

Language and verbal memory abilities of internationally-adopted children from China

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Dedication

I dedicate this thesis to the bravest and most loving man I know, my father. No words can express how much I miss you. I also dedicate my thesis to Fernand, Claire, and Manon Delcenserie. Your love and courage guide me every day to realize my greatest dreams.

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Abstract

Internationally-adopted (IA) children's language acquisition pattern is particularly interesting in that they abruptly discontinue exposure to their first language and have delayed onset of exposure to their adopted language, also referred to as their "second first language" (DeGeer, 1992). This unique pattern of language development makes it possible to investigate whether first language loss and/or delayed onset of exposure to the adopted language have long-term effects on language development. Because IA children are generally adopted into high socioeconomic status (SES) families, and thus benefit from enriched learning environment, the language abilities of IA children in the present studies were always compared to those of non-adopted monolingual children matched on age, gender, and SES instead of being compared strictly to norms. Matching made it possible to carefully investigate IA children's abilities by controlling for possible discrepancies caused by the higher parental level of education and family income of the families they are adopted into (see Hoff, 2006).

The purpose of the present research program was to investigate IA children's language abilities during school-age in order to see whether the difficulties reported in this population at younger ages persist (e.g., Gauthier & Genesee, 2011; Cohen, Lojkasek, Zadeh, Pugliese, & Kiefer, 2008) or if they decrease or disappear with more exposure to the adopted language. If the difficulties decrease or disappear, it would mean length of exposure to the adopted language was the cause of the difficulties found in IA children during preschool, but if the difficulties persist, it would mean that other factors, such as early age effects, are at play.

Because Gauthier and Genesee have previously reported that an important percentage of IA children from China scored below the norms on the Recalling Sentences subtest of the Clinical Evaluation of Language Fundamentals-Revised (CELF-R), another goal of the present research was to investigate if IA children have verbal memory difficulties in addition to their language lags. To our knowledge, these studies are the first to carefully examine the memory abilities of IA children from China and also the first to document the acquisition of French in IA children during school age.

Study 1 evaluated the language abilities of IA children from China adopted into Canadian French-speaking families as well as their non-verbal cognitive abilities, their socio-emotional development, and their health status. The children were compared to non-adopted monolingual French-speaking children matched on age, gender, and SES. The children were between 7 and 8

years of age at the time of testing. The IA children's age at the time of adoption ranged between 6 and 21 months. The results of this study showed that, while the groups did not differ on non-verbal cognitive abilities and socio-emotional development, the IA children, as a group, performed significantly lower than the controls on expressive vocabulary, knowledge of word definitions, and receptive grammar. Similar to what Gauthier and Genesee found during preschool, the IA children performed significantly lower than the controls on the Recalling Sentences subtest of the CELF-R and also more than 1 *SD* below the norms. The IA children's performance on the other measures was within age-appropriate levels.

In the light of the findings of Gauthier, Genesee, and Kasparian (2012) who found that, during spontaneous language production, preschool IA children from China made significantly more errors involving accusative object clitics than non-adopted children, Study 2 was conducted to further investigate IA children's mastery of object clitics during school age. The goal of this study was to determine whether, with additional years of exclusive exposure to French, IA children are able to master this aspect of French, which has been found to be a marker of specific language impairment (Paradis, Crago, Genesee, & Rice, 2003). This study goes beyond that of Gauthier et al. in that it provides an in depth analysis of IA children's use of accusative object clitics rather than a broad evaluation of their spontaneous morphosyntactic competence. The IA children were assessed using a Clitic Elicitation task and were compared to non-adopted monolingual French-speaking children matched on age, gender, and SES. The participants in Study 2 were the same as those in Study 1. The results indicated that the IA children omitted significantly more accusative object clitics and made significantly more agreement errors using clitics than the non-adopted monolingual French-speaking children matched on important variables. This suggests that, even with several years of exposure to French, IA children were unable to master this linguistic feature that is often acquired between 2;6 and 3;3 years of age by native speakers of French (Hulk, 1997; Hulk & Müller, 2000).

Study 3 was undertaken in order to examine IA children's memory abilities. Children's verbal short-term memory, verbal working memory, verbal long-term memory, non-verbal short-term memory, non-verbal working memory, non-verbal cognitive development, socio-emotional development, and language abilities were assessed. The IA children, 26 of whom participated either in Study 1 and/or in Gauthier and Genesee's study, were compared to non-adopted monolingual French-speaking children matched for age, gender, and SES. The children were

between 9-12 years of age at the time of testing and the IA children's age at the time of adoption ranged between 6 and 24 months of age. The results of this study showed that, although the groups did not differ on measures of non-verbal cognitive ability and socio-emotional development, the IA children performed significantly lower than the controls on expressive and receptive vocabulary, receptive grammar, a word association test, and on measures of verbal short-term memory, verbal working memory, and verbal long-term memory. The IA children did not differ from the controls on measures of non-verbal memory ability, suggesting that their memory difficulties are language-specific rather than domain-general. Their performance on the other measures was within age norms. Regression analyses further suggested that the IA children's language abilities were best predicted by their verbal memory abilities, verbal short-term memory in particular, while the CTL children's performance on language measures were best predicted by their length of exposure to French.

Overall, the findings suggest that, while IA children are quite resilient and exhibit normal general development as well as language and memory abilities that are generally within age-appropriate levels, their verbal memory abilities and aspects of their language abilities are below those of non-adopted monolingual French-speaking children matched on important variables. These difficulties suggest very early age of acquisition effects on language and verbal memory abilities, but also that the IA children's verbal memory lags might account for their lags in language, at least proximally.

Résumé

L'acquisition du langage chez les enfants adoptés internationalement (AI) est particulièrement intéressante parce que ces enfants cessent abruptement leur exposition à leur langue maternelle et ont une exposition retardée à leur langue d'adoption, aussi appelée « deuxième langue maternelle » (DeGeer, 1992). Ce modèle unique de développement du langage permet de déterminer si la perte de la langue maternelle et/ou l'exposition retardée à la langue d'adoption des ces enfant ont des effets à long-terme sur leur développement langagier. Parce que les enfants AI sont généralement adoptés dans des familles ayant un statut socioéconomique élevé et que, par conséquent, ils bénéficient d'un environnement d'apprentissage enrichi, les habiletés langagières des enfants AI qui ont participé aux présentes études ont toujours été comparées à celles d'enfants non-adoptés unilingues appariés pour l'âge, le sexe et le statut socioéconomique plutôt que d'être seulement comparés aux normes. Cet appariement a permis d'évaluer les habiletés des enfants AI en contrôlant d'éventuel écarts causés par la scolarité et le revenu familial généralement plus élevés des familles dans lesquelles ils sont adoptés (voir Hoff, 2006).

Le présent programme de recherche avait pour but d'évaluer les habiletés langagières des enfants AI d'âge scolaire afin de voir si les difficultés rapportées chez cette population, mais chez des enfants plus jeunes, persistent (e.g., Gauthier & Genesee, 2011; Cohen, Lojkasek, Zadeh, Pugliese, & Kiefer, 2008) ou si elles diminuent ou disparaissent avec davantage d'exposition à la langue d'adoption. Une diminution signifierait que la durée d'exposition à la langue d'adoption était la cause des difficultés rencontrées chez les enfants AI d'âge préscolaire. Si, au contraire, leurs difficultés persistent, cela signifierait que d'autres facteurs, tels que les « effets précoces de l'âge », doivent être considérés. Parce que Gauthier et Genesee ont précédemment rapporté qu'un nombre important d'enfants AI de Chine performant sous les normes au sous-test de répétitions de phrases de l'Évaluation Clinique des Notions Langagières Fondamentales – Édition Révisée (CELF-R), les présentes études avaient également pour but de déterminer si les enfants AI ont des difficultés de mémoire verbale en plus de leurs délais langagiers. À notre connaissance, ces études sont les premières à évaluer en détails les habiletés mnésiques des enfants AI de Chine et aussi les premières à documenter l'acquisition du français chez les enfants AI d'âge scolaire.

L'Étude 1 a évalué les habiletés langagières d'enfants AI adoptés de Chine par des familles canadiennes francophones ainsi que leurs habiletés cognitives non-verbales, leur développement

socio-émotionnel et leur santé générale. Les enfants AI ont été comparés à des enfants non-adoptés monolingues francophones appariés pour l'âge, le sexe et le statut socioéconomique. Les enfants étaient âgés entre 7 et 8 ans au moment de l'étude. Les enfants AI étaient âgés entre 6 et 21 mois au moment de leur adoption. Les résultats de cette étude démontrent que, bien qu'aucune différence n'ait été trouvée entre les groupes en terme d'habiletés cognitives non-verbales ou de développement socio-émotionnel, les enfants AI, en tant que groupe, performant significativement plus faiblement que les enfants contrôles au sous-test de répétition de phrases du CELF-R et plus d'une déviation standard sous les normes. La performance des enfants AI aux autres mesures était à l'intérieur des normes prévues pour leur âge.

À la lumière des résultats de Gauthier, Genesee et Kasparian (2012), qui ont découvert que, lors de productions langagières spontanées, les enfants AI de Chine d'âge préscolaire font significativement plus d'erreurs en utilisant des clitiques accusatifs objets que les enfants non-adoptés, l'Étude 2 a été créée afin d'évaluer en détails la maîtrise des clitiques accusatifs objets chez les enfants AI d'âge scolaire. Le but de cette étude était de déterminer si, avec davantage d'années d'exposition au français, les enfants AI sont en mesure de maîtriser cet aspect du français, aspect qui est un marqueur linguistique des troubles spécifiques du langage (Paradis, Crago, Genesee, & Rice, 2003). Cette étude va au-delà de celle de Gauthier et al. car elle fournit une analyse en profondeur de l'utilisation des clitiques accusatifs objets plutôt qu'une large évaluation de leur compétence morphosyntaxique spontanée. Les enfants AI ont été évalués à l'aide d'une tâche d'explicitation et ont été comparés à des enfants non-adoptés monolingues francophones appariés pour l'âge, le sexe et le statut socioéconomique. Les participants de l'Étude 2 sont les mêmes que ceux de l'Étude 1. Les résultats indiquent que les enfants AI omettent significativement plus de clitiques accusatifs objets que les enfants non-adoptés francophones appariés pour des variables importantes. Cela suggère que, malgré plusieurs années additionnelles d'exposition au français, les enfants AI sont incapables de maîtriser cette particularité linguistique qui est habituellement acquise entre 2;6 et 3;3 ans par les locuteurs natifs du français (Hulk, 1997; Hulk & Müller, 2000).

L'Étude 3 a été réalisée dans le but d'évaluer les habiletés mnésiques des enfants AI. La mémoire verbale à court terme, la mémoire de travail verbale, la mémoire verbale à long-terme, la mémoire non-verbale à court terme, la mémoire de travail non-verbale, les habiletés cognitives non-verbales, le développement socio-émotionnel et les habiletés langagières de ces enfants ont

été évalués. Les enfants AI, dont 26 ont participé à l'Étude 1 et/ou à l'étude de Gauthier et Genesee, ont été comparés à des enfants non-adoptés monolingues francophones appariés pour l'âge, le sexe et le statut socioéconomique. Les enfants étaient âgés de 9 à 12 ans au moment de l'étude et les enfants AI étaient âgés de 6 à 24 mois au moment de leur adoption. Les résultats démontrent que, malgré que les groupes étaient similaires en terme d'habiletés cognitives non-verbales et de développement socio-émotionnel, les enfants AI performant significativement moins bien que les contrôles aux mesures de vocabulaire expressif et réceptif, de grammaire réceptive, d'association de mots ainsi qu'aux mesures de mémoire verbale à court terme, de mémoire verbale de travail et de mémoire verbale à long terme. Les enfants AI et les contrôles performant de façon similaire aux tests de mémoire non-verbale, ce qui suggère que leurs difficultés mnésiques sont spécifiques au langage plutôt que d'être générales. La performance des enfants AI aux autres mesures était à l'intérieur des normes prévues par les tests. Des analyses de régression ont par ailleurs suggéré que les habiletés langagières des enfants AI sont mieux prédites par leur performance aux tests de mémoire verbale, au test de mémoire verbale à court terme tout particulièrement, alors que la performance des contrôles aux tests de langage est mieux prédite par la durée de leur exposition au français.

Dans l'ensemble, les résultats suggèrent que les enfants AI sont très résistants et présentent un développement général qui est normal et des habiletés langagières et mnésiques qui sont généralement à des niveaux appropriés pour leur âge. Cependant, leur performance aux tests de mémoire verbale et certains aspects de leurs habiletés langagières sont en-deçà de ceux des enfants non-adoptés monolingues francophones appariés pour des variables importantes. Ces difficultés suggèrent des « effets précoces de l'âge à l'acquisition » sur les habiletés langagières et mnésiques verbales, mais également que les délais de mémoire verbale des enfants AI pourraient expliquer leurs délais langagiers, de façon plus ou moins directe.

Statement of Original Contributions

IA children have a unique language acquisition pattern, that is, they experience delayed exposure to their adopted language and attrition of their birth language. By looking specifically at IA children from China, who are known to experience relatively good pre-adoptive care and who are not generally abandoned for reasons related to family hardship, the present research project made it possible to examine the effects of these unique language experiences on the children's subsequent language ability as well as verbal memory. Despite the fact that the data do not make it possible to disentangle the effects of delayed exposure to the adopted language and attrition of the birth language, since all the IA children whom we assessed experienced both conditions, the results of Studies 1, 2, and 3 still represent a significant advancement in the debate surrounding the consequences of delayed language exposure on development. Indeed, our results corroborate those of Abrahamsson and Hyltenstam (2009) and Vejnovic, Milin, and Zdravkovic (2010) that, despite several years of exposure to an L2, non-native language abilities and significantly lower verbal memory abilities are to be expected in learners who experience even small delays in L2 exposure.

The three manuscripts in this dissertation also all make specific original contributions specifically to our understanding of internationally-adopted (IA) children's language and memory development. First, they looked at IA children's long-term language ability and morphosyntactic competence, that is, several years after adoption. Second, they provide the first detailed evaluation of IA children's memory abilities in relation to non-adopted control children and, also, in relationship to their language development. More specifically, Study 1 is one of the first comprehensive assessments of IA children's language development that looked at a diverse range of abilities using direct assessments. Study 2 is one of very few studies that have analyzed IA children's morphosyntactic competence in depth and Study 3 is the first detailed evaluation of IA children's memory abilities in relation to non-adopted control children and, also, in relationship to their language development. These studies are the first to examine the acquisition of French in IA children from China during school age and to do so by comparing them to controls matched on age, gender, and SES. Generally speaking, controlling for these variables, which have been shown to influence children's language abilities (e.g., Hart & Risley, 1995; Hoff, 2006), made it possible to evaluate more precisely IA children's language and memory abilities in comparison to those of non-adopted children from similarly enriched learning environments.

Contributions of Authors

I defined and developed the questions, rationale, and the methodologies of each of the studies included in the present dissertation in collaboration with Fred Genesee. These studies were written by myself as manuscripts and were co-authored by Fred Genesee. Because it was originally designed to be a follow-up of the study by Gauthier and Genesee, Study 1 was also co-authored by Karine Gauthier.

I recruited and tested the participants, transcribed and coded the language samples used in Study 2, selected the measures included in the studies, and analyzed the data. Kristina Maiorino helped in the testing of the participants of Study 1 while Marta Gunin helped in the testing of the participants in Study 3. Karine Gauthier, Liane Comeau, Caroline Erdos, Aileen Bach, and Corinne Haigh helped in the selection of the measures included in Study 1 while Theres Grüter created the coding scheme used in Study 2. I drafted and edited the three manuscripts. Dr. Genesee has contributed to all stages of the process and, in particular, to the interpretation of the data, editing, and fine-tuning of the manuscripts.

Study 1 was published in *Applied Psycholinguistics* while Studies 2 and 3 are currently in press in the *Journal of Child Language*. The results of these studies were presented at several different conferences during my doctoral studies. Yuriko Oshima-Takane, Debra Titone, Theres Grüter, Kenneth Hyltenstam, and Erika Hoff have provided insightful and useful feedback and comments on earlier versions of these manuscripts. Their help is greatly appreciated and is acknowledged at the beginning of each manuscript.

During my doctoral studies, I co-supervised students and research assistants, they helped me in the recruitment and the testing of the participants. Their help is also acknowledged at the beginning of each manuscript.

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General Introduction

Since 1995, around 2000 children have been adopted from foreign countries every year in Canada (Adoption Council of Canada, 2011), most of them coming from China, Haiti, the United States, and Eastern Europe. Studies generally indicate that internationally-adopted (IA) children are adopted early in life, although this depends on several factors, such as country of adoption and reasons for adoption. In 2011, for example, more than 70% of children were adopted before 4 years of age in the U.S. (Howard & John, 2011).

It is often expected by parents, scientists, and professionals that IA children will suffer from several types of delays (Golding, Leita, & Williams, 2013). First, depending on their country of adoption and the reasons for their abandonment, IA children might have suffered from peri-natal complications, such as low birth weight, poor prenatal care, prematurity, prenatal exposure to toxins, as well as the various consequences of poverty (Golding, et al., 2013). Second, a majority of IA children is placed in institutions that do not meet their basic needs (Browne, 2009). There are indeed three main types of deprivation that children can encounter in institutional settings (Gunnar, Bruce, & Grotevant, 2000). The first includes nutrition, hygiene, and medical care; the second comprises stimulation and support for motor, cognitive, social, and language development; while the third includes stable interpersonal relationships and the possibility of developing secure attachment relationships with specific caregivers. Although researchers consider that, nowadays, institutions have greatly improved (Gunnar et al., 2000; Pomerleau et al., 2005), they often fail to fulfill children's needs adequately, and this can result in a variety of delays and difficulties. Third, reasons for giving children up for adoption differ from country to country. In China, the country of origin of the children who participated in the present studies, for example, children are put up for adoption because of that country's one-child policy, whereas in Eastern European countries, they are put up for adoption because of disabilities (23%), abuse and neglect (14%), or simply because they were abandoned (32%).

The increase in the number of IA children and the uniqueness of this population have resulted in a great deal of research that examines their general development and health and also, more specifically, their language, cognitive, and socio-emotional development. The study of IA children is not only interesting in itself, it also provides a way to examine the developmental outcomes of at-risk populations who experience adversity early in life (Gunnar et al., 2000) and, more specifically, children who experience a change from an adverse to an enriched environment.

In short, IA children provide a unique natural experiment in which to evaluate whether or not such children are resilient and are able to recover from early life adversity. Collectively, studies of IA children have aimed both to explore theoretical issues raised by their unique experiences and to better understand their post-adoption development in order to provide appropriate and effective intervention, when necessary.

The focus of the present dissertation was on language and verbal memory development in IA children and, thus, detailed reviews of relevant research in these domains are included in each of the three manuscripts that comprise this thesis. This general introduction will review research on their development in the following domains: (1) general health and development; (2) socio-emotional, behavior problems, and attention; (3) cognition, executive functions, and memory; and (4) language. Each of these domains is reviewed in the following sections.

General Health and Development

The physical growth and general health of IA children are topics of great interest in research on this population because of their importance for our understanding of the impact of pre-adoption adversity on subsequent development. Understanding development in these domains is important not only because it allows researchers to document children's ability to overcome early life adversity following the transition to a new and more enriched environment (Gunnar et al., 2000), but also because it can shed light on the developmental outcomes of other populations that experience early adversity, such as children who have been maltreated or whose parents have died. The general health and development of IA children is of particular importance because medical factors that can result in limitations to health and physical growth are likely to affect cognitive and language development as well.

In order to understand the impact of the pre-adoption environment on IA children's post-adoption development, details about their pre-adoption rearing conditions are desirable. However, unfortunately, very few details about children's pre-natal and pre-adoption conditions are usually available. To compensate for these gaps, indices of physical growth at the time of adoption (e.g., head circumference, height, and weight) are often used as surrogates for children's pre-adoptive status. Understanding the influence of the pre-adoption environment on IA children's post-adoption development is complicated further by the fact that most information about the pre-adoption environment that is available to researchers is based on parent reports and questionnaires, which are of unknown reliability.

Keeping these limitations in mind, research suggests that, in the first few months after adoption, IA children often exhibit delays in physical growth and overall medical condition. These findings have often been interpreted to reflect poor nutritional intake and lack of psychosocial stimulation pre-adoptively (van den Dries, Juffer, van IJzendoorn, & Bakermans-Kranenburg, 2010). More specifically, studies indicate that, at the time of adoption, IA children's height, weight, and head circumference (Cohen, Lojkasek, Zadeh, Pugliese, & Kiefer, 2008; Jacobs, Miller, & Tirella, 2010), sometimes as low as 1.5 *SD* below the population mean. For example, Miller and Hendrie (2000) examined 452 IA children from China, 443 girls and 9 boys, and found that the children had significant growth and developmental delays – 39% had delays in height, 18% had delays in weight, and 24% had delays in head circumference. These results have been found in other populations of IA children, such as IA children from Romania and Eastern Europe (Groze & Ileana, 1996). Other indicators of general health at the time of adoption that are often reported in studies of IA children include the presence of intestinal parasites, lead toxicity, anemia, and hepatitis B (Jacobs et al., 2010; Miller & Hendrie, 2000). Some studies also report that IA children exhibit delays in gross and/or fine motor skills at the time of adoption (Miller & Hendrie, 2000; Tan, Marfo, & Dedrick, 2010). Although there is some evidence that some IA children suffer from peri-natal complications and/or received inadequate care from their birth parents, institutional rearing seems to have particularly detrimental consequences on IA children's general health and development. Indeed, institutions often fail to fulfill children's needs adequately, which often results in several medical problems, the most common being growth failure (Johnson, 2002).

Although few studies have focused on these additional indicators of IA children's general health, reports indicate these delays and difficulties are usually resolved soon after adoption and do not affect a majority of IA children (Miller & Hendrie, 2000). Thus, in terms of long-term outcomes and catch-up, studies suggest that IA children show marked improvements over time in growth and general development post-adoption (Jacobs et al., 2010). For example, Rutter and the English and Romanian Adoptees (ERA) study team (1998) looked at 111 IA children who were adopted before two years of age from Romania into U.K. families; they had been assessed shortly after arrival and again at 4 years of age. These children were of particular interest because they had experienced severe pre-adoption deprivation. The children exhibited poor physical development at the time of adoption: 59% had a developmental quotient below 50 and 15% of

these children had a quotient in the mildly impaired range. When assessed at 4 years of age, the results showed that, despite the fact that they were still below U.K. norms, the IA children's physical catch-up was dramatic. Although 51% had been below the third percentile at the time of adoption, only 2% were below the third percentile at 4 years of age. These results show that, although the catch-up was not yet complete in these severely deprived children by age 4, their physical growth and their recovery were remarkable.

Empirical evidence suggests further that IA children who spend more time in institutions, and who are thus exposed for longer periods of time to inadequate caregiving, have poorer general health than children adopted at earlier ages in the short and long term (Pomerleau et al., 2005). In particular, several studies have found that length of time spent in institutions (measured in months) is positively and significantly related to adoptive parent reports of below normal weight, below normal height, and months of delay in fine and gross motor skills (e.g., Groze & Ileana, 1996). It has been estimated that IA children lose one month of growth for every 2-3 months spent in an institution (Gunnar et al., 2000; Johnson, 2001). Because children who spend more time in institutions are often the children who are adopted at older ages, age at adoption is also considered to be an important determinant of IA children's general health and development post-adoption.

There may be a distinction between IA children who were in institutional care and those who were placed in foster care. Although earlier studies tended to suggest that foster care is more desirable than institutional care for children's development (Barth, 2002), more recent studies indicate otherwise. Studies of IA children from Asian countries, China more specifically, have found no differences between foster care and institutionalized children with respect to height, weight, and head circumference (van den Dries et al., 2010) and that both groups suffered only from modest delays in growth over the long run. Thus, it would appear that, although they do not always provide optimal care, institutions in China have greatly improved (Johnson, Banghan, & Liyao, 1998). Unfortunately, adoption institutions have not significantly improved everywhere and countries such as Romania still struggle to give children the pre-adoptive care they need (Johnson, Browne, & Hamilton-Giachritsis, 2006). Taken together, these results indicate that countries differ in terms of the quality of pre-adoptive care they offer, and this may explain some of the heterogeneity in general health outcomes that is reported among IA children from different countries.

Notwithstanding differences due to country of adoption and age at the time of adoption, it is apparent from current research that IA children show great resilience with respect to their general health and development post-adoption. Indeed, even in instances where they have suffered from profound pre-adoptive deprivations, IA children often exhibit remarkable catch-up in their general health and development. These findings indicate both that the post-adoption environments that IA children experience are stimulating and positive and, thus, help foster their development and, also, that they are able to recover from early adversity given such environments.

Socio-Emotional Development, Behavior Problems, and Attention

The study of IA children's socio-emotional development, behavior problems, and attention has received a great deal of research attention. IA children experience unique life events that may exert a negative influence on later attachment relationships and on their socio-emotional and behavioral development in general (e.g., Eigsti, Weitzman, Schuh, De Marchena, & Casey, 2011; Groze & Ileana, 1996; Spratt et al., 2012; van den Dries, Juffer, van IJzendoorn, & Brakermans-Kranenburg, 2009). In this regard, not only do IA children experience separation from their birth parents or other caregivers when they are put up for adoption, they also spend their first months or years of life in institutions. Even though their physical needs might be adequately met, IA children who are institutionalized are nevertheless deprived of parental care and do not have the opportunities to develop stable relationships or to receive the social stimulation and support that they need for healthy social development (Gunnar et al., 2013; van den Dries et al., 2009). Thus, examining IA children's socio-emotional development, behavior, and attention is a way to examine the resilience of children who transition from a suboptimal environment to an enriched learning environment to examine the impact of early deprivation on the development of emotional, behavioral, and attention problems (Gunnar, van Dulmen, & The International Adoption Project (IAP) Team, 2007). Socio-emotional abilities, behavior, and attention will be examined first, followed by a review of research on IA children's social attachment post-adoption.

Overall, studies suggest that young IA children often experience socio-emotional and behavioral difficulties immediately after adoption. The behavior problems that are most commonly reported by adoptive parents at that time include sleeping difficulties, eating disturbances, sensory processing problems, attachment issues, behavioral problems, poor

regulation of attention, and withdrawal behavior (Jacobs et al., 2010; Rojewski, Shapiro, & Shapiro, 2000). However, the proportion of children who experience these types of difficulties decreases relatively rapidly. For example, studies estimate that 28% of IA children experience socio-emotional difficulties or behavior problems at the time of adoption (Miller & Hendrie, 2000), but only 14.4% experience delays in social skills between 2;7 and 4;8 years of age (Tan et al., 2010).

Research indicates further that not only does the proportion of children who exhibit such difficulties decrease with age, but also that, at older ages, IA children from East Asia, China, and even Eastern European countries can perform at age-appropriate levels on measures of behavioral and socio-emotional abilities. Overall, studies have found that most preschool and school-age IA children perform slightly below or within the population norms on a variety of standardized questionnaires and reports that assess aspects of social and behavioral competence, such as internalizing behaviors, externalizing behaviors, hyperactive behaviors, aggression, anxiety, attention problems, atypicality, conduct problems, depression, hyperactivity, somatization, and withdrawal. Despite the fact that most preschool and school-age IA exhibit socio-emotional and behavioral abilities that are age-appropriate, those who continue to experience difficulties usually display behaviors related to opposition, inattention, hyperactivity, and attention deficit hyperactivity disorder (ADHD; Jacobs et al., 2010). These behavior problems are thus quite different from those that are experienced by IA children at the time of adoption, indicating that the nature of the socio-emotional difficulties that they experience changes as they age.

Of particular interest are studies on the difficulties experienced by IA children who were placed in institutions where they suffered severe privations. Rutter, Kreppner, O'Connor, and the English and Romanian Adoptees (ERA) study team (2001) examined several domains of social dysfunction, including attachment, inattention and hyperactivity, emotional difficulties, and autism in a relatively large group of 165 IA children adopted from Romania. They were adopted before 42 months of age and were six years of age at the time of testing. These children are of particular interest because they had suffered from severe institutional deprivations and were, at the time of adoption, in very poor condition. The IA children from Romania were compared to 52 children who were adopted within the U.K. and experienced no serious deprivation. They found that the IA children from Romania exhibited more dysfunctional behaviors than the U.K. adoptees, particularly with respect to attachment, inattention and hyperactivity, and autism.

However, the results also suggested that these difficulties were limited to only one domain of dysfunction for 50% of the children and that 20% to 25% of the Romanian adoptees who were adopted after two years of age were free of any dysfunction at the time of assessment. Once again, these results indicate that IA children are very resilient and are able to benefit from supportive adoption environments.

Although the evidence indicates that IA children are resilient, their socio-emotional and behavioral development in general rely heavily on length of institutionalization. For example, Groze and Ileana found that length of time in institutions (assessed in number of months) was positively and significantly correlated with parents' reports of degree of delay in the development of social skills and also with IA children's scores on the Internalizing problems subscale of the Child Behavior Checklist (Spratt et al., 2012). The quality of the care that IA children receive pre-adoptively also appears to be related to subsequent behavior problems. In this regard, Roy, Rutter, and Pickles (2000) found that the IA children from Eastern Europe who were placed in institutions before 12 months of age and were about 80 months of age at the time of assessment had significantly higher levels of inattention, hyperactivity, and disruptive behavior than the IA children from Eastern Europe placed in foster care at the same age.

