions:

1. How do the degree and balance of children's knowledge in two languages affect the cognitive consequences of bilingualism?
2. How does learning in one language translate to knowledge expressed in another?

There are certainly many other questions that one might ask about bilingualism and cognition, but new advances concerning the advantages and disadvantages of bilingualism on the developing cognitive system underscore the importance of these two issues. Furthermore, questions about language and bilingualism are often colored by ideas (not necessarily empirically established ideas) about specific immigrant groups. Thus, it is important to address the issue of the cognitive consequences of bilingualism in the context of immigrant children's learning environments in order to find solutions to the real-world challenges facing these children in American educational settings.

Cognitive Benefits of Bilingualism

Earlier perspectives on the consequences of bilingualism often viewed speaking two languages as a source of developmental problems or delays. New findings from researchers working in a variety of disciplines, including education, psycholinguistics, psychology, speech and hearing sciences, and neural processes (Bain, 1974; Peal & Lambert, 1962; Ricciardelli, 1992; Torrance, Wu, Gowan, & Aliotti, 1970), suggest that there are positive consequences of bilingualism. Researchers have discovered that the cognitive systems of bilingual children differ from those of monolingual children in some remarkable ways. Learning, speaking, and using two languages may affect fundamental aspects of cognitive and neural development, potentially influencing the way those systems learn and represent information (Bialystok, 1999; Bialystok, Craik, Klein, & Viswanathan, 2004; Bialystok & Martin, 2004; Mechelli et al., 2004).

Executive Function

The positive effects of bilingualism are seen most profoundly in what are known as executive function (or self-control) tasks. These are tasks that require the child to inhibit preferred patterns of responding (e.g., not jumping up when one should be sitting, not taking the candy when told not to, doing a task in a new way rather than an old way; Beaver & Wright, 2007; Kochanska, Murray, & Harlan, 2000; Luria, 1966; Luria, Pribram, & Homskaya, 1964; Mischel, Shoda, & Rodriguez, 1989; Zelazo & Frye, 1998). Performance in these executive function tasks is positively related to classroom success, and difficulties in these tasks are diagnostic of attentional and conduct disorders in children (Barkley, 1997; Bradshaw, 2001; Friedman et al., 2007; Schachar, Tannock, Marriott, & Logan, 1995). Indeed, there has been a surge of interest in the role that executive function plays in school activities that include planning, organizational skills, maintaining a mental set, selective attention, and inhibitory control in cognitive and social development (Blair, 2002; Blair & Razza, 2007; Carlson & Moses,

Abstract

The study of bilingual children shows that learning and using two languages may affect fundamental aspects of cognitive and neural development that influence how knowledge is acquired and used. The positive effects of bilingualism are seen most profoundly in what are known as executive function or self-control tasks, and in how the knowledge that young bilingual speakers have in one language is transferred to the other language. The author explores how the findings about cognitive flexibility among bilinguals are critical issues for classroom learning.

2001; Dempster, 1992; Graham & Harris, 1997; Hughes, 1998; Kochanska et al., 2000; Welsh, Pennington, & Groisser, 1991; Zelazo, Carter, Reznick, & Frye, 1997).

Here is the intriguing new finding concerning bilingualism: Children who speak more than one language seem to show developmentally advanced executive control. What is not known is the extent and kind of bilingualism that fosters increased executive control. What is the mechanism involved? What are the other possible correlates that *have not* been studied that may also be relevant? And, finally, what should all of this mean for educational practices?

The idea that knowing and using two languages results in advanced cognitive functioning in the area of executive function and self-control is supported by new research in cognitive neuroscience. Self-control usually means *stopping* oneself from doing something. Perhaps, then, self-control—and the neural pathways that support it—can be strengthened by practice. If this is so, children who speak two languages and must regularly shift between them must learn to inhibit the words in one language to speak the other language. A number of questions come to mind. One, which is not settled in the bilingual research literature, is whether languages comingle or are kept separate. It is unclear whether all the languages one knows remain accessible and active while one language is in use (Brysbaert, 1998; Gollan & Kroll, 2001). If both languages do remain active, then bilingualism should pose a challenge (and an effective training ground) for inhibitory processes. In fact, a number of recent studies report individuals use the same executive functions in controlling attention as they do in the suppression and separation of languages (Martin & Bialystok, 2003; Mezzacappa, 2004).