Evidence suggests that IA children are particularly prone to experience difficulties with hyperactivity and inattention. More specifically, between 15% and 40% of IA children are diagnosed with and treated for ADHD (e.g., Glennen & Bright, 2005; Welch, Viana, Petrill, & Mathias, 2007). A particularly relevant study by Lindblad, Weitoft, and Hjern (2010) examined rates of medication for ADHD among IA children from several countries who were adopted by Swedish families before two years of age and who were between 6 and 21 years of age at the time of assessment. They found that, compared to non-adopted children matched on gender, the IA children had significantly higher rates of medication for ADHD. Interestingly, the highest rates of ADHD medication were found among adopted boys, between 10 and 15 years of age, who were adopted from Eastern Europe (12.6%) and the Middle East/Africa (6.7%). Adopted girls from Eastern Europe, between 10-15 years of age, also had a relatively high rate (6.7%) of ADHD medication.

Because institutionalization interrupts the parent-child bonding cycle (Groze & Ileana, 1996), there are reasons to believe that IA children might have particular difficulties with attachment. Indeed, studies reveal that IA children do have attachment problems (e.g., Eigsti et

al., 2011), but that their attachment difficulties may not be long lasting. Cohen and Farnia (2011) examined attachment in IA children from China after 6 weeks of arrival in Canada, when they were about 13.5 months of age, and then again at 6 months, 12 months, and 24 months post-adoption. The IA children were compared to non-adopted children matched on age and family background. Their results showed that, although, at the time of adoption, the IA children were less securely attached than the control children, by 24 months after adoption, they exhibited the same levels of secure attachment as their non-adopted peers. Findings indicate further that, taken together, age at adoption and country of origin are particularly important for attachment security. Indeed, in a meta-analysis of 39 studies ($N = 2912$ adopted children), van den Dries et al. (2009) found that the IA children who were adopted before 12 months of age displayed the same levels of secure attachment as non-adopted children. In addition, they found that, although no differences were found between Asian adoptees and non-adopted children on attachment security, this was not the case for the IA children from Romania. The latter were found to show less secure attachment than their non-adopted peers. Similar findings have been reported with respect to length of institutionalization, with duration of institutionalization being positively and significantly correlated with disorganized and insecure attachment behaviors (Eigsti et al., 2011).

Taken together, the findings from these studies are in agreement with the developmental niche theory (Harkness & Super, 1994). This theory is based on the assumption that the household is particularly important for a child's survival and development. Three subsystems of the household are thought to be important for children – namely, the physical and social settings they live in, the culturally-related customs of child care and child rearing, and the psychology of the caretakers (Harkness & Super, 1994). More specifically, the psychology of the caretakers includes the cultural beliefs of the parents concerning the behavior and the development of their child, which, in turn, influences the care that they will provide their children and the choices that they make for them (Harkness & Super, 1994). These subsystems are thought to be particularly important for a child to be able to abstract the social and affective rules/norms of his/her culture. Because IA children live their first months of life in institutions that do not provide optimal settings or close relationships with caregivers, they are at-risk of developing social and affective difficulties. This theory is quite similar to Bronfenbrenner's bioecological model of development, which specifies that the social environment children live in has shaped their development in significant ways (Hoff, 2006). The social environment, according to Bronfenbrenner's theory,

includes proximal and distal systems such as culture, socioeconomic status, and ethnicity. A growing body of research suggests that IA children's behavioral and socio-emotional difficulties could have a neurological basis; but it is reviewed in the next section since it also pertains to IA children's risk for cognitive difficulties.

Although such theories and empirical evidence suggest that IA children are at-risk of developing socio-emotional, behavioral, and attentional difficulties, findings from numerous studies have also found that this is not true for a majority of children in the long run.

Cognitive Development, Executive Function, and Memory

Another major area of research on IA children is cognitive development. The study of IA children's cognitive development is of particular interest because it provides insights on the effects of adoption on cognitive development and, more specifically, on specific aspects of cognition that might be affected by institutionalization (Pollak et al., 2010), but also because cognitive abilities have often been found to be related to children's development in other areas, such as language, the focus this dissertation. While early studies tended to focus on non-verbal IQ, more recent studies of IA children's long-term cognitive abilities have included measures of non-verbal memory and executive function, such as cognitive control. The tasks usually used to measure cognitive development include verbal and non-verbal IQ tests or other standardized measures of cognitive functioning, such as the Mental Developmental Index of the Bayley Scales of Infant Development or the McCarthy Scales of Children's Abilities.

In terms of cognitive development at the time of adoption, or shortly after adoption, research has shown that IA children generally exhibit poorer cognitive abilities than non-adopted children (e.g., Cohen et al., 2008; Eigsti et al., 2011; Hostinar, Stellern, Schaefer, Carlson, & Gunnar, 2012). However, research also indicates that, in general, IA children are able to catch-up to non-adopted children over time. For example, Gauthier and Genesee found that the non-verbal IQ of IA children from China who were adopted between 6-24 months of age and who were tested between 41.5 and 56 months of age, 19-46.5 months after adoption, was not significantly different from that of non-adopted children matched on age, gender, and socio-economic status (see also Cohen et al., 2008, for similar results). Similarly, Roy et al. examined the cognitive development of IA children from Romania who were adopted at various ages (up to 42 months of age). Although more than half of the children were severely retarded at the time of adoption into U.K. families, by six years of age, their cognitive functioning had almost caught up to the

population mean. Perhaps the most encouraging results on IA children's cognitive abilities come from a report by van IJzendoorn, Juffer, and Klein Poelhuis (2005) based on a meta-analysis of 62 studies ($N = 17\,767$ adopted children). They found that IA children had significantly higher IQ than their non-adopted siblings and peers who stayed in their birth country, but also that their IQ did not differ from that of their environmental peers or siblings. These studies suggest, moreover, that these positive results are long-term. Indeed, several studies reveal no difference in cognitive ability (IQ) exist between IA and non-adopted children, at least from 4;0 years of age until 13;0 years of age (Eigsti et al., 2011; Scott, Roberts, & Krakow, 2008; Roy et al., 2000).

As reported earlier with respect to IA children's health and physical growth, researchers have found that length of institutionalization and, in a related vein, age at the time of adoption are important correlates of adoptees' cognitive development. Rutter and the ERA study team, for example, found that, among their sample of IA children from Romania, those who had experienced less than 6 months of institutionalization performed similarly to U.K. population norms and also did better than IA children who were institutionalized for longer periods of time (see Croft et al., 2007, for similar results). They also reported that age at the time of arrival was the most powerful predictor of IA children's cognitive abilities at age 4. Studies that have compared the cognitive abilities of IA children placed in foster care with that of IA children placed in institutions suggest that foster care children develop better cognitive abilities than children who are institutionalized (e.g., Güler, Hostinar, Frenn, Nelson, Gunnar, & Thomas, 2012; van den Dries et al., 2010). Notwithstanding such between-group differences in overall ability, both groups are reported to display the same rate of growth in cognitive abilities as experienced by non-adopted children (van den Dries et al., 2010).

A detailed examination of studies that have examined IA children's cognitive abilities call for caution when interpreting their results. More specifically, most studies that have found differences in cognitive abilities between adopted and non-adopted children used tests of cognitive ability that include a verbal component, such as the Stanford Binet (Hostinar et al., 2012) or the Wechsler Intelligence Scale for Children (Merz, McCall, Wright, & Luna, 2013). In contrast, studies that report no differences in cognitive ability used non-verbal measures, such as the Leiter International Performance Scale (Gauthier & Genesee, 2011) or the Differential Ability Scale (Scott, Roberts, & Krakow, 2008). Thus, IA children's language abilities, a topic that will be discussed later, might bias the evaluation of their cognitive abilities.

As mentioned earlier, recent studies of IA children have examined more specific aspects of cognitive ability, such as cognitive control, cognitive flexibility, and inhibitory control, although these studies are few in number. The results of these studies indicate that IA children generally perform more poorly than non-adopted children on all these measures of executive function, even several years after adoption into an enriched environment (e.g., Hostinar et al., 2012; Loman et al., 2013; Pollak et al., 2010). For example, Hostinar et al. examined the cognitive flexibility and inhibitory control of IA children adopted between 16-36 months who were between 2;6 and 4;0 years of age at the time of testing. They found that the IA children performed more poorly than the non-adopted children on these measures, even when the effects of IQ were partialled out.

A topic somewhat related to executive function and cognition but that has received even less attention is memory. Few studies have included measures of memory ability, either verbal or non-verbal. In general, these studies have found that IA children experience difficulties on measures such as sentence recall (Gauthier & Genesee, 2011; Windsor, Moraru, Nelson, Fox, & Zeahah, 2012), non-word repetition (Windsor et al., 2012), and short- and long-term recall of lists of words (Eigsti et al., 2011). In contrast, studies suggest that IA children generally do as well as non-adopted children on measures of non-verbal memory, such as spatial working memory, except for children who have been institutionalized for more than 12 months (Güler et al., 2012; Merz et al., 2013; Pollak et al., 2010, Windsor et al., 2012). A more complete review of this topic will be left to the thesis studies themselves.

As mentioned earlier, a growing body of research indicates that IA children's cognitive difficulties implicate glucocorticoids, that is, stress hormones, and the biological systems involved in stress responses. According to these studies, including recent reports by Eigsti et al. and van den Dries et al. (2009), the stress of institutionalization modifies both the development and the activity of glucocorticoid stress hormones that are regulated by the hypothalamic-pituitary-adrenal (HPA) axis to cause long-lasting behavioral and neuroanatomical impairments. It has also been found that more severe deprivation is associated with higher levels of stress hormones (Wisner Fries, Shirtcliff, & Pollak, 2008). These heightened levels of glucocorticoids have been found to affect biological systems involved in stress responses, such as the hippocampal-dependent learning systems (Lupien & McEwen, 1997) and the prefrontal cortex (Arnsten & Goldman-Rakic, 1998; Eigsti et al., 2011). Together, these systems are involved in higher order cognitive processes, such as memory and executive processes, as well as language

acquisition and competence (Eigsti et al., 2011). Although this hypothesis would explain IA children's lags, it does not explain children's resilience and how they can catch up to age-appropriate levels of abilities.

Despite the fact that IA children seem to experience lags in general cognitive abilities and, more specifically, in executive functions and, possibly, verbal memory abilities, most studies suggest that IA children are resilient and are able to catch up to age-appropriate levels and to their non-adopted peers. Although the hypothesis attributing IA children's cognitive difficulties to high levels of stress hormones seems promising, more research is needed to verify this hypothesis and to explain how it could eventually explain IA children's lags and their catch up to appropriate levels of abilities. Moreover, while some results suggest that IA children might have difficulties with verbal memory, it is important to keep in mind that, to date, no detailed assessment of IA children's memory abilities has been carried out; this was the topic of Study 3 in the present thesis.

Language Development

As noted earlier, IA children's language acquisition experiences are unique in comparison to other language learners. First, IA children differ from monolinguals insofar as it is widely reported that many IA children experience loss of the first language when they begin to acquire the adopted language; this is reported to occur soon after adoption (Gindis, 1998, Nicoladis & Grabois, 2002). For example, Gindis reported that most IA children lose expressive language abilities in their first language (L1) within three months post-adoption while they lose receptive language abilities within six months to one year after adoption (see Nicoladis & Grabois, 2002, for similar results). However, the extent to which IA children lost their L1 completely is unresolved insofar as some recent evidence based on neuroimaging studies suggests that IA children's short experience with their birth language has some lasting effects (Pierce, Klein, Chen, & Genesee, 2013); in contrast, other studies suggest that IA children do not retain long-term neuro-cognitive traces of their birth language (Pallier, 2007).

Second, IA children also differ from children who acquire more than one language. Specifically, they differ from simultaneous bilinguals, who acquire two or more languages from birth because IA children are not exposed to two languages simultaneously and acquire only the adopted language post-adoption; thus, they do not divide their exposure between two languages. Although IA children and second language (L2) learners both experience delayed onset of

exposure to the L2, these groups differ in that L2 learners continue to acquire their birth language while IA children's exposure to their birth language stops at the time of adoption. For this reason, IA children's language acquisition has often been referred to as "second first language acquisition" (DeGeer, 1992). As a result of this unique language learning profile, IA children are an interesting natural experiment of the effects of early delayed language exposure on language learning, on the one hand, and of attrition of the birth language on subsequent language learning, on the other hand.

In terms of age-of-acquisition effects, the critical period hypothesis (CPH) would lead one to believe that IA children might attain native like levels of ability in the adopted language because they begin to acquire this language well within what is thought to be the critical period, that is, before 12-15 years of age (Lenneberg, 1967). Nonetheless, more recent studies, that will be reviewed later, suggest that even small delays in L2 exposure can lead to non-nativelike language performance (Hyltenstam, Bylund, Abrahamsson, & Park, 2009). By examining the language development of IA children adopted very early in life it is possible to investigate whether even a small delay in language acquisition might cause long-term language lags or difficulties. Thus, the studies included in the present thesis were designed to see if IA children's language outcomes would be equivalent to those of native speakers or whether there would be lags or deficits in their development due to delayed onset of exposure to the adopted language.

However, there is also growing evidence that L2, even early L2 learning, is critically dependent on L1 learning. As a result, IA children who undergo attrition of the L1 might be expected to be at a disadvantage in learning the L2. Indeed, research on early language learning suggests that L1 exposure and acquisition provide a critical foundation for acquisition of additional languages. In effect, several studies by Mayberry (2007) showed that L1 acquisition is a determining factor not only for successful L1 acquisition, but also for L2 acquisition. For example, a study of deaf adults ($n = 31$; 17-53 years of age) who had been exposed to American Sign Language (ASL) as a primary language for at least 10 years showed that adults who had higher levels of sign language proficiency were more skilled at reading English as a second language than adults whose ASL proficiency was poorer, suggesting that, even when languages involve different modalities, strong L1 skills facilitate L2 learning. Thus, it might be expected that, given attrition and/or incomplete acquisition of the birth language, IA children might not

possess a critical foundation for acquisition of the adopted language and, therefore, exhibit poorer language skills than native speakers.

In contrast, some studies suggest, on the one hand, that L1 acquisition would limit the processing of a L2. This idea is also known as the Native Language Neural Commitment Hypothesis (NLNC; see Kuhl, 2004 for a complete description of this hypothesis). The general idea of this hypothesis is that, at birth, infants possess the ability to discriminate the phonetic units used in all natural languages (Kuhl, 2004; Werker & Tees, 2002), thereby ensuring that infants will be able to discriminate the phonetic contrasts used in the language they will be exposed to. However, after 12 months of age, infants lose the ability to discriminate non-native phonetic contrasts and this gives rise to language-specific patterns of listening. Language learning becomes possible as infants' brains commit neural networks to the native language, and subsequent learning focuses on the patterns of variation of that language and not on non-native patterns that were initially learned (Kuhl, 2004). Therefore, the brain's neural commitment to the statistical and prosodic properties of the native language will foster the use of these patterns in higher-order native-language computations and will, at the same time, interfere with or limit the processing of non-native language patterns that do not conform to those that have been learned (Kuhl, 2004). This hypothesis might argue that IA children's exposure to their birth language, both prenatally and prior to adoption, would limit the acquisition and learning of the language patterns of their adopted language and, in consequence, could cause language difficulties or non-nativeness.

On the other hand, there is also evidence suggesting that it is the incomplete attrition of the L1 that limits the acquisition of an L2. As mentioned earlier, Pallier's hypothesis states that loss of the birth language permits full acquisition of the adopted language. Indeed, the more advanced the learning of the L1, the less the language networks that have been established can be modified by exposure to L2 (Pallier, 2007). In terms of international adoption, this hypothesis would predict that IA children who are adopted at younger ages are better at acquiring their adopted language since few language networks have been established by exposure to the L1.

Pre-school language outcomes. Most studies of language development in IA children have focused on the preschool years. The study of IA children's language acquisition during the preschool years, that is, during the first few years after adoption, is particularly interesting since it is the time during which these children adjust to the major changes that occurred in their

personal, social, linguistic, and physical environment (Paradis, Crago, & Genesee, 2011). Studies carried out on this age group indicate that, on average, IA children perform within age-appropriate levels on general measures of language ability, such as standardized tests of vocabulary and grammar, parent reports, and questionnaires, relatively soon after adoption – often within 12 months post-adoption (Krakow & Roberts, 2003; Snedeker, Geren, & Shafto, 2007; Roberts, Krakow, & Pollock, 2003). More specifically, it has been reported that most IA children below 6 years of age who were adopted before 25 months of age perform within or above age-appropriate levels on measures of receptive and expressive vocabulary (Clark & Hanisee, 1982; Roberts et al., 2003), vocabulary size (Roberts et al., 2005; Tan, Locker, Dedrick, & Marfo, 2012), articulation (Roberts et al., 2005; Roberts et al., 2003), auditory comprehension, and expressive communication (Jacobs et al., 2010).

A number of studies, although few in number, have analyzed preschool IA children's language development in detail. These studies have found that IA children display the same patterns of vocabulary and grammatical development as non-adopted monolingual children. In this regard, Snedeker et al. found that IA children adopted around 4;0 years of age and who had been in the U.S. for 18 months exhibited the same shifts in vocabulary composition as non-adopted children; that is, the IA children's production of nouns decreased as their general vocabulary grew and as the proportion of closed-class items in their repertoire increased. In comparisons of IA children's morphosyntactic development to that of first language learners, on the one hand, and second language learners, on the other, Pierce, Genesee, and Paradis (2012) found that IA children who were learning French as a new language and were between 0;10 and 1;1 at the time of adoption and were assessed from 9 to 34 months post-adoption exhibited the same morphosyntactic patterns of development as L1 learners. In particular, like L1 learners, they used tense and non-tense morphemes flexibly 15 months post-adoption; they were able to use auxiliary "*be*" productively by 12 months post-adoption; and they had mastered affixal verbal inflections, such as third person singular *-s*, past tense *-ed*, and past tense irregular forms, by 27 months post-adoption. Taken together, these results indicate that the developmental trajectory of IA children with respect to both vocabulary and grammatical development mirrors that of non-adopted first language learning children and that this is evident relatively soon after adoption.

Despite these positive findings, several studies report large inter-subject variability in their samples of preschool IA children, meaning that the IA children had a large range of scores (e.g.,

Gauthier & Genesee, 2011; Glennen, 2007; Scott, Roberts, & Glennen, 2011). This could be attributed to several reasons, such as IA children's different pre-adoption experiences or bias in parent reports. As will be reviewed later, this large variation in outcomes can also be attributed to the wide ranges in ages at adoption and in ages at assessment that are characteristic of several studies of IA children's language acquisition.

Language outcomes during the school years. Fewer studies have focused on IA children's language abilities during school age; but those that have found that they continue to display signs of successful adaption and developmental resilience at older ages. Specifically, it has been found that IA children often score within or above age-appropriate levels or similar to non-adopted children on a variety of measures of language development, including parent questionnaires and rating scales as well as standardized tests, such as the Clinical Evaluation of Language Fundamentals (CELF; e.g., Scott et al., 2008). IA children have also been shown to score average or above average on measures of oral language (including the Formulated Sentences subtest of the CELF and tests of narrative abilities), phonological processing, reading, spelling, word reading, reading comprehension, and phonetic decoding (e.g., Scott, Pollock, Roberts, & Krakow, 2013; Scott et al., 2008). A study by Dalen and Ryvgold (2006) also suggests that, as evaluated on a 19-point scale by teachers, the IA children acquire appropriate levels of both everyday and academic language skills. However, their study also showed that there was greater disparity or variance in their scores on tests of everyday and academic language skills than among non-adopted children of similar age, gender, and school-grade. Greater variability in IA children's performance has also been reported in several studies of older IA children (e.g., Dalen & Ryvgold; Gauthier & Genesee, 2011; Roberts, Pollock, & Krakow, 2005), suggesting that a larger than expected subgroup of IA children experience language difficulties during the school years (Scott, Roberts, & Glennen, 2011). Indeed, studies report that between 29% and 52% of school-age IA children experience language difficulties and about 40% receive speech and language services (Raaska et al., 2013; Tirella, Chan, & Miller, 2006; Welsh et al., 2007). Similarly, it has been found that between 16% and 36% of IA children receive special education services, and other studies report that their school achievement is significantly lower than that of their non-adopted siblings or peers (van IJzendoorn et al., 2005). However, this difference appears to be significant only for IA children who were adopted after 2 years of age (van IJzendoorn et al., 2005).

Aside from the neuroimaging studies discussed earlier, only one study to date has examined IA adults' language abilities (Hyltenstam et al., 2009). These researchers examined whether IA adults were able to acquire native-like levels of language ability in their adopted language. More specifically, Hyltenstam and his colleagues examined the language performance of four IA participants who had been adopted in Sweden from Spanish-speaking countries when they were between 1 and 9 years of age and were between 29 and 33 years of age at the time of testing. They were compared to 15 native speakers of Swedish and to 27 L2 speakers of Swedish who were immigrants from Spanish-speaking families. Both comparison groups were similar to the IA adults in terms of age. The L2 learners were similar to the IA adults in terms of onset of exposure to Swedish while both comparison groups were matched to the IA children on age, gender, and education. Their performance was compared using a battery of demanding tests, such as tests of speech perception in noise, grammaticality judgment tasks, a voice onset time (VOT) task, and a Cloze test. Although the four IA participants performed within the native-speaker range on some of the measures, only one of the IA adults performed within the native-speaker range on all tests in the battery. There were no differences between the results of the IA adults and the L2 learners of Swedish, even though the latter had maintained their L1. Despite the small sample size, these results suggest that, despite several years of exposure to the adopted language, most IA adults do not attain native-like levels of language abilities.

Few studies have investigated IA children's or adults' knowledge and retention of the birth language. Research that has been conducted on this issue (e.g., Hyltenstam et al., 2009; Pallier et al., 2003; Pierce et al., 2013) has been carried out under the hypothesis that, since most IA children are adopted after the closure of the sensitive period for phonology, usually taken to be one year of age (Kuhl, 2000), they will retain at least the phonology of the birth language. Ventureyra, Pallier, and Yoo (2004) compared the phonological abilities of IA adults adopted from Korea between 3-9 years of age by French-speaking families; they were assessed between 22-36 years of age and compared to a group of 12 native speakers of French and 12 native speakers of Korean. Some of the IA adults (9/18) had been re-exposed to their birth language during stays in Korea that lasted from 10 days to 6 months. The groups were compared on their capacity to discriminate Korean voiceless consonants in pseudo-words that included consonant and vowel contrasts characteristic of Korean but not French. No significant differences were found between the IA adults and the native French speakers or between the IA adults who have

been re-exposed to Korean and those who had not (see also Hyltenstam et al., 2009 for similar results), suggesting that the IA adults did not have access to neuro-cognitive traces of phonetic categories in Korean and that their birth language probably underwent attrition. Using fMRI, Pallier et al. also looked at the activation patterns of IA adults adopted from Korea by French families between 3-8 years of age and of native French speakers. The participants, who were between 20-32 years of age at the time of testing, were presented with full sentences in French, Korean, Polish, and Japanese while their cortical activations were being monitored. Because none of the participants had prior exposure to Polish or Japanese, these sentences were used as controls. No significant differences were found between the activation patterns of the IA adults and those of the native French speakers when they were presented with full sentences in Korean, French, Polish, and Japanese sentences. That is to say, the IA adults showed no evidence of long-lasting traces of Korean. These results suggest that IA adults do not retain neurological traces of their L1 (Pallier et al., 2003). However, more research is called for in order to confirm these results and uncover the processes involved in IA adults' L1 attrition.

Notwithstanding generally positive findings concerning IA children short- and long-term language outcomes, there are important factors to consider when looking at the language development of IA individuals (see Scott et al., 2011, for a review). On the one hand, evidence indicates that IA children who start to acquire the adopted language early, more specifically before 24 months of age, generally display better language outcomes and are more likely to attain levels of ability that are similar to native-speaking, non-adopted children or within age norms more easily and sooner than IA children who are adopted at older ages (e.g., Gauthier & Genesee, 2011; Jacobs et al., 2010; Scott et al., 2008). On the other hand, children who are adopted at older ages usually show more rapid progress initially after adoption than children who are adopted at younger ages. However, their overall progression is slower and they are less likely to reach parity with that of native-speaking non-adopted children (e.g., Krakow, Tao, & Roberts, 2005; Pollock, 2005; Snedeker, Geren, & Shafto, 2012). These age-related differences can be explained, in part, by the fact that, in contrast to older adoptees, young IA children spend less time in institutions and, therefore, experience less deprivation. Younger adoptees may also retain more developmental plasticity which helps them overcome any adverse effects associated with their pre-adoptive rearing environments and makes it possible for them to adjust and thrive better in their new environment than older adoptees. Children adopted at older ages, in contrast, not only

spend more time in institutions or in a pre-adoptive environment that might be dysfunctional, but the delay in exposure to the adopted language is also longer.

The short and long-term outcomes of IA children are also dependent on their country of origin. The reasons why children are put up for adoption, the typical age at adoption, and the pre-adoptive care that IA children receive, either in their families or in institutions, vary greatly from one country to another. For example, IA children from China are usually given up for adoption because of the country's one-child policy (Johnson et al., 1998). In contrast, children in other countries are often given up for adoption because of socio-economic, drug- and health-related problems in the birth families, birth parents' difficulties coping with adverse conditions in their lives, etc. Thus, adoptees from China are likely to spend less time in institutions and, moreover, they often experience more favorable pre-adoption living conditions than children from other countries (e.g., Gauthier & Genesee, 2011; Johnson et al., 1998; Miller & Hendrie, 2000; Pomerleau et al., 2005). Studies report that IA children who live in seriously impoverished or adverse pre-adoptive conditions are more likely to exhibit long-term developmental, behavioral, cognitive, and language outcomes that are lower than age-matched non-adopted peers (e.g., Rutter & the ERA study team, 1998). However, adoption itself is not a risk factor for IA children's language or general development. As mentioned earlier, research shows that adopted children generally show significant improvement in many aspects of development following adoption and performance when compared to non-adopted siblings or peers who are left behind (van IJzendoorn et al., 2005).

As well, despite the fact that IA children have often been found to perform within age-appropriate levels on standardized measures of language abilities or similar to their non-adopted peers when assessed using parent reports, recent studies have shown that even children who have been raised in favorable pre-adoptive environments may exhibit long-lasting lags in language ability when compared to monolingual non-adopted children matched on important variables such as age, gender, and socioeconomic status, factors that are often associated with language ability (e.g., Hoff, 2006). Of particular relevance to the present study, Gauthier and Genesee compared IA children adopted by French-speaking families in Canada between 7 and 24 months of age with non-adopted monolingual French-speaking children matched for age and SES. The children were assessed between 41-57 months of age and a second time between 64-74 months of age. They found that the IA children performed within age-appropriate levels on standardized

measures of language abilities, such as the CELF, the Peabody Picture Vocabulary Test (PPVT), and the Expressive One-Word Picture Vocabulary test (EOWPVT). Most importantly, however, they scored lower than the matched non-adopted children on these measures (see also Cohen et al., 2008, and Eigsti et al., 2011, for similar results). Thus, it would appear that, compared to non-adopted children raised in similarly enriched learning environment, IA children exhibit language lags that may not be revealed when their performance is only compared to norms that do not take socio-economic status (SES) or gender into account. Moreover, because most previous studies included children adopted from several different countries and at different ages and assessed them using norm-referenced measures instead of comparing them to non-adopted children matched on important variables (except see Cohen et al., 2008; Eigsti et al., 2011; Gauthier & Genesee, 2011), caution is called for when interpreting and generalizing their results.

Present Research Project

The present dissertation focused on IA children from China. This group of IA children was chosen specifically because, as mentioned earlier, they are put up for adoption for reasons that are unlikely to affect their long-term development than is the case for children adopted from other countries. Moreover, most IA children from China are given up for adoption at relatively young ages in comparison to children from other countries and, thus, that they are institutionalized for shorter periods of time. Consequently, they have less exposure to adverse pre-adoptive circumstances. They thus provide a unique and important context for understanding issues related to early delay in language exposure and retention (or attrition) of the birth language.

The studies reported here were designed to take into account weaknesses of previous research, while, at the same time, extending previous work. Thus, the studies that comprise this dissertation included only IA children from China who were both adopted and assessed within a narrow age range. Specifically, the IA children who participated in the studies included in the dissertation were between 6-24 months of age at the time of adoption and were between 7-8 or 9-12 years of age at the time of testing. Several studies of IA children that have been done to date included children adopted from several different countries and/or children with a very wide range in both age at adoption and age at the time of testing. For example, Eigsti et al. looked at IA children from Europe, Asia, and South America who had been adopted at different ages – from one month to more than 25 months of age, and who were assessed when they were between 4 and 13 years of age. As mentioned earlier, this is problematic because it creates wide outcome

variation, making it impossible to generalize results from specific studies to individual children (Paradis et al., 2011).

In addition, the IA children who participated in the present study were compared directly to non-adopted children matched on age, gender, and socio-economic status, factors that are often associated with language development. All of the factors used to match the children contribute to a relatively enriched language-learning environment (e.g., Hart & Risley, 1995; Hoff, 2006); thus, the design of the present studies made it possible to evaluate IA children's language development in comparison to children who had benefited from similarly enriched environments.

As revealed by the preceding review of research, few studies of older IA children have been carried out, making it difficult to determine if any lags in language development they exhibit soon after adoption are evident over the long term. Moreover, few studies have been conducted to document IA children's linguistic abilities in detail and, to date, no in-depth evaluation of IA children's memory abilities has been done. The aim of this dissertation was to address these gaps in our knowledge by examining: IA children's general language abilities during the early school years (Study 1), specific features of their language development that have been shown to be difficult for other learners of French to acquire, namely, accusative object clitics (Study 2), and their verbal memory abilities and possible links to their language outcomes (Study 3). These studies are unique because they compared IA children to non-adopted monolingual children matched on age, gender, and SES, variables that can influence children's language development and abilities, but also because they looked at the acquisition of a language that is not often investigated in IA children, namely, French.

More specifically, Study 1 was conducted to examine whether the lags in language abilities found by Gauthier and Genesee in IA children from China could be attributed to insufficient exposure to the adopted language. This was done by assessing the expressive and receptive vocabulary, receptive grammar, reading comprehension, knowledge of word definitions, sentence recall, and the ability to make word associations in a group of 7-8 year old IA children. Their non-verbal cognitive abilities and their socio-emotional development were also assessed to examine other aspects of their development post-adoption and, thereby, to determine whether the impact of pre-adoption and post-adoption experiences were general in nature or language-specific. The IA children who participated in Study 1 ($n = 27$; ages: 7;0-8;8 years of age) were adopted into French-speaking families when they were between 7 and 21 months of age. They

were compared to 27 non-adopted monolingual French-speaking children (ages: 6;9-8;10 years of age) on age, gender, and SES. The results showed that, although the IA children performed within age norms on most measures, their performance was significantly lower than that of the controls on expressive vocabulary, receptive grammar, sentence recall, and knowledge of word definitions. Similar to what has been found by Gauthier and Genesee for preschool IA children from China, the IA children in Study 1 were also found to perform more than one standard deviation below the norm on sentence recall, giving rise to the possibility that IA children could also have underlying memory difficulties. Analyses of the relationship between the IA children's scores on tests of language ability and sentence recall further suggest a link between performance on these measures leading to the hypothesis that performance on sentence recall might play a role in mediating differences in language outcomes between the IA and CTL children. Because the groups did not differ in terms of non-verbal cognitive abilities and socio-emotional development, the results of Study 1 suggest that it is unlikely that the IA children's language difficulties were due to pre-adoptive adverse circumstances. Similarly, their long-term exposure to French suggests that their language lags are unlikely to be caused by insufficient language exposure. The implications of the results are discussed in terms of possible effects of age-of-acquisition, attrition of the birth language, and verbal memory abilities on long-term language development.

The goal of Study 2 was to conduct an analysis of IA children's use of accusative object clitics to determine if the long-term difficulties that were found in Study 1 using general measures of language ability extend to more specific aspects of morphosyntactic competence. Accusative object clitics are particularly interesting because they have been found to be difficult to acquire by monolingual French-speakers, L2 learners of French, and French-speaking children with SLI (e.g., Grondin & White, 1996; Hamann, 2004; Paradis, 2004), but also because Gauthier, Genesee, and Kasparian (2012) found that IA children make significantly more errors using object clitics in spontaneous language samples than their non-adopted peers. Study 2 is different from and goes beyond Gauthier et al.'s study because it examined specific aspects of their morphosyntactic competence long term. Indeed, Study 2 examined if difficulties in the use of object clitics demonstrated by the IA children in Gauthier et al. persisted despite more than four additional years of exposure, but also investigated whether or not the vulnerabilities in the language development of IA children are the same as those demonstrated by other learners of French. The IA children and the controls who participated to Study 1 also participated in Study 2.

They were assessed using a Clitic Elicitation task (Grüter, 2006) whose goal was to elicit the use of accusative object clitics in IA children. It was found that the IA children omitted significantly more accusative object clitics, made significantly more gender and number agreement errors using these clitics, and used significantly fewer accusative object clitics than the matched controls. Taken together, the results indicate that, as found by Gauthier et al., the IA children had long-term lags in their acquisition and mastery of accusative object clitics, a linguistic feature particularly difficult to acquire in French. Again, the implications of the results are discussed in terms of IA children's delayed onset of exposure to French, attrition of the birth language, and possible underlying memory difficulties.

Findings from Study 1 suggested that IA children may have difficulties with verbal memory, as measured using the Recalling Sentences subtest of the Clinical Evaluation of Language Fundamentals-Revised (CELF-R), and that these difficulties are linked to their lags in language development. However, it is not clear from existing research what tests of sentence recall actually assess. Thus, Study 3 was designed to look at IA children's verbal memory abilities more directly and in more detail. An additional goal of Study 3 was to conduct a longer-term evaluation of their language abilities. Study 3 included 20 of the IA children who participated to Study 1 and 2, but also 18 of the IA children who participated in Gauthier and Genesee's original study. The IA children ($n = 30$) were between 9;0 and 12;4 years of age ($M = 10;8$ years) at the time of testing and had been adopted between 6 and 24 months of age ($M = 12.85$ months). They were compared to non-adopted monolingual French speaking children matched on age (range: 9;2 and 12;2 years of age ; $M = 10;7$ years), gender, and SES. Groups were compared on non-verbal cognitive abilities, socio-emotional development, expressive and receptive vocabulary, receptive grammar, sentence recall, the ability to listen to concepts and to follow directions, lexical access, verbal short-term memory, verbal working memory, verbal long-term memory, non-verbal short-term memory, and non-verbal working memory. The results showed that the groups did not differ on non-verbal cognitive abilities and socio-emotional development, confirming the results of Study 1. However, the IA children were found to perform significantly lower than the controls on all measures of language and verbal memory abilities, but not on non-verbal memory abilities. Overall, these results suggest that IA children continue to experience long-term lags in language abilities despite several years of exclusive exposure to French, but also that they have verbal specific memory difficulties. The implications of the

results are discussed in terms of age-of-acquisition effects and attrition and the possibility that IA children may experience language difficulties due to limitations in verbal memory, possibly as a result of their delayed exposure to the adopted language.

Study 1

Language Abilities of Internationally-Adopted Children from China during the Early School Years: Evidence for Early Age Effects?¹

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Abstract

We assessed the language, cognitive, and socio-emotional abilities of 27 IA children from China, adopted by French-speaking parents, 12 of whom had been assessed previously by Gauthier and Genesee (2011). The children were 7;10 years of age, on average, and were matched to non-adopted monolingual French-speaking children on age, gender and socioeconomic status. Although there were no significant differences between the groups with respect to socio-emotional and cognitive development, the adoptees scored significantly lower than the controls on measures of receptive grammar, expressive vocabulary, word definitions, and sentence recall; findings that were similar to those reported by Gauthier and Genesee. Analyses of correlations between the adopted children's language test results and their age at adoption, length of exposure to the adoption language, and health and other developmental problems revealed relatively few significant associations. In contrast, analyses of the relationship between their language test scores and their performance on the Recalling Sentences subtest suggest a link between performance on these two tests. We speculate on the role that performance on sentence recall might play in mediating differences in language outcomes between the two groups of children.

Keywords: cross-language adoption, second language acquisition, early age effects

The primary goal of the present study was to examine the language development of school-age internationally-adopted (IA) children from China during the early school years, including a group of IA children who had previously been evaluated by Gauthier and Genesee (2011). Thus, this study is the third phase of a longitudinal evaluation of IA children's language development spanning the pre-school and early school age years. The language acquisition of IA children is unique in that they are exposed to a first language (L1) during several months, sometimes years, and then their exposure to this language is abruptly interrupted when they begin acquisition of their adoption language. Because of these unusual circumstances, along with other factors, the language development of IA children is often thought to be at-risk. First, IA children often experience pre-adoptive environments in the homes of their birth parents or in orphanages that may not meet their basic needs (e.g., nutritional) and that may even involve abuse, neglect, and inconsistent care-taking (Meacham, 2006), all conditions that can cause short and long-term developmental delays (Glennen, 2002). Most orphanages have low caregiver-child ratios limiting the duration and frequency of interactions between IA children and a single caregiver, which may lead, in turn, to a lack of physical, cognitive, and social stimulation. Evidence suggests that the duration of institutionalization, along with the severity of deprivation pre-adoptively, might explain the poor speech and language development exhibited by some adoptees and, in particular, those from Eastern Europe (Glennen, 2002; Groze & Ileana, 1996; Meacham, 2006). The extent to which their pre-adoptive environment puts some IA children at risk may be related to the country of adoption, given that the reasons for abandonment and the quality of institutional care adopted children receive vary among countries (Gunnar, Bruce, & Grotevant, 2000; Hyltenstam, Bylund, Abrahamsson, & Park, 2009).

Second, many, although not all, IA children discontinue exposure to and acquisition of the birth language upon adoption and this abrupt termination of L1 acquisition may influence their acquisition of the adoption language. According to the exercise hypothesis, the capacity for language learning must be exercised early in life so that it remains intact for subsequent language acquisition (Johnson & Newport, 1989). All of the IA children in the present study discontinued exposure to and acquisition of their birth language and this raises the question of whether discontinuing acquisition of the L1 undermines the neuro-cognitive substrates for acquisition of the adoption language (e.g., Johnson & Newport, 1989).

Another related factor that could compromise IA children's acquisition of their new language is their delayed onset of exposure to the adoption language. According to the classic version of the critical period hypothesis (CPH), language learning is more effective and complete the earlier it begins and is more likely to result in less than native-like competence as age of onset is delayed (Penfield & Roberts, 1959). Under this hypothesis, one would expect IA children who are adopted within one to two years of birth to acquire full, native-like competence in their adoption language. However, there is recent evidence for very early age effects on L2 learning, much earlier than previously thought (e.g., Hyltenstam, 1992). More specifically, Abrahamsson and Hyltenstam (2009) found that, despite more than 20 years of exposure to Swedish-as-a-second language, only three of the 31 pre-school learners of Swedish (i.e. 1-5 years of age) they assessed performed like native Swedish speakers on all measures of an extensive battery of language ability and processing tasks they administered (i.e. Cloze test, speech perception in noise). It might thus be expected that IA children who acquire a new language after 1 to 2 years of birth would exhibit similar early age effects (see also Hyltenstam et al., 2009). In the case of many IA children, delay in exposure to the adoption language is confounded with disruption in acquisition of the birth language, a point we return to later.

While IA children's language development may be at-risk for several reasons, there are other reasons for expecting that they might be advantaged in learning their new language in comparison to other L2 learners. First, adoptive parents have higher than average levels of income and education (e.g., Hellerstedt et al., 2008; Roberts et al., 2005), and these factors would be expected to have positive effects on the amount and type of parent talk and the quality of interaction IA children experience post-adoption (Tan & Yang, 2005). Mothers with high education levels and SES tend to speak more to their children than mothers from lower SES backgrounds and their children, in turn, have been found to exhibit above average expressive and receptive vocabulary, general language abilities, and more lexically complex utterances (e.g., Hoff, 2003, 2006; Hoff & Tian, 2005; LeNormand, Parisse, & Cohen, 2008).

Second, despite much controversy concerning the existence of a critical period for language development and the precise termination of this period, there is still considerable evidence that early L2 learning is more successful than L2 learning that occurs later in life (e.g., Birdsong & Molis, 2001; DeKeyser, 2000; Johnson & Newport, 1989). Thus, since IA children from China are adopted early, usually before 24 months of age, one might expect no adverse effect of age of

acquisition of their new language. Also, since they are exposed to the new language so early, the neuro-cognitive mechanisms that underlie L1 acquisition might still be fully available for acquisition of the adoption language.

Finally, in contrast to successive and simultaneous bilinguals who are exposed to and learn two languages, most IA children's exposure to the adoption language is not divided between an L1 and an L2. They, therefore, do not need to acquire or process more than one language at a time since they benefit from full exposure to their new language and this should in turn facilitate acquisition of that language.

Language Development of IA Children

Research has shown that despite risk factors, most preschool IA children perform within the normal range when assessed using parent reports or standardized tests designed for monolingual speakers of the same age (Geren, Snedeker, & Ax, 2005). Indeed, based on parental reports of vocabulary development, such as the MacArthur Communicative Developmental Inventory (Glennen, 2002), Chinese adoptees have been found to perform at the same level as native English speakers within 12 months post-adoption (Snedeker, Geren, & Shafto, 2007). In the remainder of this report, and for ease of reference, we refer to native speaking children of the adoption language (e.g., English in the U.S.) as "non-adopted children", although we recognize that there are children in orphanages in China and elsewhere who are also not adopted. It has also been found that more than 85% of children who were adopted from China between 6 and 25 months of age and living in English-speaking homes performed within or above the average range on other standardized language measures, such as the Peabody Picture Vocabulary Test, at 30-47 months post-adoption (Roberts & Krakow, 2003). Evidence shows that, in general, IA children who are adopted before 24 months of age often achieve native-like levels of proficiency within 12 months post-adoption, thereby demonstrating a rate of language acquisition that is faster than that of native speakers of the target language. For example, Snedeker et al. found that preschool Chinese adoptees, who were between 2;7 and 5;6 years of age at the time of testing and assessed every 3 months had a vocabulary size that was similar to that of native English-speaking children of 24 months of age after only 3 months of exposure to English.

Although IA children make impressive gains in acquiring their new language post-adoption, their language outcomes depend on their age at adoption and their length of exposure to their new language. There is well-documented evidence that children adopted at younger ages,

typically before 12 months of age, display better language outcomes during the preschool years and attain native-like language proficiency sooner than children adopted at older ages (e.g., Krakow, Tao, & Roberts, 2005). In contrast, older IA children have been shown to exhibit faster rates of acquisition initially, and in the short term, but also to be less likely to achieve parity with native speakers in the long term (e.g., Glennen, 2009). For example, Pollock (2005) assessed the vocabulary growth of children who were adopted from China at different ages and found that children who were adopted after 24 months of age had a vocabulary of 400 words after 6 months of exposure to English, while children adopted before 12 months of age had a vocabulary of 50 words. Although the older adoptees exhibited faster initial vocabulary development than the children adopted at younger ages, as just noted, the children adopted at older ages had more to learn to catch-up to same-age native speakers and, therefore, required more time to score within the typical range for their age.

Another factor that can influence IA children's language abilities is their pre-adopted language environment. The primary reason why children in the present study were given up for adoption in China is this country's strict birth planning policy, a one-child policy designed to reduce population growth. Most parents who abandon children in China, usually girls, are married, of average SES, and come from rural areas, creating a pre-adoptive environment that is more advantageous than in other countries (e.g., Gauthier & Genesee, 2011; Johnson, Banghan, & Liyao, 1998). In contrast to IA children from other countries, Chinese adoptees are therefore less likely to suffer from the effects of parental alcoholism, drug abuse and/or poor mental health, poverty, general neglect and abuse, and familial dysfunctionality (Paradis, Genesee, & Crago, 2011).

In a related vein, the language outcomes of adoptees can also be related to their country of origin. All of the adopted children in the present study had been in orphanages at the time of adoption, according to parent reports. Although Chinese orphanages often provided suboptimal care for abandoned children in the past, evidence shows that the situation has improved (e.g., Hwa-Froelich & Matsuo, 2008; Johnson et al., 1998). Accordingly, IA children from China are healthier and, thus, less prone to exhibit language difficulties that are associated with early health problems in comparison to children adopted from other countries (e.g., Cohen, Lojkasek, Zadeh, Pugliese, & Kiefer, 2008; Roberts, Krakow, & Pollock, 2003). Also, parents usually take the decision to put their children up for adoption early, within the first six months of birth (Johnson

et al., 1998) so that adoptees from China are adopted relatively early and are, consequently, institutionalized for shorter periods of time. This might explain why they have fewer health and development difficulties as well as fewer socio-emotional and cognitive problems, all factors that can affect language development.

Notwithstanding evidence of normal development for many IA children during the preschool years, there is also evidence of difficulties in a subgroup of IA children that is larger than what one finds in the general population of children in the population at large (e.g., Roberts et al., 2003). To be more specific, evidence shows that IA children exhibit higher referral rates for assessment and treatment by speech-language pathologists than non-adopted children. For example, in a longitudinal study by Glennen and Masters (2002) in which they collected data on Eastern European adoptees' language development using surveys and language scales, it was found that, of the 130 children who had been adopted from below 6 months of age to 30 months of age, 53.8% had speech-language assessments, while 64.3% were recommended for speech-language therapy. Moreover, studies that have directly assessed IA children's language development during preschool have also found evidence of difficulties. For example, and of particular relevance to the present study, is the longitudinal study by Gauthier and Genesee that examined the language, cognitive, and socio-emotional development of Chinese adoptees. The children were, on average 1;2 years of age at the time of adoption and were acquiring French; they were assessed twice, once between 3;6 to 4;8 years of age and, again, between 4;9 to 6;0 years of age. Their language abilities were compared to that of non-adopted monolingual French-speaking children matched for gender, age, and SES. Their results showed that the expressive language and vocabulary scores of the Chinese adoptees were significantly lower than those of native French-speaking adopted children as were their receptive language skills and their performance on the Recalling Sentences subtest of the Clinical Evaluation of Language Fundamentals-Revised (see also Cohen et al., 2008). Gauthier and Genesee argued that their results were not due to the children's pre-adoptive learning environment because they performed, as a group, in the normal range on most measures in all domains (socio-emotional, cognitive, and language). They argued further that their results were not due to amount of exposure. Were exposure the primary factor, one would have expected the gap between the IA and comparison children to have been reduced at the second assessment, and they did not find this. However, since the comparison children had also had more exposure to French, it could be argued that the

exposure that the IA children had had to French at the time of their second assessment was insufficient. Thus, the present study was undertaken to examine this possibility.

The question remains, nevertheless, whether the IA children examined by Gauthier and Genesee would reach parity with non-adopted control children with yet more exposure to the adoption language, especially if that additional exposure occurred in the context of schooling. Schooling is an enriched and challenging learning environment in which children are taught to extend their language competencies for abstract, cognitively-demanding, and complex communication. On the one hand, it might be expected that this language learning environment would provide enrichment that would enhance the language abilities of IA children and in particular the minority of adoptees who exhibit lags in development during the preschool years. On the other hand, the linguistic demands of schooling might challenge IA children's language abilities further, resulting in continued or possibly even greater lags in their language abilities relative to non-adopted peers.

Results of research on the language, academic, and cognitive development of IA children during the early school years are mixed. On the one hand, and generally speaking, the majority of IA children demonstrate considerable resilience in cognitive, academic, and linguistic development during the school years. A majority of IA children perform similarly to their classmates, environmental siblings, or peers in the general population on measures of cognitive ability, such as IQ (van IJzendoorn, Juffer, & Poelhuis, 2005), and on measures of academic ability, such as parent and/or teacher reports of school performance and grades (Dalen & Ryvgold, 2006). Studies have also reported that IA children demonstrate relatively good language outcomes during the school years on several measures, including tests of receptive vocabulary, reading, writing, narrative abilities, and everyday language (Andresen, 1992; Clark & Hanisee, 1982; Croft et al., 2007; Scott, Roberts, & Krakow, 2008).

On the other hand, there is also considerable evidence that more school-age IA children experience language and academic difficulties than is found in the general population of school children. Evidence from rates of referral for speech-language assessment and treatment indicates that a substantial proportion of IA children may exhibit delays or difficulties in comparison to the general population of non-adopted children, and also that these referral rates increase with age at adoption. For example, in a longitudinal study of IA children from Eastern European countries, Glennen and Masters found that 47% of IA children who were adopted before 12 months of age,

58% of children who were adopted between 13 and 18 months of age, and 73% of children who were adopted between 19-24 months were referred for speech-language assessments. Because referral rates for speech-language assessments can reflect adoptive parents' level of concerns for the language development of their child, these results should be interpreted with caution.

There is additional evidence from direct assessments that the language difficulties of IA children during the early school years can persist even with additional exposure to the adoption language. For example, Roberts, Pollock, and Krakow (2005) monitored the language development of 10 low-performing IA children who had been identified in an earlier investigation (see Roberts et al., 2003). The children were 5;10 years of age, on average, at the time of the follow-up assessment, some 2;3 years after the initial assessment. The purpose of the study was to ascertain whether the additional exposure to English that occurred between the initial and follow-up assessment would reduce or close the gap with the norming group. Their language abilities were examined using a battery of standardized language measures that assessed their expressive and receptive vocabulary, language abilities, and articulation. Results showed that, although the adoptees made considerable gains on these measures from the initial to the follow-up assessment, their performance continued to be significantly lower than that of the comparison group despite two additional years of exposure to their adoption language.

It can be difficult to interpret results from these studies because different studies and even sometimes the same studies included children with different ages-at-adoption and/or from different countries. Studies that include a relatively high proportion of IA children who were relatively old when adopted and/or from countries with institutionalized care that is seriously impoverished could skew the results of the entire sample to the low end of performance, given the association between these two factors and language outcomes discussed earlier.

In a meta-analysis of 62 studies ($N = 17,767$) of school-age adopted children that could potentially control for these confounding factors, van IJzendoorn et al. reported no significant differences between adopted children, both domestic and international, and non-adopted children on measures of cognitive ability, but that adopted children were rated significantly lower, albeit the differences were small, on parent and teacher ratings of language and school achievement compared to non-adopted peers in the same community as the IA children. However, children from China were not included in this analysis and there were no direct assessments of the children's language or academic performance.

The Present Study

The present study sought to examine the long-term language outcomes of IA children from China into the school years. In fact, the study was a partial extension of Gauthier and Genesee's study insofar as a subsample of the adoptees in the present study ($n = 12$) were children who had participated in Gauthier and Genesee's study. This permitted us to conduct a longitudinal assessment of their language development. An additional 15 IA children were added to increase the sample size; this permitted us to examine the generalizability of results from Gauthier and Genesee's subsample. The primary objective was to determine if lags in language development, as exhibited by the preschool IA children examined by Gauthier and Genesee, were still evident in older IA children. Evidence that earlier lags were resolved in the present study would argue that the children examined by Gauthier and Genesee simply had not had sufficient exposure to master all aspects of French. In contrast, evidence of a persistent lag in the present study would argue that other factors are at play, possibly early age effects.

In contrast to previous studies of school-age IA children which have tended to rely on parent/teacher report measures or comparisons with test norms, the present study included a comparison group of non-adopted children who were carefully matched with the IA children on age, socio-economic status, and gender. All of these factors can influence language learning, to varying degrees, but are seldom taken into account in other studies (in contrast, see Cohen et al., 2008, and Gauthier & Genesee, 2011). As a result, extant research does not necessarily provide a complete picture of the language development of school-age IA children relative to same age peers when factors that are known to influence language development are taken into account and, in particular, socio-economic status. As demonstrated by Gauthier and Genesee, as well as Cohen and her colleagues, when direct comparisons are made between IA and carefully-matched comparison groups, a more differentiated profile of similarities and differences emerges, with evidence of relatively low performance for IA children, than when only test norms or report measures are used.

Method

Participants

As noted earlier, it was possible to recruit only 12 of the 24 IA children tested by Gauthier and Genesee to participate in the present study. The major reason parents reported for non-participation was lack of time. Therefore, an additional 15 girls adopted from China by French-

speaking parents were recruited to increase the sample size to 27. The children had been adopted between 7 months and 1;9 years of age ($M = 12.9$ months, $SD = 3.8$ months). As a group, they had had a mean length of exposure to French of 6;9 years ($SD = 7.4$ months), and were between 7;0 and 8;8 years of age ($M = 7;10$ years, $SD = 6.0$ months) at the time of testing. Families of the adopted children were invited to participate using either contact information we already had for returning children or with the assistance of adoption agencies for new recruits.

The IA children were compared to a control group of 27 monolingual non-adopted French-speaking children who were between 6;9 and 8;10 years of age at the time of testing ($M = 7;11$ years, $SD = 6.9$ months). Participants were in grades 1 to 3. The control children (CTL) were recruited from local schools and were matched to the IA children to within 6 months of birth and on SES (see Appendix A). Exclusionary criteria for controls were: 1) presence of psychiatric or neurological antecedents, 2) history of intellectual deficiency and language problems, 3) premature birth, 4) serious health, motor or behavior problems, 5) first language other than French, and 6) more than 25% exposure to an L2, as reported by parents on the Language Environment Questionnaire, described in the next section.

Questionnaires and Assessment Materials

The Developmental Questionnaire, used by Gauthier and Genesee and adapted from the Language Development Questionnaire for Children Adopted from Eastern Europe (Glennen & Masters, 2002), was given to parents to collect information about each children's health, behavior, development, socio-emotional adjustment, and also about parents' age, level of education, and income.

The Child Behavior Checklist (CBCL; Achenbach, 1991a), a parent report designed for children between 6;0 and 12;0 years of age, was used to assess the children's behavior and social competence at home. Twenty-four adoptive parents and 24 control parents completed the questionnaire. The major reason reported by parents for not completing the questionnaire was lack of time. Close examination of the results of the six children whose parents did not complete the CBCL revealed that these children scored in the average or above average range on the language tests in comparison to the other adoptees.

The Child Behavior Checklist-Teacher Report Form (CBCL-TRF; Achenbach, 1991b), which is similarly appropriate for children between 6;0 and 12;0 years of age, was used to elicit teacher's perceptions of the children's academic performance, adaptive functioning, and behavior

problems in school. Eighteen questionnaires were completed by IA children's teachers, while 22 were completed by the teachers of control children.

The Language Environment Questionnaire from Gauthier and Genesee was used to ascertain the amount of input children received in French or other languages from all family members and in diverse situations (i.e. television, at school).

The Wechsler Non-Verbal IQ test (Wechsler & Naglieri, 2006) was used to assess general cognitive abilities. This test was chosen because it can be administered and completed without the use of language, making it suitable for use with French-speaking children; as well, the influence of language ability on test performance is minimized. The test is appropriate for children between 4;0 to 21;11 years of age, although different subtests are recommended for children between 7 and 8 years of age. IA and CTL children between 7;0 and 7;11 years of age were administered the Matrices, Coding, Object Assembly, and Recognition subtests and children between 8;0 and 8;11 years of age were administered the Matrices, Coding, Spatial Span, and Picture Arrangement subtests. Children who were above 7;11;15 years of age were administered the tests for 8;0 years olds. For the Matrices subtest, the children examined an incomplete geometric figure and selected the missing portion from five response options. For the Coding subtest, the children copied symbols paired with simple geometric shapes or numbers. Using a key, the children had to copy a series of symbols that corresponded to a series of shapes within a specific time limit. For the Object Assembly subtest, the children were presented with prearranged puzzle pieces and had to fit the pieces together to form a meaningful whole (e.g. an apple, a bear) within a specified time limit. For the Recognition subtest, the children inspected a series of complex geometric designs for 3 seconds each and then identified which of four or five options matched the target shape. The options and the target differed, sometimes subtly, in terms of colors and patterns. For the Spatial Span subtest, children had to tap a series of blocks, forward or backward, according to a sequence demonstrated by the examiner. For the Picture Arrangement subtest, the children have to reorder sets of picture cards to tell a logical story within a specified time limit.

The Expressive One Word Picture Vocabulary Test-Third Edition (EOWPVT; Brownell, 2000, French adaptation) was used to assess expressive vocabulary. This test, a French adaptation of the original English version, assesses children's ability to make word-picture associations. Children were shown pictures that they then had to name. Although the psychometric properties

of this version of the test are not comparable to those of the English version, this adaptation is used widely by the Speech and Language Pathology Department of the Montreal Children's Hospital and was used in previous assessments by Gauthier and Genesee. The results for five IA children were omitted due to irregularities in testing procedures.

The *Échelle de Vocabulaire en Image Peabody* (EVIP; Dunn, Theriault-Whalen, & Dunn, 1993) was used to assess receptive vocabulary skills and had been used in Gauthier and Genesee's previous assessments. In this test, the child has to find the image from among a set of four images that corresponds to a word spoken by the tester. Norms for French-speaking Canadians are available for this test. The internal validity of this test, as measured by the *Claparède indice* (Gauthier & Genesee, 2011), indicates that the EVIP is a sensitive test up to 13;0 years of age, after which the results are more representative of individual differences related to age. This test is thus sensitive for the age range of the children.

The French version of the Reading Comprehension subtest of the Wechsler Individual Achievement Test-Second Edition (WIAT-II; Wechsler, 2005) was used to assess reading comprehension skills, a school-specific language ability. The children were required to read single sentences and short texts of 7 to 10 sentences in length and then to answer a series of questions about the content of each text. Norms for French-speaking Canadians are available.

The *Word Definition* subtest of the Wechsler Intelligence Scale for Children-Fourth Edition (WISC-IV; Wechsler, 2003), French version, was used to assess the children's expressive language skills. This subtest requires children to correctly recall and coherently express the definition of words (e.g., éponge, île, etc.). Norms for French-speaking children are available.

The Word Associations and Recalling Sentences subtests of the Clinical Evaluation of Language Fundamentals-Revised (CELF-R; Semel, Wiig, & Secord, 1987), French adaptation, were used to assess early literacy and verbal memory abilities, respectively. The Word Associations subtest assesses children's early literacy abilities by requiring them to name words in specific semantic categories (e.g., food, animals, and professions) within one minute. For the Recalling Sentences subtest, the children were asked ability to repeat sentences, varying in length and syntactic complexity, presented by the experimenter. This subtest was included because Gauthier and Genesee found that the IA children in their study scored significantly lower than the control children on this test and also significantly below test norms. In fact, they scored more than 1 standard deviation below the norm. This was the only test on which their performance was

below test norms. This is noteworthy because it has been found that tests of sentence recall are sensitive to age of acquisition among both first and second language learners (Mayberry & Eichen, 1991; Mayberry & Fischer, 1989) and performance on such tests is often used as a clinical marker of specific language impairment (e.g., Conti-Ramsden, Botting, & Faragher, 2001; Stokes, Wong, Fletcher, & Leonard, 2006). While Gauthier and Genesee were careful to emphasize that the IA children were not language impaired in the clinical sense, they proposed that their performance on this test indicates that they had difficulty with aspects of French that show age-sensitivity and are difficult for children with SLI. In other words, IA children's acquisition of French is vulnerable in the same way as some researchers have suggested is the case for other learners of French.