One standard task for measuring executive control in children is the Dimension Change Card Sort (DCCS) task (Zelazo & Frye, 1998). In the standard DCCS task, children are asked to sort test cards into different boxes according to some dimension (e.g., color, shape) selected by the examiner. Typically, 3-year-olds have difficulty switching from sorting by one dimension (e.g., color) to sorting by another dimension (e.g., shape) and often perseverate, sorting by the first rule even when reminded that there is a new and different rule. Older children show greater flexibility, switching to the new rule without error. This task illustrates the two sides of executive control: inhibiting responses (sorting by the old rule) and flexibility (adapting behavior to new circumstances). Recent studies document that bilingual children do better than their age mates in this task (Bialystok, 1999), and this seems to be true even when bilingual children have significantly lower English proficiency than monolinguals (using the Attention Network Test; Yang & Lust, 2004).

Photo: Hanako Yoshida

A child participates in the Dimension Change Card Sort (DCCS) task to measure executive function.

Word Learning

Past research—*all with monolingual children*—suggests that children have trouble learning a new label for an object that has an already known label. For example, young learners who know that a horse is called "horse" might reject the label "brown" if it were applied to it. Many have speculated that this is one reason why young children have such difficulty learning adjectives (e.g., Carey, 1978; Markman, 1989; Regier, 1996). However, I have recently observed (Yoshida & Smith, 2007) that bilingual 2- and 3-year-old children demonstrated greater cognitive flexibility in a novel word-learning task when compared with monolingual children.

The one-label-to-one-object assumption, called "mutual exclusivity," is sometimes considered a positive constraint on *early* word learning that promotes the early learning of nouns, but it is also a constraint that has to be overcome in later word-learning stages in order to learn adjectives, synonyms, and higher order category names (Markman, 1989; Markman & Wachtel, 1989). Indeed, considerable work suggests that monolingual children often do benefit in learning object names, based on the assumption that names refer one-to-one to categories. Moreover, older children, when challenged with two labels for a single object, will search alternative meanings (if "horse" means horse, then "brown" must mean something about the horse; Klibanoff & Waxman, 2000; Waxman, 2001). Indeed, in my own work, I have shown that when a child is given a novel word, for example, *stoof* when describing a red horse, and the child already knows the words "red" and "horse," he or she might take "stoof" as referring to a novel property of the object (such as the texture) because the red and horse aspects of the object already have labels.

When I tested both monolingual and bilingual children in this task, I found that monolingual children show stronger mutual exclusivity effects than do bilingual children (Davidson, Jergovic, Imami, & Theodos, 1997). But critically, bilingual children were better able to inhibit competing meanings in a related task and thus were better able to learn words with closely overlapping meanings. This result is consistent with models of lexical access (a process by which a person accesses words when he or she speaks) as applied to both bilinguals and monolinguals, specifically the Bilingual Interactive Model of Lexical Access (Léwy & Grosjean, 2000) and the TRACE model (Elman & McClelland, 1985).

Knowledge Transfer

These ideas about lexical competition within and between languages are related to another unresolved topic in research on bilingualism. Lexical competition refers to how an

Photo: Hanako Yoshida

A child participates in another measure of executive function, the Dragon and Bear task.

individual recognizes spoken words. For example, newly learned words will compete with existing words that sound similar (e.g., the novel word *cathedruke* will compete with *cathedral*). It has often been assumed that if an individual knows two languages, it would be better if the person's cognitive system treated them as entirely separate and noninteracting systems. This older idea of "separate systems for each language" is giving way to newer evidence on interactions in development and knowledge transfer. In fact, one intriguing result relevant to the present discussion is that knowledge of two languages deepens children's understanding of key mathematical concepts (Charmian, 2007). Most work in this area, however, has focused on the positive transfer between first and second languages in areas related to language itself, such as phonemic awareness, decoding through phonics and word recognition strategies (reading), use of a broader sense of cognates (recognizing words by their origin or similarity, or both). This transfer could mean that when children are learning through a minority language (i.e., their home language), they are not only learning this language in a narrow fashion but are also learning concepts and intellectual skills that are equally relevant to their ability to function with the majority language. For example, children who learn how to do addition in their home language do not need to learn how to add numbers in another language when they learn English. They simply acquire the new labels for what they have already learned.

How do children who learn multiple languages with different language structures develop concepts about objects and the corresponding language for those concepts? For bilingual children, the different languages may have unique and complex effects on development, particularly on object concept development. Studies of early cognitive development reveal that individuals learn to categorize concepts differently in different languages. Cross-linguistic studies of monolingual English, Spanish, and Japanese speakers suggest that speakers of all of these languages end up with the same knowledge but learn the categories in a different order. In each language, for example, individuals learn that animates move on their own, eat, and sleep; that objects are categorized by function and shape; that substances are categorized by material; and that their shapes can be altered by containers and pressure (Colunga & Smith, 2005; Imai & Gentner, 1997; Smith, Colunga, & Yoshida, 2003; Yoshida & Smith, 2001). However, there are subtle developmental differences in what is learned first in different languages. English speakers focus on object categories first, Japanese speakers focus on categories of animates, and Spanish speakers have early flexible understandings of objects and substances (e.g., that a block can be both a block and some wood; Colunga & Smith, 2005; Yoshida & Smith, 2001, 2003, 2005).

I examined how bilingual children developed an understanding of animates, objects, and substances in a study that compared English-Japanese bilingual children, half of whom lived in Japan and half in the United States, in an artificial noun-learning task (Yoshida & Smith, 2007). The results showed that (a) children learning either language as their first and only language know that animal categories are organized by multiple similarities, that object categories are organized by shape, and that substance categories are organized by material; (b) this knowledge develops as children learn language and seems to be cued by specific and different linguistic strategies in the two languages (e.g., determiners in English, verb contrasts in Japanese); and (c) there are different patterns of development in the two languages, with English children showing knowledge of objects versus substances before animates and Japanese speakers showing knowledge of animates versus objects earlier than objects versus substances (Colunga & Smith, 2005; Imai & Gentner, 1997; Landau, Smith, & Jones, 1998; Yoshida & Smith, 2001, 2005).

The next question I asked was whether the knowledge that young bilingual speakers have in one language is transferred to the other language. The results indicate a strong yes—although it depends on the strength of the children's knowledge in each of the two languages. For example, I sought to determine how well a bilingual child's knowledge of the animate-versus-object distinction when tested in English was predicted by *the strength of the child's knowledge when tested in Japanese* rather than the child's knowledge of English. Thus, learning new ideas in one language may benefit understanding of the idea even when the idea is presented in another language. The finding suggests that the benefits from being bilingual may mean more than just behavioral (attention) control but may also be important for learning and for transferring knowledge.

The Learning Environment

The issue of knowledge transfer is critical for an understanding of bilingualism for educational purposes. This issue, however, has been surprisingly poorly studied, and thus there is little evidence to make strong inferences about how and under what circumstances knowledge may be transferred into another language, and about the developmental progression (for

Learn More

University of Houston Cognitive Development Lab
www.class.uh.edu/psyc/cogdev/

The Cognitive Development Lab is conducting a variety of studies concerning how children's understanding of the world changes over time. The researchers focus on infants' and children's language learning as a tool to better understand their learning processes.

older children's transfer of literacy skills, see Legarreta-Marcaida, 1981; Miramontes, Nadeau, & Commins, 1997; Odlin, 1989; Roberts & Pennington, 1996). It is also true that these studies rarely consider the significance for immigrant children who are mostly learning concepts in a bilingual learning environment. The reasons for the failure of the contemporary cognitive literature to generalize the findings to immigrants or to examine the possible significance of the cognitive consequences for immigrant children—though the implications may well be particularly valuable for early education—are as follows:

1. There is the serious issue of the impact of sociocultural variables on bilingual research. For example, not all immigrant or bilingual populations have the same mix of cultures and languages, and, further, they are not viewed in the same way by the majority culture.
2. Identification of the contribution of the socioeconomic status factor has been challenging, particularly because there is an overwhelming proportion of low-income families among parents who have limited English proficiency (Anderson, Capps, & Fix, 2002).
3. Bilingual studies often test children whose language proficiency can be measured explicitly, so the effect of *early* exposure (under 4 years of age) to multiple languages has not been systematically studied.