Sentence recall is thought to reflect children's phonological short-term memory (PSTM) abilities and, more specifically, the capacity of their phonological short-term store (Baddeley, 2003), as well as components of long-term memory (Alloway & Gathercole, 2005), probably, linked to knowledge of syntax because children have to comprehend the syntactic constructions of the sentences in order to memorize and repeat them correctly (Semel, Wiig, & Secord, 1987). There is evidence that phonological memory improves with language development (French & O'Brien, 2008) and, in particular, that the ability to actively rehearse the content of the phonological store matures around seven years of age allowing children to hold more material in memory without decay (Gathercole, n.d.). Including the Recalling Sentences subtest allowed us to examine if IA children's ability on this test would improve with age and more exposure to the adoption language or whether they would continue to perform below that of non-adopted children and age norms. We also sought to determine whether the lags in memory demonstrated by the IA children on the Recalling Sentences subtest would extend to tests that assess visuo-spatial short-term memory. Accordingly, we administered the Recognition and the Spatial Span subtests of the Wechsler Non-Verbal IQ test. Both assess visuo-spatial short-term memory and, more precisely the capacity of children's visuo-spatial sketchpad (Baddeley, 2003). Including these tests permitted us to ascertain whether the IA children's lags in verbal memory relative to controls are similar to those of children with low working memory, who typically have difficulties on measures of both verbal and visuo-spatial STM, or if, in contrast, their memory difficulties are specific to verbal memory (Alloway, Gathercole, Kirkwood, & Elliott, 2009).

The Épreuve de Compréhension Syntaxico-Sémantique (ECOSSE; Lecocq, 1996) is a French version of the Test for Reception of Grammar (TROG; Bishop, 1983) and was used to assess children's receptive language abilities and, more specifically, their comprehension of syntax. Knowledge of pronouns, adjectives, negative phrases, and word order were assessed. The experimenter read a sentence aloud to the child, such as "La vache pousse la dame" (The cow pushes the woman), and the child had to find the image that corresponded to the sentence from among a set of four images. Correct responding depended on understanding of target forms, such as passive voice and relative pronouns. Norms for French-speaking children are available.

All the standardized measures included in the present study have reliability coefficients that are at or above .80.

Procedure

Before testing began, the experimenter explained the procedure of the study to the parents and children, presented the questionnaires to the parents, and answered questions. Parents were then asked to sign the consent form. Parents who consented to participate were then asked to complete the CBCL, the Language Environment and the Developmental Questionnaires. They were allowed to fill out these forms quietly in the room during testing; however, most preferred to fill them out between the first and second testing sessions, separated by no more than 15 days. Depending on parents' preferences, the CBCL-TRF was either given directly to the child's teacher by the experimenter or to parents who, in turn, gave it to their child's teacher.

Each child was tested individually in a separate room at the university, in the child's school, or in the home. When testing was carried out in the home or at the university, parents were asked to remain as quiet as possible and not to help their child. Each testing session lasted about 50 minutes, and two sessions were required. The order of administration of the tests was counterbalanced to avoid biases due to order effects. Narrative and clitic elicitation tasks were also administered during these testing sessions, but these results will not be presented in this report.

Results

Demographic Information

One-way independent groups analyses of variance (ANOVAs; $\alpha = .05$) were carried out to compare the IA and CTL children on age at testing, fathers' age, and mothers' age (see Appendix A). Results showed that the groups differed significantly only in terms of fathers' age, $F(1, 30) =$

8.45, $p = .01$, and mothers' age, $F(1, 31) = 11.13$, $p < .01$, with adoptive parents being significantly older than control parents. Chi-square tests ($\alpha = .05$) were performed to compare the IA and CTL children in terms of school grade, educational level of each parent, and family income. No significant differences were found between the groups in terms of school grade ($\chi^2(2, 54) = 2.88$, $p = .24$), educational level of mother ($\chi^2(2, 54) = .92$, $p = .63$), educational level of father ($\chi^2(2, 54) = 1.06$, $p = .59$), and family income ($\chi^2(2, 54) = 1.39$, $p = .85$).

General Health and Socio-Emotional Development

As in the case of Gauthier and Genesee's study, information was collected about each child's past and current health status. None of the parents in either the IA or CTL group expressed concerns about their child's current general health; see Appendix B for a summary of information about the children's past and present health status. With regards to the children's past health status, results revealed that the IA and CTL children had had a comparable number of reported problems. The reported problems for the CTL children were mostly related to ear infections, which are common in infants and young children (Hôpital Ste-Justine, 2009), whereas the main problems reported for the IA children by their parents were emotional and attachment difficulties, as well as behavioral problems. With respect to current health status, results revealed that although the IA children had fewer health problems than in the past, they currently had more problems than the CTL children. However, 38% of the reported problems of the IA children were related to vision and these were in no case severe; moreover, there is evidence showing that children of Asian descent have more vision difficulties than Hispanic or Caucasian children (Kleinstein et al., 2003). More IA children (11.1%) were diagnosed with attention-deficit hyperactivity disorders (ADHD) than CTL children (0%); but the results for the IA children are still within the normal range for this age group (Glennen & Bright, 2005).

In terms of socio-emotional development, the IA children's performance on the CBCL and the CBCL-TRF indicated that they were developing as well as their non-adopted peers. Indeed, one-way independent-groups ANOVAs ($\alpha = .05$) were performed to compare children's total scores, scores on the internalizing and externalizing scales of the questionnaires, and on each subscale composing these scales. Results showed that the scores of the IA and CTL children were not significantly different on any of these, except for the social problems subscale of the CBCL-TRF, $F(1,38) = 5.27$, $p = .03$, on which the CTL children were reported to have more problems than the IA children. The latter results corroborate the findings of previous studies that IA

children are generally well adjusted, but also that Chinese adoptees tend to obtain scores on standardized assessments of emotional and behavioral abilities, such as the CBCL, that are similar or better than the norms (e.g., Rojewski, Shapiro, & Shapiro, 2000; Tan & Marfo, 2006).

Academic and Non-Verbal Cognitive Development

In terms of cognitive development, the IA children's total raw scores on the Wechsler non-verbal IQ test as well as their raw scores on each subtest (the Matrix, the Coding, the Recognition, the Image Arrangement, the Spatial Span, and the Object Assembly subtests) were compared to those of the CTL children using one-way independent-groups ANOVAs ($\alpha = 0.05$). No significant differences were found between the IA and CTL children on the total raw score, $F(1, 52) = 2.63$, $p = .11$, or on the total standard score, $F(1, 52) = .10$, $p = .76$. However, the IA children had significantly higher scores on the Coding subtest than the CTL children, $F(1, 52) = 5.45$, $p = .02$, suggesting above normal non-verbal processing speed for the IA children; no other significant differences were observed. Otherwise, there were no significant group differences on the other sub-scales of this test.

Comparisons between the IA and CTL children on academic performance, using teachers' responses on the Adaptive Functioning Subscale of the CBCL-TRF (including the following scales: works hard, behaves appropriately, learning level, and happiness), revealed no significant difference between the groups. Although none of our participants repeated a grade, five IA children and five CTL children were reported by their parents and/or teachers, on the CBCL and the CBCL-TRF, to have academic abilities that were below those of their same-age peers. In contrast to some of the CTL children who were reported to have difficulties in French, English as an L2, mathematics, and history, the five IA children who were reported to have academic difficulties all had difficulties with French. Indeed, as will become evident in the next section, our statistical analyses of the IA children's language results revealed difficulties on the part of the IA children in comparison to the CTL children with respect to French.

Language Development

Parental responses to the Developmental Questionnaire revealed that, while approximately the same number of parents of IA and CTL children consulted specialists, speech-language pathologists were the specialists consulted most often by adoptees and their parents ($n = 6$). Our results also revealed that these same six IA children (22.2% of our sample) had had or were still receiving speech-language therapy. These results are in line with previous studies that have

found, as mentioned earlier, that a larger than expected subgroup of IA children require the services of speech-language professionals (Glennen & Bright, 2005; Scott et al., 2008). Interestingly, the adoptees who were identified by their parents or teachers as having lower academic abilities than their non-adopted peers were not the same IA children who were receiving speech-language therapy.

In terms of language test results, the IA and CTL children were compared using one-way independent-groups ANOVAs ($\alpha = .05$; see Table 1). The performance of the IA children was significantly lower than that of the CTL children on the ECOSSE, the EOWPVT, the Word Definitions subtest, and the Recalling Sentences subtest. The groups did not differ significantly on the Word Association subtest, the EVIP, or the WIAT.

Insert Table 1 about here

To better characterize the performance of the IA children, the distribution of their scores was compared to that of the CTL children by calculating the percentage of IA children who scored above and below the average of the CTL children in terms of standard deviations (see Table 2). IA children who scored between +1 and -1 *SD* of the mean of the CTL children can be considered to have a “normal” score compared to their non-adopted peers. A significant percentage of IA children performed at least 1 *SD* below the mean of the CTL children. More specifically, 66.6% of the IA children scored at least 1 *SD* below the mean of the CTL children on the Recalling Sentences subtest, 29.6% on the Word Association subtest, 48.1% on the ECOSSE, 50% on the EOWPVT, 22.2% on the EVIP, 11.1% on the WIAT, and 51.8% on the Word Definition subtest.

Insert Table 2 about here

The preceding statistical analyses were performed using raw scores on the language tests. The IA children’s performance was also compared to norms for French-speaking children, when these were available. When the norms for French-speaking children were not available, the norms for English-speaking Canadians were used, but must be interpreted with caution. Results indicated that the IA children, on average, performed at or above the norms on all language tests,

except for the Recalling Sentences subtest. On the latter, the IA children's results were equivalent, on average, to that of French-speaking children of 6;0 years of age ($SD = 1.28$); that is, 1;10 years younger than the IA children (see Table 3).

Insert Table 3 about here

In order to better understand the language test results of the IA children, a series of correlations were carried out between their language test scores and a number of age, health, and other related variables; these results are described now.

Correlations between Language Scores and Health Problems, Speech-Language Services, and Recruitment Cohort

To further explore a possible link between the IA children's language test results and health issues, correlations were calculated between their language test scores and the presence of developmental or health problems, either in the past or at the time of testing. Accordingly, each IA child was assigned a score of 0 or 1 depending on whether their parents reported that they had no (0) or some health problems (1), either previously or at the time of testing. Results indicated that there were no significant correlations between the presence of reported developmental or health problems experienced by the IA children, either in the past or at the time of testing, and their performance on any of the language measures.

Additional correlations were carried out to ascertain whether there was a relationship between the prevalence of speech, language, academic, or behavioral problems and the IA children's language results. Thirteen IA children (the "learning difficulty" subgroup) who were reported by teachers or parents to have either: a) speech and language therapy or b) academic or behavioral difficulties, including ADHD, were identified and assigned a code of "1". The remaining 15 children (the "typical learners" subgroup) were assigned a code of "0". Analyses revealed that there were no significant correlations between the IA children's learner status and their performance on any of the language tests.

Finally, to examine whether the low language test performance of the IA children could be attributed to differences between the IA children who had participated in Gauthier and Genesee's study (IA_C, continuing) and the newly recruited children (IA_N, new), each IA child was classified as "continuing" and assigned a code of "0" or "newly recruited" and assigned a code of "1".

Correlations were then carried out between these subgroup codes and language test scores. Results for all these correlations are presented in Table 4. The only significant correlations that were found were between recruitment subgroup and age at testing ($r = -.53, p < .01$), length of exposure to French ($r = -.39, p = .04$), and performance on the Word Definition subtest ($r = -.44, p = .02$). These correlations indicated that the new IA children were younger at the time of this testing ($M = 7;6$ years) and, thus, had had less exposure to French ($M = 6;6$ years), and scored significantly lower on the Word Definition subtest ($M = 18.1$) than the continuing IA children from Gauthier and Genesee's study ($M_{\text{Age}} = 8;1$ years, $M_{\text{Exposure}} = 6;11$ years; $M_{\text{Word Definition}} = 23.8$). Because significant differences between the IA cohorts were restricted to the Word Definition subtest, cohort differences are not considered further.

Correlations between Language Scores and Age-Related Variables

Correlations were calculated between age at testing, age at adoption, and length of exposure to French and the IA children's scores on the language tests (Recalling Sentence and the Word Association subtests of the CELF-R, ECOSSE, EOWPVT, WIAT, EVIP, Word Definition subtest of the WISC) in order to examine if differences in these age-related variables were related to differences among the IA children on the language tests. The age at which adopted children produced their first words in French post-adoption was also correlated with their language scores because Gauthier and Genesee found it to be a significant, and in fact the most significant, predictor of adoptees' expressive language abilities at 5;0 years of age. Our results showed that age at adoption was significantly and negatively correlated with exposure to French ($r = -.59, p < .01$), as one would expect (see Table 4). Thus, age at adoption and amount of exposure to French are confounded, but there is no way to disentangle the effects of these variables using the present data. Unlike in Gauthier and Genesee, amount of exposure to French, and therefore age at adoption, was not significantly correlated with performance on the EVIP or the EOWPVT, although both correlated significantly with performance on the Word Associations ($r = .39, p = .04$) and Word Definitions ($r = .54, p < .01$) subtests; these two subtests test higher order vocabulary skills and were not administered by Gauthier and Genesee. Like Gauthier and Genesee, we did not find significant correlations between age at adoption or amount of exposure to French and performance on the ECOSSE, a test of grammatical competence. In contrast to Gauthier and Genesee's results, age at which adoptees produced their first words in French post-adoption was not significantly correlated with any of the language scores.

In brief, the only significant correlations that emerged between amount of exposure to French and age of adoption involved tests of higher order knowledge of words. Moreover, and unlike Gauthier and Genesee, we found that delay in production of first words in French was not correlated with any of our language measures. Thus, with the exception of Word Associations and Word Definitions, the age-related variables, all of which pertain to the early language experiences of the IA children, did not correlate with the language outcome measures in the present study.

Insert Table 4 about here

Relationships between Language Scores and Verbal Memory

In order to explore the relationship between the IA children's performance on the language tests and the Recalling Sentences subtest, a measure that has been found by others to be sensitive to age of acquisition and learner status and is thought to assess aspects of verbal memory (both short and long-term), additional correlations were calculated between scores on the Recalling Sentences subtest and the IA children's language test scores. Results revealed that performance on the Recalling Sentences subtest was significantly correlated with all the other language measures – correlations varied from .40 ($p < .05$) for Word Definitions to .55 ($p < .01$) for Receptive Grammar. To investigate the relative importance of performance on the Recalling Sentences subtest in comparison to age at adoption, length of exposure to French, and age at which first words were produced in French, we ran a series of stepwise linear regression analyses using scores on each of these measures as predictor variables; scores on each of the languages tests on which the IA children scored significantly lower than the CTL children (namely, the EOWPVT, the ECOSSE, and the Word Definition Subtest) were entered as outcomes variables. The results of these analyses revealed that the IA children's performance on the Recalling Sentences subtest was a significant predictor of their scores on the following tests: ECOSSE ($R^2 = .35$, $\beta = -.60$, $p = .01$), EOWPVT ($R^2 = .29$, $\beta = .54$, $p = .03$), WIAT ($R^2 = .40$, $\beta = .43$, $p = .04$), EVIP ($R^2 = .23$, $\beta = .48$, $p = .03$), and Word Associations ($R^2 = .24$, $\beta = .43$, $p = .05$). The beta value is negative for the ECOSSE because scores represent the number of errors. Age at adoption was also a significant predictor of performances on the WIAT ($R^2 = .21$, $\beta = -.49$, $p = .02$), while length of exposure to French was a significant predictor only of performance on the Word

Definition subtest ($R^2 = .24$, $\beta = .49$, $p = .03$). These results suggest that reading comprehension and knowledge of word definitions are best predicted by IA children's age at adoption and length of exposure to French, respectively, while IA children's performance on the Recalling Sentences subtest is an important predictor of their performance on all the measures of language abilities, except the Word Definition subtest.

The IA and CTL children's results on the language tests on which they differed (namely, EOWPVT, the ECOSSE, and Word Definitions) were compared again using a multivariate analysis of covariance (MANCOVA; $\alpha = .05$), using Recalling Sentences subtest scores as a covariate to see whether significant differences between the IA and CTL children's performance on these would persist once the effects of performance on the Recalling Sentences subtest were partialled out. Results showed that there were no longer any significant group differences on any of these tests: EOWPVT, $F(1, 47) = .09$, $p = .76$; ECOSSE, $F(1, 52) = .20$, $p = .66$; Word Definitions, $F(1, 52) = .11$, $p = .75$, once performance on the Recalling Sentences subtest was partialled out.

Taken together, these results suggest that the differences between the IA and CTL children on the language tests may be due to differences in their performance on the Recalling Sentences test which, as suggested by Gauthier and Genesee, may in turn be related to their delayed onset of exposure to French, a point we return to in the Discussion section.

Discussion

The purpose of the present study was to conduct a 3-year follow-up of IA children from China who were being raised by French-speaking parents and who had been tested initially by Gauthier and Genesee when they were 4;2 years of age, on average. More specifically, the study sought to examine if the IA children in Gauthier and Genesee's study would close the gap in language performance they exhibited relative to non-adopted comparison children with extended exposure to French into the early school years. Only 12 of Gauthier and Genesee's original sample agreed to participate in the present study, owing largely to time constraints, and thus an additional 15 IA children were recruited to increase the total sample size to 27. The IA children's results on a battery of language tests were compared to those of non-adopted monolingual French-speaking children who were carefully matched for age, gender, and SES. The inclusion of new IA children made it possible to examine the generalizability of Gauthier and Genesee's

results to a new cohort of IA children. The IA children's socio-emotional, health, and non-verbal cognitive development were also assessed and compared to that of the non-adopted children.

In terms of general health, the adoptive parents reported more health problems than did the parents of the non-adopted children. However, most of these problems were accounted for by vision difficulties, which were in no case severe. Moreover, although adoptive parents reported more socio-emotional and behavioral difficulties than control parents on the Developmental Questionnaire, no significant differences were found between IA and CTL children on the CBCL and CBCL-TRF, two standardized measures. Results from the Wechsler Non-Verbal IQ test indicated that the IA children did not differ from the controls with respect to non-verbal cognitive abilities and, in particular, visuo-spatial memory, a result we return to later. Overall, these results indicate that the general physical, socio-emotional and cognitive development of the IA children was comparable to that of matched non-adopted peers, indicating both their resilience in overcoming possible pre-adoptive deprivations and remarkable progress in general development since adoption. Since the conditions of institutionalization of the IA children are unknown, these results could also be interpreted to indicate that the adoptees' pre-adoption environments were not severely impoverished or that any pre-adoption impoverishment they had experienced had limited and short-term effects. This latter interpretation corroborates the findings of previous studies that have found that, in general, Chinese adoptees do not suffer from health or general developmental difficulties post-adoption (e.g., Johnson et al., 1998; Pomerleau et al., 2005).

In terms of language outcomes, the primary focus of the present study, the IA children scored within the normal range on all language tests, except the Recalling Sentences subtest. These findings replicate those reported by Gauthier and Genesee. These results reinforce the point that any pre-adoption deprivation that the IA children might have experienced was either relatively minor or had limited and short-term effects on the children's language development and corroborate Gauthier and Genesee's and other's findings that, with sufficient exposure to their adoption language, IA children can develop skills in their new language that are within the normal range for typically-developing average children (e.g., Cohen et al, 2008; Scott et al., 2008).

At the same time, our results indicate that there were important differences in language outcomes between the IA and control children. The IA children had significantly lower scores on measures of expressive vocabulary, receptive grammar, word definitions, and sentence recall.

Moreover, the IA children exhibited larger within-sample variation than the control group and, in fact, a substantial percentage of IA children scored more than 1 *SD* below the mean of the control group on all language measures, although some of the IA children performed at the same level or higher than the control children. Large variation in language test performance was been reported by Gauthier and Genesee and has been reported by others (e.g., Dalen & Ryvgold, 2006; Roberts, et al., 2005). In short, a significant number of IA children had difficulty attaining parity with non-adopted peers from similar SES backgrounds, corroborating Gauthier and Genesee's findings, and those of Cohen and her colleagues, indicating that their results are not specific to the cohort of children they tested.

As just noted, adverse effects associated with pre-adoption adversity or impoverishment seem unlikely explanations of the differences in language outcomes for the two groups, as do effects related to differences in cognitive, including academic, and socio-emotional development since, in fact, the IA children performed as well as the control children in these domains. In corroboration with Gauthier and Genesee's argument, insufficient exposure to French also seems an unlikely explanation since this is the third evaluation of these children that has provided evidence of lags in the IA children and, moreover, there is no evidence from the present study that the gap between the IA and control children was diminishing even after three years of additional exposure to French. Delayed onset of exposure to French, i.e., early age effects, remains a viable possibility. In this regard, the results of the IA children on the Recalling Sentences subtest are of particular interest.

Performance on tests of sentence recall has been shown to be sensitive to age of acquisition effects in both first and second language learners (French & O'Brien, 2008; Jessop, Suzuki, & Tomita, 2007; Mayberry & Fisher, 1989; Rosselli et al., 2000; Vinther, 2002), and it is, in part, for this reason that we are hypothesizing that it is differences in age-related effects on performance on tests of sentence recall that might be mediating the differences in language outcomes between the IA and control children. Evidence in support of this possibility comes from the results of our regression and MANCOVA analyses which indicated that scores on the Recalling Sentences subtest were significantly correlated with all other language test results and, in fact, no significant differences between the IA and control children on the language tests remained once performance on the Recalling Sentences subtest was co-varied out. If the failure of the IA children to close the language gap as a result of increased exposure to French is linked to

their performance on the Recalling Sentences subtest, one might also expect to find little or no improvement in their performance on this test over time. In order to examine this possibility, we compared the Recalling Sentences results of the continuing IA children from Gauthier and Genesee's study ($n = 12$) with their results in the present study and found no significant improvement over time (Gauthier & Genesee: $M = 31.2$; present results: $M = 38.8$; $t = 1.49$, $p = .20$). In fact, four of the 12 continuing IA children had lower scores on the Recalling Sentences subtest at 7;0-8;0 years of age than at 4;0-5;0 years of age, and two had scores that did not improve at all from one assessment to another. In contrast, the control children in the present study scored significantly higher than the control children ($n = 23$) in Gauthier and Genesee: mean of present controls = 51.1; mean of Gauthier & Genesee controls = 43.3; $t(22) = 2.29$, $p < .05$.

The IA children's results on the Recalling Sentences subtest contrast with their results on two other language tests that were administered in the present study as well as by Gauthier and Genesee. Specifically, there were significant improvements over time on both the EOWPVT, $n = 6$ (Gauthier and Genesee: $M = 53.3$; present results: $M = 81.7$; $t = 7.27$, $p = .001$) and the EVIP, $n = 12$ (Gauthier and Genesee: $M = 78.5$; present results: $M = 114.0$; $t = 5.93$, $p < .001$). The IA children's longitudinal results on the Recalling Sentences subtest also contrast with results of age-related improvements reported by Gallimore and Tharp (1981) in an eight-year longitudinal study of sentence recall performance in typically-developing monolingual English-speaking children. They found statistically significant age-related improvements in sentence recall performance between 5;0 and 8;0 years of age that were reliable across several cohorts of children who participated in their study. In sum, the IA children's performance on the Recalling Sentences subtest has been consistently low; unlike their performance on the other language measures, it did not demonstrate significant improvement from the previous to the present assessment, contrary to what one would expect (Gallimore & Tharp, 1981); and differences in language outcomes between the IA and control children were not found once differences on the Recalling Sentences subtest were taken into account statistically.

The question arises: What aspect of performance on the Recalling Sentences subtest might account for these results? Although, as mentioned earlier, tests of sentence recall are often used in clinical assessments of children's language abilities (Archibald, Joanisse, & Shepherd, 2008) and, indeed, performance on tests of sentence recall has been found to be a consistent and significant

correlate of language impairments and dyslexia (Alloway & Gathercole, 2005), there is uncertainty as to what specific skills these tests involve. Several studies suggest that they assess children's knowledge of language in long-term memory, including grammar and vocabulary (Alloway & Gathercole, 2005; Gallimore & Tharp, 1981). There is also evidence that they involve auditory or phonological short-term memory, especially when tests are used that include sentences of increasing length, as was the case in the present study (Alloway & Gathercole, 2005). Thus, performance on tests of sentence recall seem to entail the integration of syntactic and lexical knowledge of language from long-term memory along with phonological information that has to be retained in short-term memory (Alloway & Gathercole, 2005; Baddeley, 2000; Gallimore & Tharp, 1981; Potter & Lombardi, 1998). That the IA children in the present study performed within age-expected levels on all of the other language tests, including tests related to vocabulary and grammar, suggests that the nature of their difficulties on the Recalling Sentences subtest is more related to the short-term memory than knowledge of language stored in long-term memory. The results from the present study also suggest that any putative gap between the IA and control children with respect to short-term memory is specific to verbal memory – there were no significant differences between the IA and control children on tests in the present battery that tapped other components of memory, namely the Recognition and Spatial Span subtests of the Wechsler Non-Verbal IQ test. Thus, unlike children with low working memory abilities who have difficulties with both verbal and visuo-spatial short-term memory (Alloway et al., 2009), the IA children's difficulties were limited to the verbal domain. Of course, these possibilities are largely speculative and can be elucidated only with more intensive investigations of the underlying components of sentence recall performance. In fact, we have such a study under way at the moment.

In conclusion, we found gaps in the language outcomes of IA children in the present study when compared to same-age control children that replicate those reported by Gauthier and Genesee from two previous assessments. These gaps, although statistically significant are subtle because they are revealed only when IA children are compared to carefully matched comparison groups. In fact, the IA children scored in the typical range for their age group on all of the language tests, except for the Recalling Sentences subtest, indicating that the gaps in language outcomes revealed in the present study and in previous work by Genesee and Gauthier and Cohen and colleagues are non-clinical in nature. Detailed analyses of the present results suggest the

intriguing possibility that delayed age of onset of acquisition of French may reduce IA children's verbal short-term memory, which in turn affects their language learning outcomes. It could also be that disruption of the children's acquisition of the birth language or a combination of disruption and delay is at issue. Whatever the contextual factor(s) at play, there is also the question of what psycholinguistic factor or factors account for these effects. We have proposed that verbal short-term memory is a possible mitigating factor. Clearly much additional research is needed to substantiate these possibilities or, alternatively, to reveal other explanations.

Limitations

Although the sample size in the present study was large enough to yield statistical significant differences and patterns, including more children would yield even more reliable results. Only IA children from China were included because of their generally good overall development post-adoption, making differences in their language development of particular interest from the point of view of age-of-acquisition effects. Nevertheless, replication of the present study with IA children from other countries and language backgrounds would serve to establish the generalizability of the present results.

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Appendix A

Demographic Data of the Adopted (IA) and Control (CTL) Children

	IA	CTL
Age (in years, <i>M</i> and <i>SD</i>)	7;10 (6.00 months) _a	7;11 (6.95 months) _a
Age at adoption (in years, <i>M</i> and <i>SD</i>)	1;1 (3.82 months) _a	
Length of exposure to French (in years, <i>M</i> and <i>SD</i>)	6;9 (7.39 months) _a	7;11 (6.95 months) _a
Mother's age (in years, <i>M</i> and <i>SD</i>)	46.70 (5.40 years) _b	40.57 (5.08 years) _c
Father's age (in years, <i>M</i> and <i>SD</i>)	48.63 (5.66 years) _d	42.57 (6.26 years) _c
Mother's level of education (% and <i>n</i>)		
High School	7.4 (2)	11.1 (3)
College	33.3 (9)	22.2 (6)
University	59.3 (16)	66.7 (18)
Father's level of education (% and <i>n</i>)		
High School	23.1 (6)	14.8 (4)
College	34.6 (9)	29.6 (8)
University	42.3 (11)	55.5 (15)
Family income per year (% and <i>n</i>)		
30 000 – 59 000		
60 000 – 89 000	7.4 (2)	3.7 (1)
90 000 – 119 000	18.5 (5)	22.2 (6)
120 000 – 150 000	33.3 (9)	25.9 (7)
150 000 and more	18.5 (5)	14.8 (4)
	22.2 (6)	33.3 (9)

Note. IA = Internationally adopted children; CTL = Control children.

^a *n* = 27. ^b *n* = 20. ^c *n* = 14. ^d *n* = 19.

Appendix B

Health and Developmental Problems

Health and/or developmental problems	In the past		Presently	
	IA % (n)	CTL % (n)	IA % (n)	CTL % (n)
Gross motor delay	7.4 (2)	0 (0)	0 (0)	0 (0)
Mild developmental delay	3.7 (1)	0 (0)	0 (0)	0 (0)
ADHD	3.7 (1)	0 (0)	11.1 (3)	0 (0)
Infectious or parasitic disease	3.7 (1)	0 (0)	0 (0)	0 (0)
Ear infections	22.2 (6)	81.5 (22)	0 (0)	7.4 (2)
[1 and 3 otitis]	22.2 (6)	29.6 (8)	0 (0)	7.4 (2)
[3 and 5 otitis]	0 (0)	18.5 (5)	0 (0)	0 (0)
[5 and more otitis]	0 (0)	14.8 (4)	0 (0)	0 (0)
Frequency unspecified	0 (0)	18.5 (5)	0 (0)	0 (0)
Hearing difficulties	0 (0)	0 (0)	0 (0)	0 (0)
Respiratory difficulties	3.7 (1)	22.2 (6)	14.8 (4)	22.2 (6)
Vision impairments	7.4 (2)	3.7 (1)	29.6 (8)	3.7 (1)
Emotional and/or attachment difficulties	18.5 (5)	3.7 (1)	14.8 (4)	0 (0)
Behavioral difficulties	14.8 (4)	0 (0)	7.4 (2)	0 (0)
Weight or height below 10 th percentile	14.8 (4)	11.1 (3)	0 (0)	0 (0)
Total instances of reported problems	27	29	21	9

Note. IA = Internationally adopted children; CTL = Control children; ADHD = Attention-deficit hyperactivity disorder. No case of physical disability, neurological problems or fetal alcohol syndrome was reported.

Table 1

Results of Tests (Raw Scores)

Measures	IA <i>M (SD)</i>	CTL <i>M (SD)</i>	<i>df</i>	<i>F</i>
CELF-R				
Recalling Sentences Subtest	36.37 (11.99) _a	50.33 (9.60) _a	(1, 52)	22.31 ^{**}
Word Association Subtest	32.30 (9.91) _a	34.07 (7.52) _a	(1, 52)	0.55
ECOSSE	10.14 (4.37) _a	7.30 (2.54) _a	(1, 52)	8.61 ^{**}
EOWPVT	78.36 (14.65) _b	87.70 (10.27) _a	(1, 47)	6.86 ^{**}
EVIP	107.29 (12.12) _a	109.48 (12.84) _a	(1, 52)	0.41
WIAT-II				
Reading Comprehension Subtest	33.19 (5.47) _a	33.74 (7.18) _a	(1, 52)	0.10
WISC-IV				
Word Definition Subtest	20.62 (6.49) _a	24.63 (4.42) _a	(1, 52)	7.00 ^{**}
Wechsler Non-Verbal IQ				
Matrix Subtest	10.89 (2.53) _a	11.44 (1.97) _a	(1, 52)	0.81
Coding Subtest	38.74 (10.42) _a	32.93 (7.67) _a	(1, 52)	5.45 [*]
Object Assembly Subtest	41.72 (8.09) _c	43.14 (5.72) _d	(1, 30)	0.31
Recognition Subtest	12.39 (2.45) _c	13.14 (2.71) _d	(1, 30)	0.68
Spatial Span Subtest	14.44 (4.53) _e	13.61 (2.81) _f	(1, 20)	0.28
Image Arrangement Subtest	5.11 (4.14) _e	7.31 (4.57) _f	(1, 20)	1.32
Total Score	92.22 (19.52) _a	83.63 (19.43) _a	(1, 52)	2.63

Note. CELF-R = Clinical Evaluation of Language Fundamentals-Revised; ECOSSE = Épreuve de Compréhension Syntaxico-Sémantique; EOWPVT = Expressive One-Word Picture Vocabulary Test-Third Edition; EVIP = Échelle de Vocabulaire en Images Peabody; WIAT-II = Wechsler Individual Achievement Test-Second Edition; WISC-IV = Wechsler Individual Scale for Children-Fourth Edition. The raw scores for the ECOSSE represent the number of errors.

^an=27. ^bn = 22. ^cn = 18. ^dn = 14. ^en = 9. ^fn = 13.

^{*} $p < .05$. ^{**} $p < .01$.

Table 2

Percentage of IA Children who Scored Above and Below the Mean of CTL Children on Language Tests

<i>SD</i>	Recalling Sentences (CELF-R)	Word Association (CELF-R)	ECOSSE	EOWPVT	EVIP	WIAT-II	WISC-IV
]-2]	29.6	7.4	22.2	18.2	0	0	22.2
[-2 and -1.25]	33.3	22.2	11.1	9.1	7.4	11.1	22.2
[-1.25 and -1]	3.7	3.7	14.8	22.7	14.8	0	7.4
[-1 and 0]	18.5	11.1	22.2	22.7	33.3	33.3	22.2
0	0	0	0	0	0	0	0
[0 and +1]	11.1	37.0	25.9	13.6	33.3	55.6	18.5
[+1 and +1.25]	3.7	7.4	0	13.6	3.7	0	0
[+1.25 and +2]	0	11.1	3.7	0	7.4	0	3.7
[+ 2[	0	0	0	0	0	0	3.7

Note. CELF-R = Clinical Evaluation of Language Fundamentals-Revised; ECOSSE = Épreuve de Compréhension Syntaxico-Sémantique; EOWPVT = Expressive One-Word Picture Vocabulary Test-Third Edition; EVIP = Échelle de Vocabulaire en Images Peabody; WIAT-II = Wechsler Individual Achievement Test-Second Edition; WISC-IV = Wechsler Individual Scale for Children-Fourth Edition.

Table 3

Results of Tests (Standard Scores)

Measures	IA <i>M (SD)</i>	CTL <i>M (SD)</i>
CELF-R		
Recalling Sentences Subtest	6.44 (2.64) _a	9.41 (1.99) _a
Word Association Subtest	12.56 (4.07) _a	12.74 (2.81) _a
ECOSSE	8.15 (1.79) _a	9.30 (1.61) _a
EOWPVT	99.09 (14.53) _b	104.70 (21.02) _a
EVIP	126.04 (11.50) _a	126.26 (11.19) _a
WIAT-II	61.00 (9.83) _a	58.41 (10.54) _a
WISC-IV		
Word Definition Subtest	8.48 (2.52) _a	9.96 (2.38) _a
Wechsler Non-Verbal IQ	95.67 (9.77) _a	94.85 (9.32) _a

Note. CELF-R = Clinical Evaluation of Language Fundamentals-Revised; ECOSSE = Épreuve de Compréhension Syntaxico-Sémantique; EOWPVT = Expressive One-Word Picture Vocabulary Test-Third Edition; EVIP = Échelle de Vocabulaire en Images Peabody; WIAT-II = Wechsler Individual Achievement Test-Second Edition; WISC-IV = Wechsler Individual Scale for Children-Fourth Edition. The raw scores for the ECOSSE represent the number of errors.

^a n=27. ^b n = 22.

Table 4

Correlations between Outcome Variables and Language Measures

Variables	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.
1. Subgroup of IA children	—	.03	-.07	-.39*	-.53**	.01	-.10	-.23	-.19	-.21	-.09	-.17	-.30	-.04	-.44*
2. Presence of difficulties		—	-.17	.20	.14	-.14	.04	.20	-.15	-.05	-.28	-.26	.07	-.05	.01
3. Age at adoption			—	-.59**	-.09	.81**	-.10	.18	.10	-.15	-.19	-.01	-.16	-.29	-.32
4. Exposure to French				—	.86**	-.34	.10	.03	.25	.39*	-.21	.19	.21	.32	.54**
5. Age at testing					—	.05	.19	.16	.36	.39*	-.14	.22	.36	.21	.46*
6. Age: first words in French						—	.16	-.11	.14	-.17	-.005	.08	.15	-.17	-.23
7. Number of health problems (past)							—	.41*	.13	.08	.06	.08	-.07	.05	-.20
8. Number of health problems (present)								—	.21	-.07	-.19	-.23	.07	.05	-.09
9. Recalling Sentences (CELF-R)									—	.45*	.55**	.52*	.44*	.53*	.40*
10. Word Associations (CELF-R)										—	.34	.49*	.43*	.52**	.42*
11. ECOSSE											—	-.54**	-.58**	-.41*	-.36
12. EOWPVT												—	.30	.23	.61**
13. EVIP													—	.39*	.35
14. WIAT-II														—	.52**
15. Word Definition (WISC-IV)															—

Note. Subgroup of children = continuing IA children (IA_C) vs. newly recruited IA children (IA_N). Presence of difficulties = Low academic performers vs. Typical academic performers. CELF-R = Clinical Evaluation of Language Fundamentals-Revised; ECOSSE = Épreuve de Compréhension Syntaxico-Sémantique; EOWPVT = Expressive One-Word Picture Vocabulary Test-Third Edition; EVIP = Échelle de Vocabulaire en Images Peabody; WIAT-II = Wechsler Individual Achievement Test-Second Edition; WISC-IV = Wechsler Individual Scale for Children-Fourth Edition.

* $p < .05$. ** $p < .01$.

Connecting Text – Study 1 to Study 2

The purpose of the previous study was to evaluate the language abilities of IA children from China at older ages, more specifically during school age, in order to examine if language lags reported in previous studies were due to length of exposure to French (see Cohen, Lojkasek, Zadeh, Pugliese, & Kiefer, 2008 and Gauthier & Genesee, 2011). The IA children were adopted at 12.9 months of age (range: 6-21 months) and were assessed at 7;10 years of age (range: 7;0 – 8;8 years of age), on average. Their performance was compared to that of non-adopted monolingual French-speaking children matched on age ($M = 7;11$ years; range: 6;9 – 8;10 years of age), gender, and socio-economic status (SES). The results of this assessment showed that the IA children performed similarly to the controls (CTL) on socio-emotional development and non-verbal cognitive abilities, but that they performed significantly lower than the CTL children on sentence recall, expressive vocabulary, receptive grammar, and knowledge of word definitions. Although the IA children performed within age-appropriate levels on all measures of language abilities, they performed more than one standard deviation below age norms. Of particular interest, they had significant difficulties on the Recalling Sentences subtest of the Clinical Evaluation of Language Fundamentals-Revised (CELF-R), which is, arguably, a measure of verbal memory abilities. IA children's performance on this test of sentence recall was also found to be the best predictor of their performance on all the language tests, suggesting that their performance on sentence recall might play a role in mediating differences in language outcomes between them and the CTL children. This possibility was examined further in Study 3.

Study 2 complements Study 1 by examining specific aspects of IA children's language abilities in detail. More specifically, it examined IA children's acquisition of accusative object clitics, a structure in French that has been shown to be difficult to acquire by other learners of French and, in particular, children with SLI. The same children who participated in Study 1 participated in Study 2. In contrast to Gauthier, Genesee, and Kasparian (2012) who examined object clitics in naturalistic language samples from IA children, Study 2 used a clitic elicitation task to elicit the production of accusative object clitics. The use of an elicitation procedure is preferable because it circumvents the possibility that children might avoid using clitics during naturalistic language use and, thus, provides a more accurate estimate of their mastery of this structure. Additional goals of Study 2 was to examine if difficulties in the use of object clitics demonstrated by the IA children in Gauthier et al. persisted despite 4 additional years of exposure

and if vulnerabilities in the language development of IA children are the same as those demonstrated by other learners of French. Similarly to the procedure used by previous studies that documented the acquisition of clitics, Study 2 focused more specifically on rates of clitic production, omission of accusative object clitics and agreement errors, both in gender and number. Interestingly, these were all found to be particularly difficult for children with SLI learning French. An additional goal of Study 2 was to examine the possibility that certain structures, like object clitics, are inherently difficult to acquire in French and create the same selective vulnerability across learning groups (Tuller, Delage, Monjauze, Piller, & Barthez (2011).

Study 2

Language Abilities of Internationally-Adopted Children from China
during the Early School Years: Evidence for Early Age Effects?²

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This work is in press in the *Journal of Child Language*

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Abstract

The present study compared the performance of 27 French-speaking internationally-adopted (IA) children from China to that of 27 monolingual non-adopted French-speaking children (CTL) matched for age, gender, and socioeconomic status on a Clitic Elicitation task. The IA children omitted significantly more accusative object clitics and made significantly more agreement errors using clitics than the CTL children. No other significant differences were found between the groups. The findings suggest that the adoptees may experience difficulties in morpho-syntactic development possibly as a result of their delayed exposure to the adopted language.

Keywords: accusative object clitics; bilingualism; attrition; delayed language exposure

Internationally-adopted (IA) children from China have a unique language learning experience. In contrast to typical second language (L2) learners who acquire two languages either simultaneous or successively, IA children from China discontinue acquisition of the birth language at a time when the neuro-cognitive substrates for language learning are becoming fine-tuned (Werker & Tees, 2002). They also differ from native speakers because onset of exposure to the adopted language is delayed. Their unique pattern of language development is often referred to as second first language acquisition (DeGeer, 1992). These unique experiences are often considered important risk factors for language development.

However, studies that have compared the performance of IA children from China to standardized test norms have generally found that they demonstrate age-appropriate language abilities soon after adoption (e.g., Snedeker, Geren, & Shafto, 2007). These results are consistent with the fact that these children are usually adopted early, typically between 1;0-2;0 years of age, and thus well within the critical period for language acquisition (Gauthier & Genesee, 2011). They are also consistent with evidence suggesting that, in contrast to other populations of IA children (e.g., Croft et al., 2007, with IA children from Romania), IA children from China benefit from relatively good pre-adoption conditions. Indeed, studies have found that the cognitive abilities and the socio-emotional development of IA children from China, as a group, are age-appropriate and comparable to that of non-adopted children (e.g., Delcenserie, Genesee, & Gauthier, 2013; Gauthier & Genesee, 2011; Pomerleau et al., 2005; Roberts et al., 2005). Our own research has also shown that IA children from China, on average, score in the typical range on most standardized language tests (Gauthier & Genesee, 2011), arguing that any pre-adoption deprivation or adversity is either short-lived or relatively minor in severity.

In contrast, studies that have made direct comparisons between the language test scores of IA children in comparison to control children who were matched for variables, such as SES, which have been found to influence language development, have obtained significant differences between the two groups (e.g., Cohen, Lojkasek, Zadeh, Pugliese, & Kiefer, 2008; Delcenserie & Genesee, in press; Delcenserie et al., 2013). More specifically, Gauthier and Genesee and Delcenserie et al. found that, at 2-3, 4-5, and 7-8 years of age, IA children from China performed significantly lower than non-adopted monolingual French-speaking children matched on age, gender, and SES on measures of expressive vocabulary, sentence recall, receptive grammar, and knowledge of word definitions (see also Cohen, et al., 2008, for similar results). It is particularly

important to take SES into account when evaluating the language abilities of IA children since these children are adopted into relatively high SES families and, thus, benefit from an enriched learning environment which, in turn, can impact their language development, and more specifically their vocabulary abilities more specifically (Hoff, 2006).

Studies that have examined the language abilities of IA children from China in detail, albeit few in number (e.g., Pierce, Genesee, & Paradis, 2012; Snedeker et al., 2007), have similarly found that although they appear to demonstrate the same developmental pattern as native speakers of the adopted language (Snedeker et al., 2007), which is usually English, their mastery of grammatical morphemes, such as markers of verb tense, possessives, and plurals does not attain native levels (Glennen & Masters, 2002). However, these studies examined IA children's mastery of grammatical morphemes after relatively little exposure to the adopted language – before the children were 5 years of age and, thus, they might not have had sufficient exposure to the language to master these morphemes within age-appropriate levels. The question arises whether these lags would disappear with more extended exposure to the adopted language.

Of particular interest in the present study are findings from Gauthier, Genesee, and Kasparian (2012). Using spontaneous speech samples, they compared IA children from China and monolingual French-speaking children matched for age, gender, and SES on the use of complement clitics, tense morphology, and lexical diversity. They found that the IA children who were between 3;6 and 4;8 years of age at the time of testing and who were adopted at 1;1 years of age, on average, performed similarly to their non-adopted peers on lexical diversity and tense morphology but made significantly more errors using complement clitics, and accusative object clitics more specifically. French accusative object clitics are a specific category of personal pronouns in French that are strongly attached to the verb. They serve the same referential role as English object pronouns in that they are both used when the referent is salient in the discourse (Gauthier et al., 2012). Their use is restricted by several properties: they appear pre-verbally, except when they are used with verbs in the affirmative imperative form; they cannot be used in isolation; they cannot be conjoined with other pronouns; they cannot be modified; and they cannot be separated from the verb (Gauthier et al., 2012; Kayne, 1975). Examples of errors, in bold font, made by the IA children in Gauthier et al. are noted below in bold font:

- (1) Incorrect choice of clitic:

Je s'en vais au pique-nique. 'I am going to the picnic.'

(child used 3rd person singular form *se* instead of 1st person singular form *me* required by the 1st person subject pronoun *je*)

[Target form:] *Je **m**'en vais au pique-nique.*

- (2) Clitics co-occurring with a post-verbal lexical object:

*Après je vais le mettre **quelque chose** dedans.* ‘After I am going to put it **something** inside.’

- (3) Use of an extra clitic

*On **le** l'ouvre.* ‘We **it** it open.’

The acquisition of French accusative object clitics has been investigated by numerous researchers who have found that they are acquired late by native speakers of French (Hamann, Rizzi, & Frauenfelder, 1996) – usually between 2;6 and 3;3 years of age, by simultaneous bilinguals (Hulk, 1997; Hulk & Müller, 2000), and by successive bilinguals as well (Grondin & White, 1996). L2 learners’ difficulties with accusative object clitics have been characterized by high omission rates (e.g., Paradis, 2004), low production rates (Grüter, 2005), and late emergence (White, 1996). Errors with accusative object clitics are often taken as a marker for specific language impairment (SLI) in children learning French as a first language. More specifically, children with SLI often omit accusative object clitics (e.g., Hamann, 2004), and they make significantly more agreement errors using accusative object clitics than typically-developing children (Paradis, 2004). Of note, children with SLI have difficulty acquiring accusative object clitics, such as *la*, *le*, and *les* (*it*-masculine; *it*-feminine, *them*), but do not exhibit difficulties acquiring definite articles of the same form (*le*, *la*, and *les*: *the*-masculine, *the*-feminine, *the*-plural), indicating that their difficulties are not likely due to perceptual processing; but, rather reflect underlying difficulties (e.g., Paradis, 2004).

Gauthier et al. hypothesized that their findings could be attributed to IA children’s unique language learning experiences and, in particular, to their delayed exposure to French; they also recognize that L1 attrition could be at play. In this regard, evidence indicates that although, at birth, infants have the capacity to discriminate between the phonetic units of any natural language, this ability decreases so that by the end of the first year of life they are progressively able to perceive only phonetic contrasts in the ambient language (Gauthier et al., 2012; Werker & Tees, 2002). Considering that children’s primary language drives the fine-tuning of the neuro-cognitive substrates for language learning and that IA children’s exposure to their L1 is abruptly

stopped at the time of adoption, it is possible that IA children are at a disadvantage for the acquisition of aspects of the adopted language that are expressed using small phonetic units, such as clitics, given that the substrates for language learning were not fully established in the L1. At the same time, there is evidence from studies on young immigrant children that early delayed onset of L2 learning, even during the preschool years, can result in incomplete acquisition of the L2 in the long-term, a point we return to later (Abrahamsson & Hyltenstam, 2009).

In any case, the question arises whether the difficulty with accusative object clitics exhibited by the IA children in Gauthier et al. was due to their relatively short exposure to French at the time of testing. More specifically, these children were adopted between 1;0 and 2;0 years of age and were tested at 4;1 years of age, on average, and thus had a maximum of 2;0 years exposure to acquire accusative object clitics which are usually mastered only after 2;6 and 3;3 years of exposure (Hamann et al., 1996). While some of the youngest IA children at adoption may have had more than 2;6 years of exposure to French and, thus, the same amount of exposure as native speakers of French, this may not have been sufficient given their delayed onset of acquisition of French. Thus, the present study was designed to examine if these IA children were able to close the gap with non-adopted monolingual French-speaking children (CTL children) after more exposure to French. The children who participated in the present study were, on average, 7;10 years of age and had had 6;9 years of exposure to French, on average, at the time of testing. If no significant differences were found between the IA and CTL children, it would mean that previous results were due to a lack of exposure to French. If, however, the lags persisted, it would indicate that other factors are at play, such as delayed exposure to the adopted language or attrition of the L1.

Method

Participants

The children who participated in the present study had participated in a larger investigation of IA children by Delcenserie et al. in which they were administered an extensive battery of tests assessing their non-verbal cognitive abilities, language abilities, socio-emotional development, and general development. The present study focuses on their performance on a Clitic Elicitation task that was administered as part of that extended battery of tests.

There were 27 IA children from China, all girls, who had been adopted by French-speaking parents between 0;7 and 1;9 years of age ($M = 1;1$ years of age, $SD = 3.8$ months). At the time of

testing, they were between 7;0 and 8;8 years of age ($M = 7;10$ years of age, $SD = 6.0$ months) and had a mean length of exposure to French of 6;9 years, on average ($SD = 7.4$ months). None were exposed to Chinese post-adoption. The IA children were compared to 27 non-adopted monolingual French-speaking children (CTL children). The CTL children were matched to the IA children on gender and age (range: 6;9 to 8;10 years of age, $M = 7;11$ years of age, $SD = 6.9$ months) as well as on family income and parental level of education, two indices of socioeconomic status (SES). This information was collected from the parents using a Developmental Questionnaire. No significant differences were found between the groups in terms of age ($F(1,52) = .81, p = .37$), parental level of education (Chi-squared tests: mother: $\chi^2(2, N=54) = .92, p = .63$; father: $\chi^2(2, N=54) = 1.06, p = .59$) or family income ($\chi^2(2, N=54) = 1.39, p = .85$). Moreover, the IA and CTL children did not differ significantly on non-verbal cognitive ability ($F(1,52) = .10, p = .76$) or on socio-emotional development, as measured by the Wechsler Non-Verbal IQ test (Wechsler & Naglieri, 2006) and the Child Behavior Checklist (CBCL; Achenbach, 1991), respectively. Both tests were administered and reported in Delcenserie, et al.

Exclusion criteria for all participants included: 1) the presence of psychiatric or neurological antecedents, 2) a history of intellectual deficiency, 3) severe language impairments, 4) premature birth, 5) serious health problems, 6) motor or behavior problems, 7) L1 other than French, and 8) more than 25% of exposure to an L2 as reported by parents on a Language Environment Questionnaire.

Assessment Measures

The Clitic Elicitation task was designed to elicit the production of sentences containing accusative object clitics (Grüter & Crago, 2012). It consisted of a picture story depicting a girl, a boy, and a dog performing different actions, such as picking apples. During the task, the experimenter showed pictures to the child while reading a script. The script included questions that were designed to elicit the production of utterances containing accusative object clitics. Because referents were made clear in the discourse, the task created contexts where the object was encoded easily using a pronoun. The task included 21 accusative clitic elicitation probes; for example, when shown a picture of a girl with a glass of milk:

Experimenter: *Que fait Dora avec le lait?* ‘What is Dora doing with the milk?’

Expected answer: *Elle **le** boit.* ‘She drinks it.’ Clitic pronoun in French appears in bold font.

Children's responses during the Clitic Elicitation task were recorded using a digital tape recorder (Sony IC-Recorder ICD-UX71). The recordings were transcribed by the experimenter and an independent second transcriber who were both native speakers of French. Inter-rater agreement was high (i.e. 98.8%) and any disagreements were resolved by discussion. Children's responses were then coded by the experimenter and the transcriber as falling into one of seven categories (see Table 1 for more details and examples). The responses containing an accusative object clitic correctly elicited were coded as CL-COR. This category included only accusative object clitics that were elicited in the proper target form, without any error and, thus, did not include productions from any of the other categories. The responses containing an accusative object clitic containing an agreement error were coded as CL-AGR. In this category, accusative object clitics were elicited but these did not appear in the target form since they included errors in gender and/or number. Responses containing a target object clitic as well as an article with an object, where the object is the referent of the clitic were coded as CL-DP. Because proper use of accusative object clitics requires that these do not appear in conjunction with full DPs that refer to the object that they are supposed to replace, these were coded as errors. Responses containing a dative clitic where an accusative object clitic was required were coded as CL-DAT. Because these responses did not contain the target object clitic although the sentence required one, these were also coded as errors. Responses lacking an accusative object clitic in obligatory contexts were coded as CL-OM, also coded as errors. Responses containing a lexical object with the same referent as the object mentioned by the experimenter in the question were coded as LEX-OBJ. Because these responses did not contain the target accusative object clitic, they were coded as errors. Although LEX-OBJ were coded as errors because they are inappropriate, we acknowledge that these are not strictly speaking grammatically incorrect. Finally, responses containing a strong pronoun instead of the appropriate accusative object clitic were coded as PRO-N. Again, because these responses did not contain the target accusative object clitic, they too were coded as errors. Aside from CL-COR, higher scores for the other categories mean a higher number of errors and, thus, poorer performance.

The children's scores for each category are expressed as a proportion of the total number of responses belonging to a given category over the total number of responses, including the omission of accusative object clitics in obligatory pronominalization contexts.

Procedure

Prior to testing, the objectives and the procedure of the study were explained to parents and their children, and parents were asked to sign the consent form; those who agreed to participate were then asked to complete the CBCL, a Language Environment Questionnaire, and a Development Questionnaire (see Delcenserie et al., 2013, for details). The entire test battery was administered to each child individually during two 50-minute sessions on separate days. The Clitic Elicitation task was administered during the second testing session. Testing took place in a quiet room at the university, in the child's school, or at home. When parents were present during testing, they were asked to remain quiet and not to help their child in any way.

Results

One-way independent groups analyses of variance (ANOVAs; $\alpha = .05$) were carried out to compare the IA and the CTL children's proportion scores on the Clitic Elicitation Task (see Table 2). Because there were very few responses in categories CL-DP, CL-DAT, and PRO-N, these results were not analyzed statistically and are not discussed further here. The results showed that, compared to the CTL children, the IA children produced significantly fewer correct accusative object clitics (CL-COR; IA = 56.44%; CTL = 84.26%) and they omitted significantly more accusative object clitics in obligatory contexts (CL-OM; IA = 22.70%; CTL = 3.93%). In terms of CL-AGR, the results show that the CTL children produced significantly more accusative object clitics containing errors of agreement in gender and/or number than the IA children (IA = 6.00%; CTL = 2.74%).

The groups were also compared in terms of the total number of clitics elicited, with or without errors. This category was calculated by adding the number of accusative object clitics correctly produced (CL-COR) and the number of accusative object clitics produced with agreement errors (CL-AGR). The results showed that the IA children produced significantly fewer clitics, with or without errors, than the CTL children (IA = 62.93%; CTL = 87.15%). No other significant differences were found between the groups.

Insert Table 2 about here

We then compared the results of the IA children to the results of the CTL children expressed in standard deviations; more specifically, we calculated the percentage of IA children who scored within + or -1 standard deviation of the mean of the CTL children, between 0 and +/- 1 standard deviations, between +/-1 and +/- 2 standard deviations of the CTL group, or more than + or - 2 standard deviations of the CTL group. This comparison was made for proportion of correct clitics (CL-COR), clitics containing agreement errors (CL-AGR), and clitics omitted in obligatory contexts (CL-OM). This revealed that all the IA children performed below the CTL children on number of correct accusative object clitics elicited (CL-COR; see Table 3 for the detailed distribution). Indeed, more than 55.5% ($n = 15$) of the IA children performed more than 2 *SDs* below the mean of the CTL children with respect to the use of correct accusative object clitics (CL-COR). In terms of accusative object clitics with agreement errors (CL-AGR), all of the IA children ($n = 17$) performed above the mean of the CTL children, consistent with the fact that they produced significantly more accusative object clitics with agreement errors than their non-adopted peers. Recall that the CL-AGR category includes responses with agreement errors and, thus, higher scores represent poorer performance. More specifically, more than 44.4% ($n = 12$) of the IA children performed more than 1 *SD* below the mean of the CTL children on this measure. Moreover, all the IA children omitted more clitics in obligatory contexts than the CTLs (CL-OM). Indeed, 59.3% ($n = 16$) of the IA children scored more than 2 *SD* above the mean of their non-adopted peers; once again, note that, higher scores on CL-OM represent poorer performance.

Insert Table 3 about here

Discussion

The purpose of the present study was to determine if IA children from China have persistent difficulties with accusative object clitics. Indeed, the IA children omitted significantly more accusative object clitics (CL-OM), produced significantly more accusative object clitics with agreement errors (CL-AGR) and, accordingly, produced significantly fewer correct accusative object clitics (CL-COR) than the non-adopted monolingual French-speaking children. Thus, the performance of the IA children was considerably poorer than that of the CTL children overall – more specifically, all the IA children omitted more object clitics in obligatory contexts

and, on average, produced more accusative object clitics with agreement errors (CL-AGR) than their non-adopted peers. In addition, all the IA children performed more than 1 *SD* below the mean of the CTL children in terms of number of correct accusative object clitics produced (CL-COR). The present results indicate that the IA children had persistent difficulties using accusative object clitics, difficulties that, although they differ in type, were reported by Gauthier et al. in younger IA children, 12 of whom in fact were the same children.

Of particular interest is the similarity between the IA children's pattern of difficulties with accusative object clitics and those of children with SLI. Although we do not think that the IA children were experiencing language difficulties that were clinical in nature because they performed within age-appropriate levels on other standardized measures of language abilities (Delcenserie et al., 2013), agreement errors, high rates of omissions, and low rates of clitic production are all difficulties that have been reported for children with SLI learning French. As argued by Tuller, Delage, Monjauze, Piller, and Barthez (2011), it could be the case that certain structures, such as accusative object clitics, are inherently difficult to acquire in French and, thus, create the same selective vulnerability across learner groups. In other words, this particular marker of SLI in French seems to be an area of difficulty for other at-risk populations, although the severity of the difficulties that these groups experience may vary. Future studies that compare IA children from China and children with SLI on other aspects of French that are difficult for other learners of French would be interesting.