The findings about cognitive flexibility—executive control and knowledge transfer—among bilinguals are critical issues for classroom learning. However, these issues need to be addressed with systematic research projects tailored to the specific issue of immigrant children's development. Learning style, attentional control, and transfer of knowledge are critical to school readiness, but we know almost nothing about the strengths and weaknesses that bilingualism brings to the learning task in early schooling. This understanding is critical to inform educational policy decisions regarding programs for bilingual learners, teachers' theoretical orientations toward bilingualism and biliteracy, and classroom decision making and instructional practices.

The joint study of cognitive development and immigrant children's learning environments promises a more integrated understanding of how bilingualism creates a different context for learning and for early cognitive development. There is a growing impetus for the research community to conduct theoretically motivated and rigorous studies of the underlying issues of what it means for the developing cognitive system to learn two languages. Two fundamental aspects of cognitive development, executive control and knowledge transfer, are specifically relevant to the question of how a two-language learning environment shapes the development of self-control, and the learning of ideas not linked to the specific language in which those ideas were first acquired. Understanding these fundamental issues should be considered prior to planning educational policies for first and second language learning for immigrant children.

Immigrant children's educational concerns certainly involve many additional factors that have not been mentioned here. Some of the relevant factors include the age of acquisition of the second language, socioeconomic status, cultural background, the balance of linguistic knowledge of each language, and how much the first and second languages differ and in what ways (e.g., grammatically or phonologically). An understanding of these issues and effective educational policies depend upon rigorous research grounded in a contemporary understanding of the learning and cognitive processes using a developmental and multidisciplinary perspective. Building a truly developmental program of research on this topic will enrich our theories of knowledge acquisition even as it advances our educational and social goals.

Hanako Yoshida, *PhD, is an assistant professor in the department of psychology at the University of Houston. Her central research focuses on language-learning mechanisms and the cognitive consequences of language learning. She is a recipient of a Young Scholars award from the Foundation for Child Development to conduct language research that aims to identify and understand the challenges faced by immigrant families and their children.*

References

Anderson, J., Capps, R., & Fix, M. (2002). *The health and well-being of children in immigrant families.* Retrieved September 11, 2003, from www.urban.org/url.cfm?ID=310584

Bain, B. (1974). Bilingualism and cognition: Toward a general theory. In S. T. Carey (Ed.), *Bilingualism, biculturalism, and education* Proceedings from the Conference at College Universitaire Saint Jean (pp. 119–128). Edmonton: The University of Alberta, Canada.

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

Beaver, M. K., & Wright, P. J. (2007). Self-control as an executive function. *Criminal Justice and Behavior, 34*, 1345–1361.

Bialystok, E. (1999). Cognitive complexity and attentional control in the bilingual mind. *Child Development, 70*, 636–644.

Bialystok, E., Craik, F. I. M., Klein, R., & Viswanathan, M. (2004). Bilingualism, aging, and cognitive control: Evidence from the Simon task. *Psychology and Aging, 19*, 290–303.

Bialystok, E., & Martin, M. M. (2004). Attention and inhibition in bilingual children: Evidence from the dimensional change card sort task. *Developmental Science, 7*, 325–339.

Blair, C. (2002). School readiness: Integrating cognition and emotion in a neurobiological conceptualization of children's functioning at school entry. *American Psychologist, 57*, 111–127.

Blair, C., & Razza, R. P. (2007). Relating effortful control, executive function, and false-belief understanding to emerging math and literacy ability in kindergarten. *Child Development, 78*, 647–663.