The question arises, what could be the cause of IA children's difficulties with object clitics? Given that the IA children performed within age-appropriate levels and similar to CTL children on tests of non-verbal cognitive abilities and socio-emotional adjustment, pre-adoptive deprivation seems an unlikely explanation. As noted previously, it has been shown that long-term impairment in language and other domains of development are exhibited by adopted children who experience severe deprivation and adversity pre-adoptively. In contrast, the adopted children who participated in this study scored within age-appropriate levels on other measures of general language abilities (see Delcenserie et al., 2013), suggesting that they did not suffer from adverse pre-adoptive conditions. Indeed, IA children are highly resilient and, despite the fact that pre-adoption adversity cannot be ruled out completely because very little is known about IA children's conditions of institutionalization, this seems an unlikely explanation of the current findings.

It also seems unlikely that length of exposure to the adopted language is a viable explanation. Although it could be argued that the results reported by Gauthier et al. were due to insufficient exposure to French, this seems unlikely in the present study since the adoptees benefited from more than 6;9 years of exclusive exposure to French, a level of exposure that is usually sufficient for non-adopted monolingual children to acquire clitics.

With respect to the IA children's unique language learning experiences, two other explanations are possible: L1 attrition and/or delayed onset of exposure to the adopted language. That the IA children were able to perform within age-appropriate levels on other measures of language ability, as reported in Delcenserie et al., suggests that disrupted L1 exposure did not impair their basic language learning abilities (Gauthier et al., 2012); but this remains a possibility.

Delayed onset of exposure to French could also be at play. In this regard, Abrahamsson and Hyltenstam found that even a short delay in onset of exposure in young L2 learners can result in long-term non-native levels of language ability. More specifically, they found that among a group of L2 learners of Swedish who were judged to be as proficient as adult native speakers of Swedish when tested in adulthood, very few were able to perform within the native-speaker range on a battery of tests of language and processing abilities, such as listening to language in noise, interpreting proverbs, voice onset time (VOT) tasks, and grammaticality judgment. This was true even of participants who started to acquire Swedish as an L2 before age 5. More specifically, fewer than 10% (three of 31 participants) of the L2 learners who had begun to learn Swedish before 5 years of age performed like native speakers of Swedish more than 20 years later. Abrahamsson and Hyltenstam argued that very young L2 learners are not likely to perform as well as native speakers even after many years of exposure if examined using demanding language tests. Similar to these findings, results from the present study suggest that even the limited delay in onset of exposure (1;0 to 2;0 years) to the adopted language experienced by the IA children in the present study may account for their language difficulties, more specifically for their incomplete acquisition of accusative object clitics (see Delcenserie et al., 2013 and Gauthier & Genesee, 2011, for more detailed discussions of this issue).

This raises a further question – why does delayed onset of exposure compromise long-term native-like attainment in young learners? In this regard, Delcenserie et al. showed that IA children from China performed significantly lower than non-adopted children on expressive vocabulary, receptive grammar, and knowledge of word definitions, but that they performed more

than 1 *SD* below the CTL children and below the norms on the Recalling Sentences subtest of the Clinical Evaluation of Language Fundamentals-Revised (CELF-R). Moreover, when the effect of the Recalling Sentences subtest was partialled out, the groups were no longer significantly different on measures of language abilities. The authors hypothesized that delayed age of onset of acquisition of French may limit IA children's verbal short-term memory, which in turn might affect their language learning outcomes. Similarly, Grüter and Crago suggest that limitations in working memory capacity could be a potential explanation of children's omissions of direct accusative object clitics in obligatory contexts. In their assessment of Chinese L2 learners of French who were 8;0 years of age, on average, and who had about 2;11 years of exposure to French at the time of testing, they observed a significant negative correlation between number of object clitic omissions and performance on a backward digit recall task, a test of verbal working memory abilities. Regression analyses also showed that this relationship remained significant when age at the time of testing and length of exposure to French were controlled for, and also that verbal working memory abilities explained 34% of the variance in frequency of object omission (Grüter & Crago, 2012). This is particularly interesting in light of recent findings by Delcenserie and Genesee (in press) that IA children from China performed significantly lower than CTL children on measures of verbal short-term memory, verbal working memory, and verbal long-term memory, but similarly to CTL children on measures of non-verbal short-term and working memory, suggesting that their memory difficulties are language-specific and not domain general. Thus, it is possible that the IA children's difficulties in language acquisition in general, including the acquisition of accusative object clitics, are related to verbal memory limitations. In other words, the acquisition of object clitics might be affected along with other more general components of language because they are vulnerable structures, as evidenced by studies of French-L1 learners who master this structure relatively late (e.g., Hamann et al., 1996). Although this is an interesting possibility, more research is needed to determine if IA children's difficulties with accusative object clitics and their verbal memory lags are correlated.

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Table 1

Codes used to classify children's responses to the Clitic Elicitation task

Categories	Code	Example
Responses containing a correct accusative object clitic (without errors)	CL-COR	Experimenter: <i>Que fait le chien à Véro?</i> 'What does the dog do to Vero?' Child: <i>Il la secoue.</i> 'He shakes her.'
Responses containing an accusative object clitic with an agreement error (number and/or gender)	CL-AGR	Experimenter: <i>Que fait Véro avec les pommes (plural)?</i> 'What does Vero do with the apples?' Child: <i>Elle la (singular) met dans la brouette.</i> 'She puts it in the wheelbarrow.' [Target form:] <i>Elle les (plural) met dans la brouette.</i>
Responses lacking an accusative object clitic in obligatory contexts	CL-OM	Experimenter: <i>Que fait le chien avec le sandwich de Luc?</i> 'What does the dog do with Luc's sandwich?' Child: <i>Il mange.</i> 'He eats.' [Target form:] <i>Il le mange.</i>
Responses containing the target object clitic and an article with an object (a DP, which is the referent of the clitic)	CL-DP	Experimenter: <i>Que fait Véro avec la pomme?</i> 'What does Vero do with the apple?' Child: <i>Elle la mange la pomme.</i> 'She eats it the apple.' [Target form:] <i>Elle la mange.</i> [Unnecessary repetition of the DP after the clitic.]
Response containing a dative clitic where an accusative object clitic is required	CL-DAT	Experimenter: <i>Que fait Luc à Véro?</i> 'What does Luc do to Vero?' Child: <i>Il lui couvre.</i> 'He him cover.' [Erroneous use of the dative <i>lui</i> instead of the appropriate clitic, <i>la</i> .] [Target form:] <i>Il la couvre.</i>
Responses containing a lexical object with the same referent as the object mentioned by the experimenter in the question	LEX-OBJ	Experimenter: <i>Que fait Luc avec le chien?</i> 'What does Luc do with the dog?' Child: <i>Il fait tomber le chien.</i> 'He brings down the dog.' [Target form:] <i>Il le fait tomber.</i>
Responses containing a strong pronoun instead of the appropriate accusative object clitic	PRO-N	Experimenter: <i>Que fait Luc avec le cerf-volant?</i> 'What does Luc do with the kite?' Child: <i>Il essaie de faire que ça vole.</i> 'He tries to make that fly.' [Target form:] <i>Il essaie de le faire voler.</i>

Table 2

Performance on the clitic elicitation task by category (expressed as percentages)

Codes	IA children Frequencies	IA children <i>M (SD)</i>	CTL children Frequencies	CTL children <i>M (SD)</i>	<i>F</i> (1, 53)	η^2
CL-COR	239	56.44% (17%)	372	84.26% (13%)	53.26**	.51
CL-AGR	26	6.00% (6%)	6	2.74% (4%)	5.42*	.12
CL-OM	93	22.70% (14%)	16	3.93% (5%)	38.75**	.44
CL-DP	2	.48% (1%)				
CL-DAT	1	.26% (1%)	1	.26% (1%)		
LEX-OBJ	58	14.11% (14%)	39	8.96% (9%)	2.26	
PRO-N	2	.56% (3%)	1	.22% (1%)		

Note. IA = internationally-adopted children; CTL = non-adopted monolingual French-speaking children; CL-COR = responses containing a correct accusative object clitic; CL-AGR = responses containing an accusative object clitic with agreement error(s); CL-OM = responses lacking an accusative object clitic in obligatory contexts; CL-DP = responses containing the target object clitic and an article with an object (DP); CL-DAT = response containing a dative clitic where an accusative object clitic is required; LEX-OBJ = responses containing a lexical object with the same referent as the object mentioned by the experimenter in the question; PRO-N = responses containing a strong pronoun. Note that, aside from CL-COR, scores represent number of errors and, thus, poorer performance.

* $p < .05$. ** $p < .001$.

Table 3

Percentage of IA children who scored above and below the mean of CTL children on the clitic elicitation task

Codes							
	2 <i>SDs</i> below	1 to 2 <i>SDs</i> below	0 to 1 <i>SDs</i> below	Mean of the CTL children	0 to 1 <i>SDs</i> above	1 to 2 <i>SDs</i> above	2 <i>SDs</i> above
CL-COR	55.5% (15)	18.5% (5)	25.9% (7)				
CL-AGR					55.5% (15)	22.2% (6)	22.2% (6)
CL-OM					14.8% (4)	25.9% (7)	59.3% (16)

Note. The numbers in parentheses represent the number of children corresponding to each percentage. Note that, as CL-AGR and CL-OM represent agreement errors and omissions, respectively, scores above the mean of the CTL children represent poorer performance. In contrast, CL-COR represents the number of accusative object clitics correctly elicited. In this case, poor performance corresponds to scores below the mean of the CTL children.

Connecting Text – Study 2 to Study 3

The previous studies focused on internationally-adopted (IA) children from China who were between 7;0 and 8;8 years of age at the time of testing and who had been adopted around 12.9 months of age, on average. They were compared to non-adopted monolingual French-speaking children matched on age, gender, and socio-economic status (SES). The results of Study 1 and 2 demonstrate that the IA children exhibited normal non-verbal cognitive abilities and socio-emotional development, but also that they generally performed within age-appropriate levels on several measures of language ability. Significant differences were found between the IA and control (CTL) children using general measures of language ability as well as detailed analyses of a specific structure in French, accusative object clitics. The lags exhibited by the IA children on expressive vocabulary, receptive grammar, knowledge of word definitions, their high rate of accusative object clitic omissions, and their high rate of agreement errors using accusative object clitics suggest that, despite the great resilience that IA children show when acquiring their second first language (DeGeer, 1992), they experience difficulties that cannot be accounted for by amount of exposure to the adopted language.

The results of Study 1 and 2 also highlight the possible implication of memory abilities in IA children's language lags insofar as the IA children performed more than one standard deviation below the norms on the Recalling Sentences subtest, a measure of verbal memory, and also significantly lower than their non-adopted peers. Similar results were reported by Gauthier and Genesee (2011), suggesting that the IA children might experience memory difficulties that persist into school age. In support of this possibility, several studies have shown that verbal memory abilities are significantly correlated with language acquisition outcomes (e.g., Baddeley, Gathercole, & Papagno, 1998) in diverse kinds of learners. For example, verbal short-term memory (STM) has been found to be involved in the acquisition of vocabulary and grammar in typically-developing (TD) first language (L1) learners and in second language (L2) learners with delayed language exposure (French & O'Brien, 2008; Masoura & Gathercole, 2005). On the other hand, working memory (WM) has been found to be significantly related to language comprehension and reading, among other abilities, in different populations of children, such as TD language learners, in children with specific language impairments (SLI), and in children with reading disabilities (Archibald & Gathercole, 2006; Daneman & Carpenter, 1980; Gathercole, Alloway, Willis, & Adams, 2006).

Despite the important role that memory abilities appear to play in language acquisition in TD children, in children with language difficulties, and in L2 learners, no detailed examination of IA children's memory abilities has been undertaken to date. Thus, Study 3 was designed to take an in-depth examination of the memory abilities of IA children from China. Testing included both verbal and non-verbal memory abilities and, specifically, verbal STM, WM, and long-term memory (LTM) abilities along with non-verbal STM and WM abilities. Both verbal and non-verbal memory were examined in order to determine whether IA children's memory lags, if any, are specific to verbal material or, in contrast, if their lags affect both verbal and visuo-spatial memory and are, thus, domain-general. Regression analyses were undertaken to examine the link between the IA and CTL children's memory abilities and their language outcomes; specially, we were interested in finding which variables among verbal STM, verbal WM, verbal LTM, and length of exposure to French best predict IA and CTL children's language abilities. A secondary goal of Study 3 was to examine if IA children's language lags persisted with even more exposure to the adopted language. Study 3 included 20 of the IA children who participated to Study 1 and 2, but also 18 of the IA children who participated to Gauthier and Genesee's study. The IA children ($n = 30$) were between 9;0 and 12;4 years of age ($M = 10;8$ years) and had been adopted between 6 and 24 months of age ($M = 12.85$ months). The IA children were compared to non-adopted monolingual French speaking children matched on age (range: 9;2 and 12;2 years of age ; $M = 10;7$ years), gender, and SES. Study 3 is, to our knowledge, the first detailed examination of IA children's memory abilities.

Study 3

Language and Memory Abilities of Internationally-Adopted Children from China³

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This work is in press at the *Journal of Child Language*

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Abstract

The goal of the present study was to examine if internationally-adopted (IA) children from China ($M = 10;8$ years) adopted by French-speaking families exhibit lags in verbal memory in addition to lags in verbal abilities documented in previous studies (Gauthier & Genesee, 2011). Tests assessing verbal and non-verbal memory, language, non-verbal cognitive ability, and socio-emotional development were administered to 30 adoptees. Their results were compared to those of 30 non-adopted monolingual French-speaking children matched on age, gender, and socioeconomic status. The IA children scored significantly lower than the controls on language, verbal short-term memory, verbal working memory, and verbal long-term memory. No group differences were found on non-verbal memory, non-verbal cognitive ability, socio-emotional development suggesting language-specific difficulties. Despite extended exposure to French, adoptees may experience language difficulties due to limitations in verbal memory, possibly as a result of their delayed exposure to that language and/or attrition of the birth language.

Keywords: international adoption, language acquisition, memory abilities, second language acquisition.

The language development of internationally-adopted (IA) children is of both theoretical and clinical interest because their language learning experiences are unique. Specifically, they experience truncated first language (L1) exposure and delayed acquisition of the second or adoption language. Exposure to the adoption language has many of the qualities of L1 acquisition insofar as IA children begin to acquire it during infancy and it is the only language that most IA children are exposed to and learn post-adoption; indeed, acquisition of the adoption language has been referred to as second first-language acquisition (DeGeer, 1992). IA children from China are of particular interest with respect to language development because, owing to China's one-child policy and unlike children adopted from some other countries, they are adopted relatively young and they experience relatively favorable pre-adoption environments. As a result, they exhibit limited and usually only short-term general developmental consequences, which, in turn, are likely to have only short-term and limited impact on their language development. Indeed, studies report that most IA children from China have relatively good health at the time of adoption and they exhibit good general development post-adoption (e.g., Gauthier & Genesee, 2011; Pomerleau et al., 2005). Studies have shown more specifically that the cognitive abilities and the socio-emotional adjustment of most IA children from China are within age-appropriate levels or are similar to those of non-adopted children within one to two years of adoption (Cohen, Lojkasek, Zadeh, Pugliese, & Kiefer, 2008; Delcenserie, Genesee, & Gauthier, 2013; Gauthier & Genesee, 2011). Issues remain, however, concerning the effects of delayed exposure to the adoption language and attrition of the L1 on their language development post adoption.

Research that has assessed the language development of IA children using standardized tests and/or parent reports has found that they often score within the typical range on such measures within 12 to 24 months post-adoption (Glennen, 2007; Roberts et al., 2005). At the same time, however, there is evidence of language difficulties and lags in comparison to non-adopted children. More specifically, there appears to be a larger than expected group of IA children who perform below average when compared to non-adopted monolingual children and/or who require the services of language specialists (e.g., Delcenserie et al., 2013; Scott, Roberts, & Krakow, 2008). Gaps in language development in IA children have been reported in research conducted during both the preschool and early school years (see Scott, 2009 for a review of research on school-age children).

Lags in language development in IA children have also been reported in research that has compared IA children's performance on a variety of language tests directly to that of non-adopted children matched on variables such as age, gender, and socioeconomic status (SES) that are often associated with language acquisition (Cohen et al., 2008; Delcenserie et al., 2013; Gauthier & Genesee, 2011; Hoff, 2006). In particular, Gauthier and Genesee (2011) compared the language test scores of IA children from China at 2-3 and again at 4-5 years of age who were living in French-speaking families to those of non-adopted children matched on age, gender, and SES. They found that, despite normal non-verbal cognitive abilities and socio-emotional adjustment, the IA children had statistically significantly lower scores than non-adopted control children on expressive vocabulary, receptive language, and sentence recall at both ages. In a follow-up assessment, when the children were between 7 and 8 years of age, Delcenserie et al. found that the IA children continued to score significantly lower than matched control children on tests of expressive vocabulary and sentence recall as well as on tests of receptive grammar and word definitions. Of particular relevance to the present study, and in contrast to their language test results, which generally fell within age-appropriate levels on test norms, the IA children scored significantly lower than the controls and also more than one standard deviation below age-norms on a test of sentence recall. Additional analyses revealed further that performance on sentence recall was a significant predictor of the adoptees' performance on all measures of language ability and that statistically significant between-group differences on the language tests disappeared when sentence recall scores were used as a covariate. Taken together, these results suggest that lags in language development exhibited by young IA children are not short-term, but rather persist into the early school years and, furthermore, that verbal memory may also be a vulnerable domain of development for these children. Delcenserie and colleagues hypothesized that, in fact, it was weaknesses in verbal memory that underlay the IA children's lags in language development.

However, Delcenserie et al.'s hypothesis was based on IA children's performance on tests of sentence recall. It is unclear at present what tests of sentence recall actually assess. They could be measures of general language ability or verbal memory (e.g., Moll, Hulme, Nag, & Snowling, 2013). On the one hand, to the extent that tests of sentence recall assess general language ability, as argued by Moll et al., then IA children's performance on this test would simply be a reflection of their lags on other tests of language ability. On the other hand, to the extent that tests of

sentence recall assess verbal memory, as argued by some (e.g., Alloway & Gathercole, 2005; Potter & Lombardi, 1998), then IA children's relatively poor performance on this test might implicate lags in verbal memory in addition to language development per se. That the IA children's language results might be linked to their verbal memory abilities is not unreasonable insofar as it has been reported that differences in language learning outcomes (both first and second) in different types of learners (e.g., typically-developed and children with specific language impairment (SLI)) are associated with differences in verbal memory, including verbal short-term memory (STM) and verbal working memory (WM).

Verbal STM, which is involved in the temporary storage of verbal information and in the long-term learning of the phonological structure of language (Baddeley, Gathercole, & Papagno, 1998), has been found to be particularly important for the acquisition of vocabulary and grammar, although significant relationships have also been reported between verbal STM and other language abilities, such as reading (Dufva, Niemi, & Voeten, 2001). With respect to vocabulary development, research has shown that typically-developing L1 learners as well as second language (L2) learners with relatively strong verbal STM abilities demonstrate greater vocabulary knowledge than children with relatively weak STM abilities (Gathercole, Willis, Emslie, & Baddeley, 1991; Masoura & Gathercole, 2005). In a study of typically-developing English-L1 learners, Gathercole and Adams (1993) found significant relationships between performance on tests of non-word repetition, a measure of verbal STM, and vocabulary knowledge at 2 and 3 years of age, even after partialling out the effects of age and non-verbal abilities. A link between verbal STM and word learning has also been found in special populations, such as individuals with SLI (Bishop et al., 1999). Similarly, significant relationships have been found between verbal STM and the acquisition of grammar, in both L1 and L2 learners (Baddeley et al., 1998; French & O'Brien, 2008). It has been found, for example, that L1 learners with relatively good verbal STM abilities produced sentences that were of higher grammatical complexity, contained more information, were longer, and contained a greater variety of syntactic constructions than children with relatively poor STM abilities. Verbal STM abilities at 2 to 3 years of age have also been found to be significant predictors of morpho-syntactic abilities at 4 to 5 years of age (Adams & Gathercole, 1995, 1996; Chiat & Roy, 2008).

Although not as extensively studied as verbal STM, verbal working memory (WM) also appears to be important for language development. While verbal STM is involved in tasks that

require the short-term storage of verbal information, verbal WM is involved in tasks that involve the simultaneous storage and processing of verbal material. Verbal WM abilities have been found to correlate with a variety of language-related abilities, such as the conceptual component of vocabulary acquisition (Daneman & Green, 1986), language comprehension (Daneman & Carpenter, 1980), reading (Gathercole, Alloway, Willis, & Adams, 2006), and academic achievement (Gathercole, Brown, & Pickering, 2003; St Clair-Thompson & Gathercole, 2006). Children with poor WM have been found to be slower to learn the associations between sound and print, which in turn impairs the ability to read and spell (e.g., Gathercole et al., 2006). Verbal WM has also been found to be important for L2 learners, both adults (Harrington & Sawyer, 1992) and children (Gutiérrez-Clellen, Calderon, & Weismer, 2004; Masoura & Gathercole, 1999), as well as for children with SLI. For example, Archibald and Gathercole (2006) found that children with SLI between 7 and 11 years of age had deficits in both verbal STM and WM (e.g., Weismer & Thordardottir, 2002).

Of particular relevance to the present study, relatively low levels of verbal STM and WM ability are associated with delays in language acquisition or other interruptions in language input. With respect to the latter, there is evidence that children who suffer from otitis media during the first year of life and who, thus, have had interrupted language input at a time during which children's ability to distinguish the phonemic contrasts in their native language is becoming fine-tuned, have verbal STM deficits (e.g., Moody, Schwartz, Gravel, & Ruben, 1999). Research also shows that age of acquisition affects verbal WM abilities in L2 learners. Vejnovic, Milin, and Zdravkovic (2010) found that Hungarian undergraduate students who acquired Serbian as an L2 at the age of 4 had significantly better verbal WM abilities than students who acquired the same L2 at age 9, even when the effect of verbal WM abilities in the L1 was controlled for.

By implication, and taken together, the results of these diverse studies lend support to Delcenserie et al.'s hypothesis that IA children, who experience both interrupted L1 acquisition and delayed acquisition of their new language, might experience verbal STM and WM difficulties in comparison to native speakers of the adoption language. However, Delcenserie et al. did not examine verbal memory ability directly and, thus, evidence for lags in verbal memory in IA children is only indirect, at present. The goal of the present study was to examine the verbal memory abilities of IA children from China directly and, moreover, to examine which components of verbal memory might be affected and the extent to which any lags in verbal

memory among IA children are domain-general, thus affecting both verbal and non-verbal memory abilities, or are specific to language. In order to examine which components of verbal memory might be implicated, we included tests of verbal STM, verbal WM, and verbal LTM. To investigate if memory lags were specific to verbal material, we included tests of non-verbal STM and WM. We also included tests of non-verbal cognitive abilities, socio-emotional adjustment, and attention in order to rule out the possibility that lags in verbal memory, if any, were related to other developmental lags. Since the children who participated in the present study were between 9 and 12 years of age, almost 10 years post-adoption, on average, we were also able to investigate the long term language outcomes of IA children from China. While a number of studies have examined IA children's language development (e.g., Glennen, 2007; Glennen & Bright, 2005), very few have documented their language abilities so long after adoption (e.g., Delcenserie et al., 2013; Eigsti, Weitzman, Schuh, De Marchena, & Casey, 2011; Scott et al., 2008).

Method

Participants

The participants were 30 IA children from China, 18 of whom had been tested by Gauthier and Genesee at 2-3 and 4-5 years of age and 20 who had been previously tested by Delcenserie et al. at 7-8 years of age. Four new IA children were included in our sample, of which three were siblings of children who had been tested at younger ages. The attrition of participants was relatively minor and the reason cited by all parents who had participated in the Gauthier and Genesee study but not in the present study was lack of time. To ensure that the children who continued to participate in the present study did not differ from those who did not in significant ways, we compared the performance of these two groups using data from Gauthier and Genesee. We found no statistically significant differences between children who participated in the present study and those who discontinued on the Expressive One-Word Picture Vocabulary test (expressive vocabulary), the Échelle de Vocabulaire en Images Peabody (receptive vocabulary), the Vineland Socio-Emotional Early Childhood Scales, the Leiter International Performance scale (non-verbal cognitive abilities), the Preschool Language Scales (expressive and receptive language skills), and the Clinical Evaluation of Language Fundamentals, including the Recalling Sentences subtest.

All the IA children were girls and, thus the present results might not generalize to samples of IA boys from China. They had been adopted between 0;6 and 2;0 years of age ($M = 1;8$

months, $SD = 0;4$ years). As a group, they were between 9;0 and 12;4 years old at the time of testing ($M = 10;8$ years) and had had a mean length of exposure to French of 9;7 years (7;5 to 11;7 years).

The IA children were compared to a group of 30 non-adopted monolingual French-speaking children matched for age, gender, parental level of education, and family income. The control children (CTL) were between 9;2 and 12;2 years of age at the time of testing ($M = 10;7$ years) and were at the same grade levels as the IA children. Exclusionary criteria for the CTL children included the presence of psychiatric or neurological antecedents, a history of intellectual deficiency and language problems, premature birth (except for twins), serious health, motor or behavior problems, first language other than French, and more than 35% exposure to a second language; this information had been collected from parents in response to the Language Exposure Questionnaire, described in the next section.

The present study was approved by McGill University Research Ethics Board.

Questionnaires

A Developmental Questionnaire similar to the one used by Gauthier and Genesee was given to parents to collect information about each child's health, general development, behavior, socio-emotional adjustment, language development, and general abilities in school. The questionnaire also included questions about parents' age, level of education, and family income. The Child Behavior Checklist (CBCL; Achenbach, 1991) was also completed by the parents. This is a parent report that evaluates children's behavior and social competence at home and is appropriate for children and adolescents between 6;0 and 18;0 years of age.

A Language Exposure Questionnaire was also completed by parents in order to ascertain the children's language exposure and how this may have changed from birth to the time of testing. Because the participants were all in the upper levels of elementary school and, thus, had had at least partial exposure to English as a second language, the extent of their exposure to English was also determined in the questionnaire.

Assessment Materials

All the measures of language and verbal memory abilities included norms for French-speaking children, with the exception of the Non-word Repetition test, the Competing Language Processing Task, and the Expressive One-Word Picture Vocabulary Test for which English norms were used. To ensure standardization of procedures, a native French-speaker recorded all

the stimuli for the tests of verbal STM, verbal WM, and verbal LTM using a digital tape recorder (Sony IC-Recorder ICD-UX71). The stimuli were presented to the participants using iTunes on a laptop computer (Sony VAIO VPC EB31FD). When necessary, the recording was stopped to allow the participants to repeat the stimuli at their own pace.

Language. A French adaptation of the Expressive One-Word Picture Vocabulary Test (EOWPVT; Brownell, 2000) was used to assess expressive vocabulary. This test is a French adaptation of the original English version and was developed by the Speech and Language Pathology Department of the Montreal Children's Hospital. It evaluates children's abilities to make word-picture associations. The experimenter showed a series of pictures to each participant who was asked to name them. This test has been used in our previous studies of these children (see Delcenserie et al., 2013, and Gauthier & Genesee, 2011).

Receptive vocabulary was assessed using the Échelle de Vocabulaire en Images Peabody (EVIP; Dunn, Theriault-Whalen, & Dunn, 1993), a French version of the Peabody Picture Vocabulary Test that is normed on French-speaking Canadians. In this test, the participants had to point to the image, among a set of four, that best represented a word spoken by the experimenter. Although norms for French-speaking children exist for this test, they end at 9 years and 11 months. Nonetheless, the internal validity of the EVIP, as measured by the *Claparède Indice* (Gauthier & Genesee, 2011), indicates that this test is sensitive for children as old as 13 years of age.

The Concepts et Exécutions de Directives subtest (a French version of the Concepts and Following Directions subtest) of the Clinical Evaluation of Language Fundamentals – Version for French Speaking Canadians (CELF-CDN-F; Semel, Wiig, & Secord, 2009) was used to evaluate participants' ability to listen to, interpret, recall, and execute oral commands that increase in length and syntactic complexity (Semel et al., 2009). The experimenter read oral commands such as *Montre moi la deuxième balle blanche* 'Show me the second white ball' to the participants who in turn had to point to the corresponding images in the testing booklet. A score of one was given for each correct response.

The Épreuve de Compréhension Syntaxico-Sémantique (ÉCOSSE; Lecocq, 1996) is the French version of the Test of Reception for Grammar (Bishop, 1983). This test assesses children's receptive language abilities and, more specifically, their comprehension of syntax. It focuses on features such as pronouns, adjectives, negative phrases, and word order. The

experimenter read a sentence to the participants who had to choose which image, among a set of four, illustrates that sentence correctly.

The Association de Mots subtest (a French version of the Word Associations subtest) of the CELF-CDN-F was used to assess the children's ability to categorize words into semantic categories, to form word associations and semantic relationships, and to name elements of the same semantic categories orally in a fast and precise manner (Semel et al., 2009). The experimenter asked the participants to name as many words as they could within one minute in each of three semantic categories: animals, food, and professions.

Sentence Recall. The Répétition de Phrases subtest (a French version of the Recalling Sentences subtest) of the Clinical Evaluation of Language Fundamentals-Revised (CELF-R; Semel, Wiig, & Secord, 2003), which had been administered by Gauthier and Genesee and Delcenserie et al., was administered to the children in the present study in order to examine the replicability of their previous findings. This test, which is comprised of 32 sentences, assesses children's ability to repeat sentences that increase in length and syntactic complexity. The administration of the test is interrupted after a participant is awarded five consecutive scores of zero. A score of three was given for each sentence correctly repeated; a score of two was awarded if only one error was made; a score of one was awarded if two to three errors were made; and a score of zero was awarded if four or more errors were made during the repetition.