Bradshaw, P. (2001). *At-risk in first grade* (Master of science thesis, Dominican University of California). (ERIC Document Reproduction Service No. ED456430)

Brysbaert, M. (1998). Word recognition in bilinguals: Evidence against the existence of two separate lexicons. *Psychologica Belgica, 38*, 163–175.

Carey, S. E. (1978). Less may never mean more. In R. N. Campbell & P. Smith (Eds.), *Recent advances in the psychology of language*, (pp. 109–132). New York: Springer.

Carlson, S. M., & Moses, L. J. (2001). Individual differences in inhibitory control and children's theory of mind. *Child Development, 72*, 1032–1053.

Charmian, K. (2007). Childhood bilingualism: Research on infancy through school age. *Literacy, 41*(2), 110–111.

Colunga, E., & Smith, L. B. (2005). From the lexicon to expectations about kinds: A role for associative learning. *Psychological Review, 112*(2), 347–382.

Davidson, D., Jergovic, D., Imami, Z., & Theodos, V. (1997). Monolingual and bilingual children's use of the mutual exclusivity constraint. *Journal of Child Language, 24*, 3–24.

Dempster, F. N. (1992). The rise and fall of the inhibitory mechanism: Toward a unified theory of cognitive development and aging. *Developmental Review, 12*, 45–75.

Elman, J. L., & McClelland, J. L. (1985). An architecture for parallel processing in speech recognition: The TRACE model. In M. R. Schroeder (Ed.), *Speech and speaker recognition* (pp. 6–35). Basel, Switzerland: Karger.

Friedman, N. P., Haberstick, B. C., Willcutt, E. G., Miyake, A., Young, S. E., Corley, R. P., & Hewitt, J. C. (2007). Greater attention problems during childhood predict poorer executive functioning in late adolescence. *Psychological Science, 18*, 893–900.

Gollan, T., & Kroll, J. F. (2001). Bilingual lexical access. In B. Rapp (Ed.), *The handbook of cognitive neuropsychology: What deficits reveal about the human mind* (pp. 321–345). Philadelphia: Psychology Press.

Graham, S., & Harris, K. R. (1997). Self-regulation and writing: Where do we go from here? *Contemporary Educational Psychology, 22*, 102–114.

Hughes, C. (1998). Finding your marbles: Does preschoolers' strategic behavior predict later understanding of mind? *Developmental Psychology, 34*, 1326–1339.

Imai, M., & Gentner, D. (1997). A cross-linguistic study of early word meaning: Universal ontology and linguistic influence. *Cognition, 62*, 169–200.

Klibanoff, R. S., & Waxman, S. R. (2000). Basic level object categories support the acquisition of novel adjectives: Evidence from preschool-aged children. *Child Development, 71*, 649–659.

Kochanska, G., Murray, K. T., & Harlan, E. T. (2000). Effortful control in early childhood: Continuity and change, antecedents, and implications for social development. *Developmental Psychology, 36*, 220–232.

Landau, B., Smith, L., & Jones, S. (1998). Object perception and object naming in early development. *Trends in Cognitive Sciences, 2*(1), 19–24.

Legarreta-Marcaida, D. (1981). Effective use of the primary language in the classroom. In *Schooling and language minority students: A theoretical framework* (pp. 83–116). Los Angeles: California State University, Evaluation, Dissemination and Assessment Center.

Lévy, N., & Grosjean, F. (2000). *A computational model of bilingual lexical access*. Manuscript in preparation, Neuchâtel University, Switzerland.

Luria, A. R. (1966). *Higher cortical function in man*. New York: Basic Books.

Luria, A. R., Pribram, K. H., & Homskaya, E. D. (1964). An experimental analysis of the behavioral disturbance produced by a left frontal arachnoidal endothelioma (meningioma). *Neuropsychologia, 2*, 257–280.

Markman, E. M. (1989). *Categorization and naming in children*. Cambridge, MA: MIT Press.

Markman, E. M., & Wachtel, G. F. (1989). Children's use of mutual exclusivity to constrain the meanings of words. *Cognitive Psychology, 20*, 121–157.