Short-Term Memory (STM). Verbal STM was assessed using a French Non-word Repetition test designed by Grant, Karmiloff-Smith, Berthoud, and Christophe (1996) and used by Thorn and Gathercole (1999). This test includes 40 non-words composed of two to five syllables, with 10 non-words at each syllable length; the phonotactic rules and dominant stress patterns of French were used to create the pseudowords (Thorn & Gathercole, 1999). As per Thorn & Gathercole's procedure, the children were told that they would hear funny made-up words and that they should repeat each as accurately as possible. Participants' answers were recorded and scored after the testing session. A score of one was given to successful repetitions and a score of zero was given to repetitions containing one or more errors.

Verbal STM was also assessed using the Répétition de Nombres (directe) subtest (a French version of the Forward Digit Recall subtest) of the CELF-CDN-F. The items in this test are comprised of sequences of digits (1 to 9) that increase in length from 2 to 9. The children were asked to repeat each sequence of numbers in the same order that they were heard. Testing started

at a sequence length of two digits and increased up to nine digits; there were two trials at each sequence length. The sequence was increased by one digit when at least one trial was performed successfully, and testing was discontinued when the child failed both trials at a given sequence length.

The *Mémoire Spatiale (directe)* subtest (Spatial Span Forward subtest) of the Wechsler Non-Verbal IQ Test (Wechsler & Naglieri, 2006) was used to assess non-verbal STM. The children were asked to tap a series of blocks according to the sequence demonstrated by the examiner. The blocks were tapped by the experimenter at a rate of one per second. Prior to administering the test items, the experimenter showed the children pictorial directions to illustrate how to perform the test. Participants were awarded a score of one when they correctly reproduced the sequence of blocks presented by the experimenter and a score of zero when they made one or more errors.

Working memory (WM). A French adaptation of the Competing Language Processing Task (CLPT) of the Working Memory Test Battery for Children (Pickering & Gathercole, 2001) was used to assess verbal WM. This test required participants to listen to a pre-recorded series of sentences and make truth-value judgments immediately after hearing each sentence. After hearing and judging all the sentences in a set, the children were asked to recall as many of the last words of each sentence as possible. The test was comprised of six sets (or spans) with six trials per set. For example, *span 1* included six one-sentence trials and participants were required to make one truth-value judgment per trial and to recall only one word; *span 2* included six two-sentence trials and participants had to make two truth value judgments and to recall two words per trial; and so on. A score of one was awarded when all the final words for a trial were recalled correctly, and a score of zero was awarded when at least one error was made. Testing was discontinued when the children had a score of zero on four of the six trials in a span.

The *Répétition de Nombres (inverse)* subtest (a French version of the Backward Digit Recall subtest) of the CELF-CDN-F was also used to assess verbal WM. The characteristics of the stimuli of this subtest were similar to those of the Forward Digit Recall, the only difference being that the participants were asked to repeat the sequence of numbers in the reverse order. The test was discontinued when a participant failed on both trials at a given sequence length.

The *Mémoire Spatiale (inverse)* subtest (Spatial Span Backward subtest) was used to assess non-verbal (i.e. spatial) WM abilities. This subtest used the same procedure described for the

Spatial Span subtest except that the participants were asked to tap the blocks in the reverse order. The blocks were tapped by the experimenter at a rate of one per second.

Long-Term Memory (LTM). Long-Term Memory was assessed using the Liste de Mots subtest of the Échelle de Mémoire pour Enfants (Cohen, 2001; French version of the Word Lists Test of the Children's Memory Scale). This test evaluates LTM using four subtests, two of which were included in the present study. The first subtest evaluated participants' abilities to learn new verbal material (*Apprentissage*, 'Learning'). In this subtest, the participants were presented with a list of 14 simple words, such as *bague* 'ring', four times. After each presentation, the participants were asked to remember as many words as they could. The second subtest assessed participants' delayed recall of the words presented in the first subtest after a delay of 30 minutes (*Rappel Différé*, 'Delayed Recall'). On each subtest, one point was given for each word correctly recalled.

Non-verbal cognitive abilities and attention deficit hyperactivity disorder (ADHD). Most of the studies that have found differences in cognitive abilities between adopted and non-adopted children used tests of cognitive abilities that include a verbal component, such as the Stanford Binet (Hostinar, Stellern, Schaefer, Carlson, & Gunnar, 2012). In contrast, studies that do not report such differences in cognitive abilities have used non-verbal measures, such as the Leiter International Performance Scale (Gauthier & Genesee, 2011) or the Differential Ability Scale (Scott et al., 2008). It is thus possible that, when evaluating their cognitive abilities, IA children's language difficulties might bias the evaluation of their cognitive abilities. Accordingly, we opted for a test of non-verbal cognitive abilities, the Wechsler Non-Verbal IQ test (French version, Wechsler & Naglieri, 2006).

The Matrices and Coding subtests of the Wechsler Non-Verbal IQ Test (French version, Wechsler & Naglieri, 2006) were used to assess non-verbal fluid reasoning and speed of processing, respectively. As in any subtest of the Wechsler Non-Verbal IQ Test, the test started with the experimenter showing the participants pictorial directions to help them understand the test requirements. In the Matrices subtest, the children were asked to select the missing portion of a matrix from among a set of five options. In the Coding subtest, the children were asked to copy symbols that corresponded to a given number; e.g., a triangle with the number 2, a circle with the number 5, and so on. Participants had to copy as many symbols as possible in two minutes. For both subtests, each child's score was the number of correct responses. In accordance with the procedures detailed in the manual of the Wechsler Non-Verbal IQ Test, the participants' non-

verbal IQ was calculated using their scores on the Matrices subtest as well as their total score on the Spatial Span forward and Spatial Span backward subtests (described in the sections on short-term and working memory, respectively). The Coding subtest was also administered to determine if the groups differed on speed of processing.

Inattention and hyperactivity were evaluated using the Continuous Performance Test – II (CPT-II; Conners, 2001). This test was administered via computer and required the participants to press the space bar of a laptop computer (Sony VAIO VPC EB31FD) whenever any letter appeared on the computer screen, except the letter X. There were 4 sets of test items with inter-stimulus intervals (ISI) of 1, 2, and 4 seconds and a display time of 250 ms. A report of participants' results was automatically generated after the test, which included a measure of participants' reaction times, an evaluation of children's profile (i.e., their classification into clinical and non-clinical profiles), and a confidence interval for this classification (i.e., percentage).

Procedure

Before testing began, the experimenter explained the study to the participants and their parents, presented the questionnaires, and answered questions. Parents were then asked to sign the consent form. Parents who consented to participate were then asked to complete the Developmental and Language Exposure Questionnaires as well as the CBCL.

Each participant was tested individually in a separate room at the university or in their home. When the participant allowed the parents to stay in the testing room, the parent was asked to remain as quiet as possible and to refrain from providing help. Testing was done in a single testing session of two hours. The order of the tests was counterbalanced to avoid biases due to order effects. However, in order to avoid putting too much burden on participants' verbal memory, the delay of 30 minutes necessary before the administration of the Delayed Recall subtest of the Word Lists Test of the Children's Memory Scale was filled by the non-verbal tests, including the CPT-II and the Self-Evaluation Questionnaire.

Results

Demographic Information

One-way independent groups analyses of variance (ANOVAs; $\alpha = .05$) were carried out to compare the IA and the CTL children on age at the time of testing, mother's age, and father's age. Results in Table 1 indicate that the groups did not differ significantly in terms of their age at

the time of testing and that the adoptive parents were significantly older than the parents of the non-adopted children. Chi-square tests ($\alpha = .05$) performed to compare the groups on parental level of education and family income (see Table 1) revealed no significant differences on any of these variables, indicating that the groups were well matched.

Insert Table 1 about here

General Health and Socio-Emotional Development

Parents were asked to provide information about their children's health status in the past as well as at the time of testing. The IA parents reported more health and/or developmental issues than the CTL parents for both time points. It is, however, important to note that none of the participants were reported to have suffered from severe health or developmental issues at any time. At the time of testing, vision problems were the most commonly reported problems for both groups, even more so for the IA children (IA children: $n = 11$, CTL children: $n = 5$). Vision problems, such as myopia, had all been corrected by the time of testing. The IA children's higher incidence of vision problems corroborates results from Kleinstein et al. (2003) who report that children of Asian descent have more vision difficulties than Caucasian children. Contrary to previous reports of relatively high rates of ADHD for IA children (Glennen & Bright, 2005; Lindblad, Ringbäck Weitof, & Hjern, 2010), only two IA children in the present study were diagnosed with ADHD, which falls in the normal range for children of this age (Glennen & Bright, 2005). Only one IA child was receiving treatment from a speech-language pathologist (SLP) at the time of testing.

In terms of socio-emotional development, ANOVAs ($\alpha = .05$) were performed to compare the groups on the internalizing and externalizing subscales of the CBCL as well as on their total scores. No significant differences were found on any of these scores (internalizing: $F(1,40) = 2.00, p = .17$; externalizing: $F(1,40) = 2.35, p = .13$; total: $F(1,40) = .62, p = .44$). These results are in agreement with previous studies that have found that IA children from China are generally well-adjusted and score within the normal range on standardized assessments of socio-emotional abilities (e.g., Delcenserie et al., 2013; Tan & Marfo, 2006).

The children's performance on the CPT-II, a measure of ADHD, was compared using an ANOVA ($\alpha = .05$). Results showed that there was no significant difference between the groups in terms of number of children presenting with a clinical profile of ADHD ($F(1,57) = .46, p = .50$).

Assumptions

Because multiple statistical comparisons were carried out on the measures of non-verbal cognitive, language, and memory abilities, an alpha level of .01 was selected for all ANOVAs. The Levene test for homogeneity of variance revealed homogeneity of variance for all the variables ($p > .05$) while the Kolmogorov-Smirnov test of normality revealed normality for both groups on all variables ($p > .05$).

Non-Verbal Cognitive Abilities

Comparisons between the IA and CTL children's performance on the Wechsler Non-Verbal IQ test revealed no significant differences between the groups on total non-verbal IQ score nor on either of the subtests of the Wechsler Non-Verbal IQ test (see Table 2).

Insert Table 2 about here

Language Development

The IA and CTL children's language abilities were compared using independent groups ANOVAs ($\alpha = .01$). Similar to previous findings reported by Gauthier and Genesee and Delcenserie et al., the performance of the IA children on the EOWPVT, the EVIP, and the ECOSSE was significantly lower than that of the CTL children. The IA children also performed significantly lower than the CTL children on the Word Associations and the Concepts and Following Directions subtests. These results not only suggest that the IA children's lags in language found in our previous studies persist into the school years, but also that the differences between both groups are still relatively large, as shown by the moderate and large effect sizes (see Table 2).

Memory Abilities

Verbal memory. Statistical comparisons (ANOVAs; $\alpha = .01$) between the groups revealed that, as in past evaluations, the IA group scored significantly lower than the CTL group on the Recalling Sentences subtest. As well, the IA children scored significantly lower than the CTL group on both measures of verbal STM - Non-word Repetition and Forward Digit Recall. The IA

children also scored significantly lower than the CTL children on the CLPT and the Backward Digit Recall subtest, two measures of verbal WM. Statistical comparison of the children's performance on the Learning subtest of the Word Lists Test indicated that the groups did not differ in terms of their ability to learn verbal material. However, the IA children's performance on the Delayed Recall subtest was significantly lower than that of the CTL children, suggesting that the IA children's memory difficulties extend beyond verbal STM and verbal WM to include verbal LTM (see Table 2).

Non-verbal memory. In contrast to their verbal STM abilities, IA children's performance on the Spatial Span Forward subtest did not differ significantly from that of the CTL children (see Table 2). Nor did the IA children differ from the CTL children on the measure of non-verbal WM (i.e., Spatial Span Backward subtest), suggesting that IA children's lags in memory are language-specific and not general in nature.

Comparisons with Test Norms

Table 3 summarizes the children's performance on each test of language and memory ability compared to test norms. Although standard scores were available for all the tests of language and verbal memory, this was not the case for the Wechsler Non-Verbal IQ subtests (Matrices, Coding, and Spatial span). The Wechsler Non-Verbal IQ test provides T scores, which are included in Table 3. The results indicate that the IA children generally performed within age-appropriate levels on all measures, except on the Recalling Sentences and the Concepts and Following Directions subtest.

Insert Table 3 about here

Distribution of IA children's language and memory test scores

In order to better understand the IA children's results, the number of IA children who scored above and below the average of the CTL group in terms of standard deviations was calculated for each language and memory test. These analyses indicate that IA children's scores were substantially lower than those of the CTL children on most measures of language and verbal memory and also that a substantial number of IA children performed more than 2 *SDs* below the mean of the CTLs (see Table 4).

Insert Table 4

Comparisons of Language and Verbal Memory Abilities

In order to compare the IA children's performance on the memory and language tests, memory-adjusted scores of their language test results were calculated following the procedure used by Archibald and Gathercole. To do so, memory ages were calculated for each child using their raw scores on the Forward Digit Recall and Backward Digit Recall subtests separately (see Table 5). These two memory tests were used because they were the only tests for which norms for French-speaking Canadian children are available. Using the test manuals, we found the age equivalents corresponding to the children's scores on the Forward and Backward Digit Recall subtests; this was done for each child individually. These ages, instead of children's chronological ages at the time of testing, were then used to calculate the corresponding standard scores on the measures of language ability (referred to as "memory-adjusted standard scores"). Memory-adjusted standard scores were not calculated for the ECOSSE because this test offers age equivalents and not standard scores. Memory-adjusted standard scores were calculated for the EOWPVT using the norms available, which were based on English-speaking children and, thus, caution is called for when interpreting these results.

Memory-adjusted standard scores of 100 on the EOWPVT and the EVIP correspond to levels commensurate with verbal memory abilities; memory-adjusted standard scores below 100 indicate that language abilities are lower than memory abilities and, conversely, for language scores above 100. Because the CELF-CDN-F uses different values as standard scores, the Concepts and Following Directions and the Word Associations subtests were compared to a mean standard score value of 10 instead of 100. For these subtests, memory-adjusted standard scores of 10 correspond to levels of language ability commensurate with verbal memory abilities whereas memory-adjusted standard scores below 10 indicate that language abilities are lower than memory abilities.

The mean age corresponding to the IA children's performance on the Forward Digit Recall was 6;9 years, whereas their performance on the Backward Digit Recall was equivalent to 9;2 years of age, indicating that their verbal STM abilities were poorer than their verbal WM abilities. The mean memory-adjusted language scores of the IA children are summarized in Table 5. To ensure

clarity, in the remainder of this section we will refer to the Forward Digit Recall as a measure of verbal STM and to Backward Digit Recall as a measure of verbal WM.

The results suggest that the IA children's language scores were higher than their verbal STM and verbal WM scores or, alternatively, that their memory abilities were lower than their language abilities (see Table 5). One-sample t-tests were performed on the averaged memory-adjusted standard scores of each child for the EOWVPT, the EVIP, the Concepts and Following Directions, and the Word Association subtests against the expected value of 100 or 10, depending on the test. IA children's language abilities were all significantly higher than their verbal STM abilities, and also higher than their verbal WM abilities. The only exception was their performance on the Concepts and Following Directions subtest. The IA children's performance on this subtest was significantly above their verbal STM abilities, but not significantly different from their verbal WM abilities. This result is not surprising given that IA children's performance on this subtest was particularly low, even below age norms and the averaged age equivalent of their performance on verbal WM was relatively high.

Insert Table 5 about here

Links between Memory and Language

Bivariate correlations between measures of language and verbal memory abilities are presented in Table 6. Age at the time of adoption and non-verbal cognitive and memory abilities are not included in this matrix because they were not correlated with any of the measures of language and verbal memory. Age at the time of adoption was only significantly correlated with length of exposure to French ($r = .58, p < .001$). It is interesting to note that, similar to Delcenserie et al.'s results, the IA children's performance on the Recalling Sentences subtest was correlated with virtually all measures of language and verbal memory.

Insert Table 6 about here

In addition, in order to examine possible links between the children's performance on the language and verbal memory tests, multiple regression analyses were performed using scores on the memory tests – verbal STM, verbal WM, and verbal LTM; see Table 7 for a summary of

these analyses. In order to reduce the number of predictor variables in the analyses, composite predictor scores were created for verbal STM and verbal WM separately. To do this, scores on the tests of verbal STM and verbal WM were converted to z-scores and, then, two composite scores were created, one composed of the average of the Non-Word Repetition test and the Forward Digit Recall subtest (verbal STM composite) and the other composed of the average of the CLPT and on Backward Digit Recall subtest z-scores (verbal WM composite). In the case of LTM, the predictor score was created by converting the scores the children obtained on the Word Lists Test into z-scores. Length of exposure to French was also included as a predictor, instead of age at the time of testing, because both variables were highly correlated ($r = .96, p < .01$), and also because length of exposure correlated significantly with language outcomes for IA children in our previous studies (Gauthier & Genesee, 2011). Of course, length of exposure to French is equivalent to the age of the CTL children at testing. Assumptions underlying the regression analyses were verified by looking at multicollinearity. Multicollinearity was examined by looking at tolerance values and variance inflation factors (VIF), which provide an estimate of the severity of multicollinearity. None of the tolerance values or VIFs approached levels indicating problems. Indeed, all tolerance values were above .724 (VIF = 1.38). Results presented in Table 7 indicate that the IA children's performance on the language measures was better predicted by their memory abilities, and their verbal STM abilities in particular, while the CTL children's performance on the same tests were more often predicted by their length of exposure to French, which in their case, represents their age at the time of testing.

Insert Table 7 about here

Discussion

The primary goal of the present study was to examine if IA children from China exhibit significant lags in verbal memory in comparison to non-adopted children in addition to lags in language ability. To do this, we administered tests of verbal STM, verbal WM, and verbal LTM, along with tests of spatial STM and WM, to groups of matched IA and CTL children. A secondary goal was to ascertain whether language lags exhibited by IA children in the pre-school and early school years persist into the middle grades of school.

As reported previously, the IA children in the present study scored significantly lower on most of the language tests than did the CTL children; including, tests of expressive and receptive vocabulary, receptive grammar, concepts and following directions, and word associations. In contrast, the IA children did not differ from the CTL children with respect to general non-verbal cognitive ability and on a measure of socio-emotional adjustment. Thus, overall, the lags exhibited by the IA children appear to be language-specific. The present results corroborate the findings of previous studies indicating that IA children from China do not suffer from serious health or general developmental difficulties (Delcenserie et al., 2013; Johnson, Banghan, & Liyao, 1998).

The present study extends previous findings to show that the IA children also exhibited significantly poorer verbal memory abilities in comparison to matched non-adopted children. In fact, the IA children performed significantly lower than the CTL children on all measures of verbal memory: STM, WM, and LTM. In the case of STM and WM, the differences between the IA and CTL children were evident on two tests of each, indicating that their lags are not test-specific. There were no differences between the groups on the tests of spatial STM and WM, indicating that the IA children's lags in memory are language-specific and not domain-general. The present study is, to our knowledge, the first investigation to find this.

The present results are similar to those from a recent study by Eigsti et al. on the language and cognitive abilities of IA children from Europe and Asia who were adopted by families in the U.S. between 2 and 84 months; the children had had, on average, 6 years of exposure to English. Similar to the present study, that study found between-group differences in language and memory abilities between the IA and non-adopted control children and also that their memory and language scores were highly correlated. The present study extends Eigsti et al.'s results by showing that IA children have even longer-term lags in language. Moreover, in contrast to Eigsti et al. who only used a test of word recall to assess short- and long-term memory abilities, we conducted a more detailed evaluation of IA children's memory abilities. Eigsti et al. also found that the adoptees experienced cognitive control difficulties in comparison to the control children and that their language and memory scores were correlated with age at the time of adoption. They argued that the association between age at the time of adoption and performance on these measures was related to the effects of stress related to institutionalization on brain development. In the present study, we did not find correlations between age at the time of adoption and either

memory or language scores; nor did we find significant non-verbal cognitive differences between the IA and CTL children. In any case, arguably, the discrepancy in these two studies' results can be attributed to the relatively narrow range of age of adoption and, thus, the relatively short length of institutionalization of the IA children in the present study in contrast to that of Eigsti et al.'s participants.

More detailed analyses of the children's performance on the tests of verbal memory and language indicated that their performance was well below that of the CTL children. In fact, a substantial percentage of IA children performed more than 2 *SDs* below the mean of the CTL group, specifically on measures of expressive and receptive vocabulary, receptive grammar, concepts and following directions, verbal STM, and verbal WM. That the IA children's results were so low probably reflects not only significantly lower performance by the IA children in comparison to the CTL children but also the relatively high performance of the CTL children who were from families with relatively high SES. These results indicate that, despite performance that is generally age-appropriate, the IA children did not perform at the level that would be expected from children who benefited from exclusive exposure to French for almost 10 years and who were being raised in families with higher than average SES. It is important to note before proceeding that when IA children's scores on the language tests in the present study are compared to test norms, in general, they fall within the normal range. This was true for all the tests except the Recalling Sentences subtest of the CELF-R and the Concepts and Following Directions subtest of the CELF-CDN-F. Caution is called for when using these results since the norms for some of these tests (i.e., Expressive One-Word Picture Vocabulary Test, Competing Language Processing Task, and Non-word Repetition test) were not based on the performance of French-speaking children, but rather English-speaking children. Nevertheless, these results are important because they indicate that the lags in language and memory exhibited by the IA children are probably not indicative of clinically-significant differences.

Further detailed examination of the IA children's results indicated that their verbal memory abilities were lower than their language abilities. If, as we conjecture, their language abilities are dependent on their verbal memory abilities, one might have expected their language and verbal memory results to be on par. While we have no definitive explanation for the discrepancy in these results, it could be that the IA children have compensated for memory difficulties using compensatory language learning strategies. We also found that, in contrast to the CTL children,

the IA children's verbal memory scores, and their verbal STM scores in particular, were better predictors of their language scores than was length of exposure to French. Length of exposure has often been found to be a significant correlate of IA children's language development, at least at younger ages (e.g., Gauthier & Genesee, 2011). It is important to note that, in the present study, length of exposure to French and age at adoption are probably confounded. Our findings with respect to STM are particularly interesting in light of previous research indicating that the influence of verbal STM on language abilities decreases with age. More specifically, Gathercole et al. (1991) found that while verbal STM is a significant predictor of typically-developing children's vocabulary acquisition until 4 to 5 years of age, a shift is subsequently observed such that vocabulary knowledge becomes a better predictor of verbal STM. Moreover, after 8 years of age, no significant association between these variables is usually found (Gathercole et al., 1991). This contrasts with the present findings where the IA children's verbal STM abilities, even between ages 9-12 years of age, still predicted their language abilities, including their lexical and general language development. Although it might be inferred that IA children's language difficulties arise because of sentence memory difficulties, as could be the case for the ECOSSE and the Concepts and Following Directions tests, this does not explain why they also scored lower on tests that assessed word-related language skills, such as the EOWPVT, the EVIP, and the Word Association subtest.

That the IA children may have particular difficulties with verbal STM is compatible with the tenets of Baddeley's multi-component model of working memory (Baddeley, 2000). In this model, verbal STM is thought to be involved specifically in the short-term storage of verbal material, whereas the central executive, a domain-general component that is involved in higher-level mental processes, is thought to work in combination with verbal STM during the performance of tasks that involve the simultaneous storage and manipulation of verbal material. Thus, tasks that assess verbal WM involve verbal STM, for short-term storage of information, and the central executive, for mental processing. Similar to verbal WM, tasks that assess non-verbal WM are thought to involve both non-verbal STM (also called visuo-spatial sketchpad, a component equivalent to verbal STM that is involved in the short-term storage of non-verbal material) as well as the central executive. That the IA children's performance on Backward Spatial Span, a test of non-verbal WM, was similar to that of the CTL children would suggest that they do not have difficulty with the "executive" component of WM but rather with the STM

component. Thus, the lags in verbal WM exhibited by the IA children in comparison to the CTL children in the present study, arguably, reflect difficulties with verbal STM. The present results are not unlike those of Rescorla (2002) who found that children who had been identified as late talkers at the age of 24-31 months had reading and language difficulties at the age of 9 as well as weaknesses in areas that subserve language, such as word retrieval and verbal working memory.

Taken together, these findings raise the possibility that the lags in language ability exhibited by the IA children and their negatively skewed distribution relative to the CTL children implicate lags in verbal memory, a possibility put forward by Delcenserie et al. While admittedly speculative, this explanation, if valid, raises the question of why the IA children have difficulties with verbal STM. Adverse effects associated with their pre-adoptive environments seem unlikely insofar as their non-verbal cognitive abilities, their attention, and their socio-emotional development are on par with those of the non-adopted controls. This possibility cannot be ruled out completely, however, as very little is known about IA children's pre-natal and pre-adoption living conditions; but, the present results are in line with those of previous studies that have found that, in general, IA children from China do not suffer from general health or developmental difficulties post-adoption (Johnson et al., 1998; Pomerleau et al., 2005). Amount of exposure to French also seems an unlikely explanation insofar as, at the time of the present testing, the IA children had had more than 9.5 years of exposure to French, sufficient for them to achieve levels of language and verbal memory abilities that were, in general, within age-expected levels.

Alternative explanations of the IA children's verbal STM results may be linked to termination of the birth language and/or delayed onset of exposure to the adoption language. With respect to L1 termination, it has been found that infants begin to tune into, retain, and learn phonological distinctions in the L1 within the first year of life (Kuhl, 2000; Werker & Tees, 1999) and that these early developments have consequences for later language and cognitive development (Fernald, Perfors, & Marchman, 2006; Marchman & Fernald, 2008). In fact, it would appear that it is development of phonological representations of the birth language that facilitates or underpins the development of verbal STM and language development in general in L1 learners (Kuhl, 2000). With respect to the present results, arguably, termination of the birth language stunts or delays the development of phonological representations and verbal STM of the birth language and, in turn, subsequent language learning. Thus, termination of L1 acquisition

may explain the relatively poor verbal STM abilities exhibited by the IA children in the present study post-adoption.

Delayed exposure to the adoption language might also play a role in explaining the present results insofar as there is evidence, reviewed earlier, that verbal memory abilities are sensitive to age of L2 acquisition (e.g., French & O'Brien, 2008; Masoura & Gathercole, 2005). To repeat, Vejnovic et al. found that Hungarian students who acquired Serbian as an L2 at the age of 4 had significantly better verbal WM abilities than students who acquired the same L2 at age 9, even when the effect of verbal WM abilities in the L1 was controlled for.

While these explanations are consistent with our findings that IA children exhibit lags in both verbal memory and language ability relative to matched control children, they remain speculative and require additional evidence for corroboration. Moreover, termination of the birth language and delayed exposure to the adoption language are confounded in the present study so that it is impossible to tease apart the relative role of each. It is possible to disentangle these two factors by studying infants who begin to acquire an L2 at the same ages as the IA children but retain their L1. This study is currently in progress in our laboratory. This study could also shed light on the impact of L2 acquisition in typical L2 learners who do not lose their L1 on their verbal memory abilities, raising the possibility that any lag in exposure to an additional language incurs lags in verbal memory relative to monolingual native speakers.

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Table 1

Demographic Data of the Internationally-Adopted (IA) and Monolingual French-Speaking Children (CTL)

	IA	CTL	<i>df</i>	<i>F</i>	χ^2
Age at testing (in months, <i>M</i> and <i>SD</i>)	128.37 (12.18)	127.37 (11.03)	(1, 58)	0.11	
Corresponding age in years	10;8	10;7			
Age at adoption (in months, <i>M</i> and <i>SD</i>)	12.85 (4.39)				
Length of exposure to French (<i>M</i> and <i>SD</i>)	115.52 (14.21)	127.37 (11.03)	(1, 58)	13.02**	
Corresponding exposure in years	9;7	10;7			
Mother's age (<i>M</i> and <i>SD</i>)	48.11 (5.75)	41.60 (4.20)	(1, 53)	29.62**	
Father's age (<i>M</i> and <i>SD</i>)	48.11 (5.75)	44.10 (5.26)	(1, 53)	13.61**	
Mother's level of education (<i>n</i> and %)					
High School	1 (3.3%)	1 (3.3%)	(2, 60)		0.08
College	10 (33.3%)	9 (30%)			
University	19 (63.3%)	20 (66.7%)			
Father's level of education (<i>n</i> and %)					
High School	6 (20%)	5 (16.7%)	(2, 60)		0.20
College	7 (23.3%)	7 (23.3%)			
University	15 (50%)	17 (56.7%)			
Family income per year (<i>n</i> and %)					
20 000 – 59 999	4 (13.3%)	5 (16.7%)	(9, 60)		4.33
60 000 – 99 999	8 (26.7%)	7 (23.3%)			
100 000 – 139 999	12 (40%)	9 (30%)			
140 000 – 179 999	1 (3.3%)	3 (10%)			
180 000 and more	5 (16.7%)	6 (20%)			

Note. IA = Internationally-adopted children; CTL = Non-adopted monolingual French-speaking children.