Martin, M. M., & Bialystok, E. (2003, November). *Two kinds of inhibition over the life span: Evidence for separate developmental trajectories.* Poster presented at the annual meeting of The Psychonomics Society, Vancouver, British Columbia, Canada.

Mechelli, A., Crinion, J. T., Noppeney, U., O'Doherty, J., Ashburner, J., Frackowiak, R. S., & Price C. J. (2004). Neurolinguistics: Structural plasticity in the bilingual brain. *Nature, 431*, 757.

Mezzacappa, E. (2004). Alerting, orienting, and executive attention: Developmental properties and sociodemographic correlates in an epidemiological sample of young, urban children. *Child Development, 75*, 1373–1386.

Miramontes, O. B., Nadeau, A., & Commins, N. L. (1997). *Restructuring schools for linguistic diversity: Linking decision making to effective programs*. New York: Teachers College Press.

Mischel, W., Shoda, Y., & Rodriguez, M. L. (1989). Delay of gratification in children. *Science, 244*, 933–938.

Odlin, T. (1989). *Language transfer*. Cambridge, UK: Cambridge University Press.

Peal, E., & Lambert, W. (1962). The relation of bilingualism to intelligence. *Psychological Monographs, 76*(Whole No. 546), 1–23.

Regier, T. (1996). *The human semantic potential: Spatial language and constrained connectionism*. Cambridge, MA: MIT Press.

Ricciardelli, L. A. (1992). Bilingualism and cognitive development in relation to threshold theory. *Journal of Psycholinguistic Research, 21*, 301–316.

Roberts, R. J., Jr., & Pennington, B. F. (1996). An interactive framework for examining prefrontal cognitive processes. *Developmental Neuropsychology, 12*, 105–126.

Schachar, R., Tannock R., Marriott, M., & Logan, G. (1995). Deficient inhibitory control in attention deficit hyperactivity disorder. *Journal of Abnormal Child Psychology 23*(4), 411–437.

Smith, L. B., Colunga, E., & Yoshida, H. (2003). Making an ontology: Cross-linguistic evidence. In L. Oakes & D. Rakison (Eds.), *Early category and concept development: Making sense of the blooming, buzzing confusion* (pp. 275–302). Oxford, UK: Oxford University Press.

Torrance, E. P., Wu, J. J., Gowan, J. C., & Aliotti, N. C. (1970). Creative functioning of monolingual and bilingual children in Singapore. *Journal of Educational Psychology, 61*, 72–75.

Waxman, S. R. (2001). Word extension: A key to early word learning and domain-specificity. Commentary on P. Bloom. *Behavioral and Brain Sciences, 24*, 1121–1122.

Welsh, M. C., Pennington, B. F., & Groisser, D. B. (1991). A normative-developmental study of executive function: A window on prefrontal function in children. *Developmental Neuropsychology, 7*, 131–149.

Yang, S., & Lust, B. (2004, November). *Effects of bilingualism on the attention network test: Its significance and implications.* Poster presented at the Boston University Conference on Language Development, Boston.

Yoshida, H., & Smith, L. B. (2001). Early noun lexicons in English and Japanese. *Cognition, 82*, 63–74.

Yoshida, H., & Smith, L. B. (2003). Shifting ontological boundaries: How Japanese- and English-speaking children generalize names for animals and artifacts. *Developmental Science, 6*(1), 1–36.

Yoshida, H., & Smith, L. B. (2005). Linguistic cues enhance the learning of perceptual cues. *Psychological Science, 16*(2), 90–95.

Yoshida, H., & Smith, L. B. (2007, March) Different developmental trajectories for bilinguals and monolinguals: Evidence from novel word learning. In H. Yoshida & J. R. Johnston (Chairs) *Proactive interference in word learning for monolingual and bilingual children*. Symposium conducted at the biennial meeting of the Society for Research on Child Development, Boston.

Zelazo, P. D., Carter, A., Reznick, J. S., & Frye, D. (1997). Early development of executive function: A problem-solving framework. *Review of General Psychology, 1*, 1–29.

Zelazo, P. D., & Frye, D. (1998). Cognitive complexity and control: II. The development of executive function in children. *Current Directions in Psychological Science, 7*, 121–126.