** $p < .01$.

Table 2

Test Results (Raw Scores)

Measures	IA <i>M (SD)</i>	CTL <i>M (SD)</i>	<i>F</i> (1, 58)	η^2
Non-verbal cognitive abilities				
Matrices (fluid reasoning)	18.57 (4.52)	19.63 (4.47)	0.84	
Coding (speed of processing)	49.53 (10.53)	52.20 (11.45)	0.88	
Total Non-verbal IQ (standard score)	98.50 (9.41)	100.87 (9.70)	0.92	
Language abilities				
EOWPVT	94.93 (12.14)	126.43 (9.86)	121.63***	.68
EVIP	116.10 (9.90)	136.10 (8.79)	68.46***	.54
ECOSSE	12.77 (3.69)	2.93 (1.93)	167.17***	.74
Concepts and Following Directions	41.20 (5.93)	51.33 (1.95)	78.96***	.58
Word Associations	46.63 (9.25)	57.70 (9.65)	20.57***	.26
Recalling Sentences				
	49.93 (9.85)	68.10 (8.49)	58.52***	.50
Verbal memory abilities				
Verbal short-term memory				
Forward Digit Recall	6.73 (1.36)	10.50 (1.76)	86.10***	.60
Non-word Repetition	32.20 (4.12)	36.63 (1.67)	29.80***	.34
Verbal working memory				
Backward Digit Recall	4.33 (1.40)	6.67 (1.15)	49.69***	.46
CLPT	13.00 (3.09)	18.67 (2.29)	65.17***	.53
Verbal long-term memory				
Word Lists Test (Learning)	31.47 (8.72)	34.77 (6.36)	2.81	
Word Lists Test (Delayed Recall)	8.63 (3.15)	10.40 (1.83)	7.07**	.11
Non-verbal memory abilities				
Spatial Span Forward (STM)	7.77 (2.05)	7.73 (1.53)	.01	
Spatial Span Backward (WM)	6.73 (1.80)	6.60 (1.54)	.10	

Note. IA = Internationally-adopted children; CTL = Non-adopted monolingual French-speaking children; CLPT = Competing Language Processing Task; ECOSSE = Épreuve de Compréhension Syntaxico-Sémantique; EOWPVT = Expressive One-Word Picture Vocabulary Test; EVIP = Échelle de Vocabulaire en Images Peabody; STM = Short-Term Memory; WM = Working Memory. The raw scores for the ECOSSE represent the number of errors.

** $p < .01$. *** $p < .001$.

Table 3

*Average Scores of IA and CTL Children Relative to Language and Non-Verbal Cognitive**Test Norms⁴*

Measures	Norms		IA	CTL
	<i>M</i>	<i>[-1SD, +1SD]</i>	<i>M (SD)</i>	<i>M (SD)</i>
Non-verbal cognitive abilities				
Matrices (fluid reasoning; T scores)	41		46.43 (9.94)	49.43 (9.76)
Coding (speed of processing; T scores)	144		55.63 (10.04)	58.53 (8.47)
Total Non-verbal IQ (standard scores)	100	85 - 115	98.50 (9.41)	100.87 (9.70)
Language abilities				
EOWPVT	100	85 – 115	94.73 (8.88)	128.80 (11.53)
EVIP	100	85 – 115	111.37 (7.85)	129.47 (7.69)
ECOSSE (age equivalents)			6.97 (1.33)	11.83 (0.65)
Concepts and Following Directions	10	7 – 13	6.53 (2.32)	12.13 (2.10)
Word Associations	10	7 – 13	11.10 (2.47)	14.07 (2.42)
Recalling Sentences				
	10	7 – 13	6.13 (2.00)	10.07 (1.89)
Verbal memory abilities				
Verbal short-term memory				
Forward Digit Recall	10	7 – 13	7.70 (2.00)	13.00 (2.48)
Non-word Repetition	100	85 – 115	99.73 (16.61)	117.50 (6.62)
Verbal working memory				
Backward Digit Recall	10	7 – 13	9.27 (2.16)	12.80 (1.81)
CLPT	100	85 – 115	93.33 (18.26)	129.63 (10.59)
Verbal long-term memory				
Word Lists Test (Learning)	10	7 – 13	9.03 (3.86)	10.37 (2.83)
Word Lists Test (Delayed Recall)	10	7 – 13	10.87 (3.61)	12.93 (1.95)
Non-verbal memory abilities				
Spatial Span Forward (STM; T scores)	16		50.83 (10.05)	51.03 (8.33)
Spatial Span Backward (WM; T scores)	16		50.93 (9.15)	51.30 (8.00)

Note. ECOSSE = Épreuve de Compréhension Syntaxico-Sémantique; EOWPVT = Expressive One-Word Picture Vocabulary Test; EVIP = Échelle de Vocabulaire en Images Peabody; CLPT = Competing Language Processing Task; LTM = Long-term memory.

⁴ All scores except where indicated otherwise are standard scores.

Table 4

Number and Percentage (%) of IA children who Scored Above and Below the Mean of the CTL Children on Tests of Language and Memory Abilities

	<i>SD</i>					
	]-2]	[-2, -1]	[-1, 0]	[0, +1]	[+1, +2]	[+2[
EOWPVT	26 (86.7%)	3 (10%)	1 (3.3%)			
EVIP	17 (56.7%)	10 (33.3%)	3 (10%)			
ECOSSE	29 (96.7%)	1 (3.3%)				
CFD	28 (93.3%)	2 (6.6%)				
WA	5 (16.7%)	13 (43.3%)	7 (23.3%)	5 (16.7%)		
NWR	17 (56.7%)	3 (10%)	5 (16.7%)	4 (13.3%)	1 (3.3%)	
FDR	13 (43.3%)	15 (50%)	2 (6.6%)			
BDR	18 (60%)	6 (20%)	3 (10%)	3 (10%)		
RS	16 (52.3%)	11 (36.7%)	2 (6.6%)	1 (3.3%)		
CLPT	23 (76.7%)	3 (10%)	2 (6.6%)	2 (6.6%)		
Word Lists Test						
Learning	3 (10%)	9 (30%)	9 (30%)	5 (16.7%)	3 (10%)	1 (3.3%)
Delayed	7 (23.3%)	6 (20%)	6 (20%)	9 (30%)	2 (6.6%)	
SSF	1 (3.3%)	8 (26.7%)	6 (20%)	9 (30%)	1 (3.3%)	5 (16.7%)
SSB		9 (30%)	6 (20%)	10 (33.3%)	4 (13.3%)	1 (3.3%)

Note. ECOSSE = Épreuve de Compréhension Syntaxico-Sémantique; EOWPVT = Expressive One-Word Picture Vocabulary Test; EVIP = Échelle de Vocabulaire en Images Peabody; CFD = Concepts and Following Directions subtest; WA = Word Associations subtest; NWR = Non-word Repetition; FDR = Forward Digit Recall; BDR = Backward Digit Recall; RS = Recalling Sentences subtest; CLPT = Competing Language Processing Task; SSF = Spatial Span Forward; SSB = Spatial Span Backward.

Table 5

Memory-Adjusted Standard Scores on Measures of Language Ability

	Verbal STM				Verbal WM			
	<i>M</i>	<i>SD</i>	<i>t</i> (29)	<i>p</i>	<i>M</i>	<i>SD</i>	<i>t</i> (29)	<i>p</i>
EOWPVT	130.30	18.88	8.79	< .001	112.23	23.76	2.82	.01
EVIP	143.93	14.55	16.54	< .001	130.17	17.73	9.32	< .001
Concepts and Following Directions	12.50	3.19	4.29	< .001	9.27	3.95	-1.02	.32
Word Associations	15.70	2.77	11.28	< .001	12.90	4.69	3.39	.002

Note. EOWPVT = Expressive One-Word Picture Vocabulary Test; EVIP = Échelle de Vocabulaire en Images Peabody; STM = Short-Term Memory; WM = Working Memory.

Table 6

Correlation Matrix

Variables	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
1. Exposure to French	—	.41*	.40*	.05	.53**	.23	.02	.32	.35	-.29	.31	.34
2. Recalling Sentences subtest		—	.67**	.40*	.34	.62**	.07	.41*	.37*	-.40*	.54**	.31
3. Forward Digit Recall subtest			—	.41*	.32	.54**	.07	.30	.41*	-.27	.50**	.26
4. Non-word repetition				—	.11	.01	.04	.37*	.34	-.07	.38*	.06
5. Backward Digit Recall subtest					—	.14	.15	.01	.17	-.31	.31	.05
6. CLPT						—	.07	.10	.13	-.30	.27	.38*
7. Word Lists test (Delayed recall)							—	.27	.01	-.28	.05	.42*
8. EOWPVT								—	.59**	-.40*	.31	.35
9. EVIP									—	-.16	.34	.03
10. ECOSSE										—	-.28	-.35
11. Concepts & Following Directions subtest											—	.21
12. Word Association subtest												—

Note. ECOSSE = Épreuve de Compréhension Syntaxico-Sémantique; EOWPVT = Expressive One-Word Picture Vocabulary Test; EVIP = Échelle de Vocabulaire en Images Peabody; CLPT = Competing Language Processing Task.

** $p < .01$. *** $p < .001$.

Table 7

Results of the Multiple Regression Analyses

	IA Children					CTL Children				
	STM	WM	LTM	Exposure	Overall Model fit	STM	WM	LTM	Exposure	Overall Model fit
EOWPVT	$\beta = .38^*$	$\beta = .16$	$\beta = .25$	$\beta = .35$	$R^2 = .32$ Adjusted $R^2 = .21$	$\beta = .27$	$\beta = .26$	$\beta = .12$	$\beta = .50^{**}$	$R^2 = .50$ Adjusted $R^2 = .42$
EVIP	$\beta = .40^*$	$\beta = .03$	$\beta = .03$	$\beta = .31$	$R^2 = .27$ Adjusted $R^2 = .16$	$\beta = .15$	$\beta = .20$	$\beta = .03$	$\beta = .43^*$	$R^2 = .31$ Adjusted $R^2 = .20$
ECOSSE	$\beta = -.07$	$\beta = -.42^*$	$\beta = -.30$	$\beta = -.10$	$R^2 = .27$ Adjusted $R^2 = .15$	$\beta = .05$	$\beta = .09$	$\beta = .11$	$\beta = .12$	$R^2 = .03$ Adjusted $R^2 = -.12$
CFD	$\beta = .44^*$	$\beta = .24$	$\beta = .06$	$\beta = .14$	$R^2 = .35$ Adjusted $R^2 = .24$	$\beta = .14$	$\beta = .10$	$\beta = .16$	$\beta = .45^*$	$R^2 = .22$ Adjusted $R^2 = .10$
WA	$\beta = .03$	$\beta = .18$	$\beta = .44^{**}$	$\beta = .26$	$R^2 = .33$ Adjusted $R^2 = .22$	$\beta = .15$	$\beta = .25$	$\beta = .15$	$\beta = .14$	$R^2 = .18$ Adjusted $R^2 = .04$

Note. ECOSSE = Épreuve de Compréhension Syntaxico-Sémantique; EOWPVT = Expressive One-Word Picture Vocabulary Test; EVIP = Échelle de Vocabulaire en Images Peabody; CFD = Concepts and Following Directions subtest; WA = Word Association subtest.

^{**} $p < .01$ ^{***} $p < .001$.

General Discussion

The present studies were undertaken to explore the long-term language outcomes and memory abilities of IA children from China adopted into French-speaking families. More specifically, these studies looked at internationally-adopted (IA) children's general language abilities during the early school years and at specific features of their language development that have been shown to be difficult to acquire by other learners of French, such accusative object clitics. In addition, verbal memory abilities were evaluated and possible links to language ability were investigated. When this research project was undertaken, most studies of IA children had focused on their language acquisition and development soon after adoption or during the preschool years. In addition, most previous studies had evaluated their language abilities using parent reports, questionnaires or standardized assessments and compared their performance to test norms (except see Cohen, Lojkasek, Zadeh, Pugliese, & Kiefer, 2008, 2008; Gauthier & Genesee, 2011). Also, many studies included IA children from several different countries, adopted at different ages, and also evaluated at different ages, making it difficult to interpret and generalize their results.

Although the topic of IA children's language acquisition became quite popular among researchers since this research project was planned in 2008, the studies included in the present dissertation continue to be unique in several ways. First, the present studies compared IA children's performance on measures of language and memory abilities directly to those of monolingual non-adopted children matched on variables that are known to influence children's general development and their language acquisition specifically (Hoff, 2006). These variables included age, gender, and socioeconomic status (parental level of education and family income more specifically). Only two studies we know of have used such strict matching criteria (Cohen et al., 2008; Gauthier & Genesee, 2011). Second, the present studies looked at IA children in several domains of development, thus taking into account factors that can influence their language and memory abilities, such as non-verbal cognition, attention, and socio-emotional development. Third, Study 3 is the first study to examine IA children's memory abilities in detail as well as in relation to their language outcomes. Fourth, Study 2 is the first study to examine specific aspects of their morphosyntactic competence long term; the few studies that have looked at specific language abilities have evaluated preschool IA children. Finally, these studies looked at the acquisition of a language that is not often investigated in IA children, namely, French.

Despite the fact that they face suboptimal pre-adoption circumstances and important life changes at the time of adoption, including changes in family environment and language, the present results corroborate a growing body of research that shows that IA children from China are able to acquire their adopted language in a flexible and robust way (Gauthier, 2011) and, therefore, that these children are extremely resilient. Indeed, the results of Study 1 and Study 3 indicate that the IA children did not differ from age-appropriate norms, or from the performance of controls matched for age, gender and socio-economic (SES), on measures of non-verbal cognitive abilities, socio-emotional development, and attention (Study 3 only), suggesting robust general developmental outcomes. When the performance of the IA children was compared to that of test norms in Studies 1 and 3, the IA children's language abilities were found to be within age-appropriate levels on most tests of language and memory ability, with the notable exception of the Recalling Sentences subtest of the Clinical Evaluation of Language Fundamentals-Revised (CELF-R), a point that will be discussed in more detail later. Overall, the results of the present studies suggest that the language and general developmental outcomes of IA children during school age continue to be positive and on par with norms, for the most part (e.g., Gauthier & Genesee, 2011).

At the same time, the present findings make unique contributions to the literature on IA children. As mentioned earlier, previous studies, which were largely driven by a normative perspective, tended to report that these children's language development was normal – that is, typical. However, the results of the present studies, along with those of Gauthier and Genesee, are among the first to find that, when proper controls are put in place, IA children show significant lags in language. Moreover, Study 3 is the first study to show that IA children experience additional lags in verbal memory that seem to persist into school age.

To summarize the main findings, the results of Study 1 revealed that, at 7-8 years of age, the IA children performed significantly below the controls on expressive vocabulary, knowledge of word definitions, receptive grammar, and sentence recall. The results of Study 3 indicate that the IA children continued to perform significantly below matched controls on measures of expressive vocabulary, sentence recall, and receptive grammar, and also that they experienced additional difficulties on measures of receptive vocabulary, the ability to understand concepts and to follow directions as well as on the ability to make word associations. These results therefore indicate that, despite several years of exclusive exposure to their adopted language, school-aged

IA children are unable to perform at the levels of non-adopted children from similarly enriched environments and they continue to display the difficulties that were previously reported in samples of preschool IA children (e.g., Gauthier & Genesee, 2011). Study 2 indicates that, in addition to lags on measures of general language ability, the IA children were found to perform significantly below the control (CTL) children on a specific measure of morphosyntactic competence, namely, accusative object clitics. The results of Study 2 indicate not only that the IA children had difficulties with a morphosyntactic feature that is hard to acquire for most learners of French, including monolinguals (Hamann, Rizzi, & Frauenfelder, 1996), simultaneous and successive bilinguals (Grondin & White, 1996; Hulk, 1997; Hulk & Müller, 2000), and children with specific language impairments (SLI; Hamann, 2004; Paradis, 2004), but also that these specific linguistic difficulties persist into school age. Additional detailed studies of their morphosyntactic competence would be useful to determine if the acquisition of other linguistic features is problematic for this population.

Taken together, the results of Studies 1, 2, and 3 corroborate the findings of previous studies that compared younger IA children to non-adopted children matched on important variables. For example, the school-aged IA children included in the present research project were similar to the preschool IA children evaluated by Gauthier and Genesee in many ways. First, both groups were found to have normal non-verbal cognitive abilities and socio-emotional development. Second, the groups were able to perform within age-appropriate levels on most standardized tests of language ability, but performed more than 1 *SD* below the norm on a Recalling Sentences test. Third, both preschool and school-age IA children were found to perform below matched controls on several measures of language ability, and specifically on vocabulary and grammar. As well, comparisons between the IA and CTL children in Study 3 indicate that the IA children not only performed below the controls on measures of language ability, but also on measures of verbal memory. Although the IA children performed significantly below matched controls on verbal short-term memory, verbal working memory, and verbal long-term memory, they did not differ on measures of non-verbal short-term memory and non-verbal working memory, indicating that their memory difficulties are specific to verbal material and not domain general.

Of particular interest, the results of these studies suggest that IA children's verbal memory difficulties might contribute to their lags in language development relative to the controls. First,

in Study 1, it was found that the IA children's performance on all measures of language ability was correlated with their performance on the Recalling Sentences subtest. Moreover, statistical analyses revealed that, once IA children's scores on the Recalling Sentences test were partialled out, the IA and CTL children no more differed significantly on any of the measures of language ability.

The results of Study 2 also point to the possibility, albeit indirectly, that the IA children's memory abilities might contribute to their lags in language development. In a related vein, recent evidence suggests that omission of accusative object clitics is negatively correlated with verbal working memory ability. Specifically, Grüter and Crago (2012) found that the rate of accusative object clitic omission in typically-developing second language (L2) learners from China, who were exposed to French after 2;10 years of age, was significantly and negatively correlated with their performance on a backward digit recall task, a measure of verbal working memory. Although more research is needed in order to corroborate this correlation, Grüter and Crago's results suggest that IA children's very high rate of accusative object clitic omissions could be proximally related to their verbal memory difficulties. More research is needed to investigate this possibility.

Perhaps the clearest evidence of the impact of verbal memory abilities on the IA children's language outcomes comes from Study 3. Indeed, as was the case for the early school-age IA children in Study 1, the performance of the IA children in Study 3 on the Recalling Sentences subtest was correlated with their performance on all measures of language ability. Of particular interest is the finding that, in general, the IA children's performance on tests of verbal short-term and working memory were significantly below their performance on measures of language ability. Moreover, regression analyses indicated that the IA children's language abilities were better predicted by their memory abilities, and verbal short-term memory in particular, than by length of exposure to French. This pattern, which is the reverse of the pattern found for the CTL children, complements the results of Study 1 and 2 to suggest that IA children's memory difficulties impact negatively on their language development. This possibility will be discussed further later.

Clinical Implications

Although it is clear from the present findings that, overall, the IA children's language and memory abilities were within age-appropriate levels and, thus, that they are not performing in a

clinical range, these results nevertheless indicate that these children were experiencing greater than expected difficulties when compared to non-adopted children matched on important variables. Therefore, the present results can provide guidance to clinicians in their assessment of IA children and, in particular, with respect to the types of difficulties they might expect these children to experience, even after several years of exposure to their adopted language. That is to say, the present results point out that IA children may need long-term support in language and memory domains. Indeed Scott, Roberts, and Krakow (2008) report that IA children are more likely than non-adopted children to receive help from speech-language pathologists and special education services (Scott et al., 2008). To be more specific, in terms of language outcomes, the results of these studies suggest that delays on measures such as use of accusative object clitics, expressive vocabulary, sentence recall, and receptive grammar are to be expected of IA children during school age, but also that, as a group, their difficulties in certain areas of language might actually increase with age. Indeed, in comparison to the results of Study 1, the results of Study 3 point out that, as they age, a larger proportion of IA children experience difficulties on expressive and receptive vocabulary, receptive grammar, and word associations. More specifically, the percentage of IA children who scored more than 1 *SD* below the mean of the CTL children on the Word Association test increased from 33.3% to 60%. With respect to receptive grammar (i.e. ECOSSE), the percentage increased from 48.1% to 100%, while on expressive vocabulary (i.e. EOWPVT) and receptive vocabulary (EVIP), percentages increased from 50% to 96.7% and from 22.2% to 90%, respectively. Although these large increases could be caused by differences in the samples of IA and CTL children who were tested, they might also indicate that, as they age and if they do not receive appropriate additional support, IA children's difficulties might increase. Longitudinal studies are needed to determine if the IA children experience more difficulties and/or different types of difficulties through the years.

In terms of memory abilities, the results of Study 3 suggest that a majority of IA children can be expected to show difficulties on measures of verbal STM, WM, and LTM during school age. A comparison of the IA children's performance on the Recalling Sentences subtest in Studies 1 and 3 also suggests that, similar to their language abilities, their memory difficulties could increase with age. Indeed, at 7-8 years of age, 66.6% of the IA children were found to perform more than 1 *SD* below the mean of the CTL children, while, at 9-12 years of age, 89% of the IA children were performing more than 1 *SD* below the mean of their non-adopted peers.

Additional studies looking at the development of IA children's memory from the time of adoption into school age are needed to further understand the development of memory abilities in IA children and how these abilities correlate with their language development. In a related vein, difficulties on non-verbal STM and WM should raise clinical concerns given that, as a group, IA children experience language-related memory difficulties only.

Although the topic of learning difficulties was not addressed directly by the present studies, it is important to consider that IA children's language and memory lags could also have an impact on their educational achievement. If, as the present studies suggest, IA children's difficulties persist and even increase, they might benefit from special assessment and classroom interventions, such as providing external memory support, alleviating the memory load of classroom activities, and repeating instructions (Pickering & Gathercole, 2004). Future studies of school-age IA children should therefore monitor their learning progress and observe their performance in the course of regular classroom activities (Gathercole & Alloway, 2008)

Theoretical Implications

The results of the present studies are also important from a number of theoretical points of view. In particular, the present findings contribute to research on age-of-acquisition effects on language acquisition, similarities between different populations of children at-risk for language and/or memory difficulties, and the role of memory in language acquisition.

Age-of-acquisition effects. Before one can attribute IA children's language and memory lags to delayed age of exposure to the adopted language, it is important to rule out other factors. To begin, as noted a number of times previously, it is unlikely that IA children's lags in language and memory are related primarily to cognitive, socio-emotional or attention factors since their abilities in these domains were found to be within age-appropriate levels and similar to those of the non-adopted control children. The latter findings also indicate that the suboptimal pre-adoptive care that IA children might have been exposed to resulted in minimal harm and, thus, probably do not account for their persistent lags in language and memory, at least as primary causes. An additional unlikely explanation of IA children's lags is length of exposure to French. Indeed, the present studies looked at IA children's abilities during school age, more than 6 years after adoption for Studies 1 and 2, and more than 9 years after adoption for Study 3. It thus seems reasonable to argue that these children had enough time to benefit from long-term exposure to their adopted language in an enriched environment. Another reason why length of exposure to

French is an unlikely explanation for their lags is that the latter should have decreased as IA children's exposure to French increased if exposure were a significant factor. As noted earlier, this was not the case. In fact, more IA children were found to score more than 1 *SD* below the mean of the CTL children at 9-12 years of age, in Study 3, than at 7-8 years of age, in Study 1. In short, it is difficult to argue that insufficient exposure to French underlies their language and memory lags.

The question that now arises is whether or not IA children's delayed exposure to their adopted language might explain their lags in language and verbal memory. This question is complex and cannot be answered with certainty using the present results since age of exposure and amount of exposure to French are confounded; as a result, the role of each variable cannot be specifically defined. However, the results of Studies 1, 2, and 3 still represent a significant advancement in the debate surrounding delayed language exposure (or age-of-acquisition effects) and of their long-term consequences. In effect, these results corroborate those of Abrahamsson and Hyltenstam (2009) and Vejnovic, Milin, and Zdravkovic (2010) to show that, despite several years of exposure to an L2, non-native language abilities and significantly lower verbal memory abilities are to be expected in learners who experienced even small delays in L2 exposure.

That delayed exposure to the adopted language might be a significant factor is supported by research on another group of delayed language learners, namely, deaf children with cochlear implants (CI). Most children who receive CIs are born deaf, although some may become deaf early on, prior to language acquisition, because of infections. CI children's delay in exposure to language is associated with an absence or significant reduction in language-related sensory input that impedes their acquisition of native-like levels of language ability. These children are diagnosed relatively early and usually receive implants within 2-3 years of age (Caselli, Rinaldi, Vazurra, Giuilani, & Burdo 2012). Studies of children with CI generally indicate that, despite performance that is age-appropriate, they experience delays in comparison to typical hearing children on measures of language comprehension, grammar, and vocabulary (Caselli et al., 2012; Geers, Nicholas, & Sedey, 2003). Children with CI have also been found to have difficulties acquiring specific linguistic structures, including French clitics (e.g., Chilosi et al., 2013; LeNormand, Ouellet, & Cohen, 2003), although there has been relatively little research on their morphosyntactic development to date. With respect to memory abilities, it has also been found that children with CI have persistent difficulties in memory from childhood into adulthood,

particularly on measures of verbal STM (Boutla, Supalla, Newport, & Bavelier, 2004; Caselli et al., 2012). These similarities are of particular interest in light of the fact that children with CI experience delayed first language (L1) exposure and acquisition. Studies looking at these similarities more closely would be interesting.

The results of Studies 1 and 3 are also in agreement with those of Mayberry (1993) who found that delayed sign language learners experience significant difficulties on tests of sentence recall. Mayberry looked at the performance of late L2 learners of American Sign Language (ASL) who were deafened in early childhood. These L2 learners were compared to native ASL speakers matched on exposure to ASL on a test of sentence recall. Mayberry found that, despite more than 50 years of exposure to ASL, L2 sign language learners' performance was significantly poorer than that of the native ASL speakers. These results, along with those of Study 1 and 3, not only show that delayed language acquisition is associated with long-term difficulties in the recall of verbal material, but also that tests of sentence recall are particularly sensitive to age of acquisition effects.

However, caution is called for when attributing IA children's lags to age-of-acquisition effects since delay in exposure to the adoption language is confounded with disruption in acquisition of the birth language. As a result, IA children's lags may be due to attrition of the L1, delay in exposure to the adoption language, or both. Although findings from previous studies by Ventureyra, Pallier, and Yoo (2004) and Pallier et al. (2003) suggest that there are no long-term neuro-cognitive traces of adopted children's birth language and, thus, that the birth language should not interfere or interact with the acquisition of their adopted language, some recent evidence suggests otherwise. Pierce, Klein, Chen, and Genesee (2013) used BOLD fMRI to compare the activation patterns of IA children from China, native speakers of Chinese who acquired French as a second language at the same time as the IA children, and monolingual French speakers. The participants, who were between 10-17 years of age at the time of testing, were scanned while discriminating between Chinese pseudo-words that differed in tone. In contrast to French, Chinese is a tonal language. Their preliminary findings revealed that native Chinese speakers recruit left hemisphere language regions (e.g., superior temporal gyrus) when processing tonal information because it is linguistically relevant. In contrast, speakers of non-tonal language process this information as complex acoustic information with no linguistic relevance and, thus, rely more on right hemisphere regions (Zatorre & Gandour, 2008). The IA

children in Pierce et al.'s study appeared to also recruit left hemisphere temporal regions when processing tonal information, suggesting that tonal information carries linguistic relevance/traces left over from formation of early formed sound categories (Pierce, personal communication, October 12, 2013), and, thus, that there is not total attrition of their birth language.

Although it is not possible to disentangle the effects of delayed exposure to French and attrition of IA children's birth language from the present results, the results of Studies 1, 2, and 3 corroborate the results of previous studies showing that even small delays in language acquisition can be associated with long-term language and verbal memory lags. A major strength of the present studies is the fact that, in addition to strict matching for age, gender, and SES, these age-of-acquisition effects were found in children without cognitive, socio-emotional, and attention difficulties and who benefited from extensive exposure to their new language.

Similarities with other language learners. Of additional theoretical interest from the present findings is the fact that IA children's specific lags in language competence occur in domains that have been shown to be vulnerable in other language learners, including children who are at-risk for language acquisition because of SLI or delayed exposure to language due to deafness. These similarities suggest that despite the specific etiology of language learners' risk, they tend to show weaknesses in the same domains. Since similarities with children with CIs have already been discussed, this comparison will not be included again in this section.

One population with whom IA children share similar difficulties is children with SLI. SLI is a neurodevelopmental disorder that is associated with performance that is more than one standard deviation below norms on omnibus language assessment instruments. It is a condition that is specific to language and, thus, does not overlap with and is not caused by other conditions, such as hearing, cognitive or neurological impairments. The cause of SLI is unknown, but research suggests that it could be genetic as many of these children have relatives who also have language impairment. Similar to IA children, children with SLI have been found to have difficulties in multiple domains of language including vocabulary, grammar, word associations, and morphosyntax (Faust, Dimitrovsky, & Davidi, 1997; Gillon, 2000; Paradis, 2010). Morphosyntactic difficulties have been shown to be a particularly vulnerable area of development for children with SLI and, in fact, they are often used as markers of SLI. The aspects of morphosyntax that are affected in children with SLI are language-specific, and children learning French have particular difficulties with object clitics (Paradis, Crago, & Genesee, 2006). Studies also

suggest that children with SLI have marked difficulties with verbal short-term (STM) and working memory (WM), but not on tests of visuo-spatial STM or visuo-spatial WM (Archibald & Gathercole, 2006). Of particular interest, children with SLI were found to have specific difficulties on tests of sentence recall; this test has indeed been identified as being one of the most specific and reliable marker of SLI (Thordardottir & Branderker, 2013).

IA children also share a similar profile of language and memory lags with L2 learners who have acquired their L1 and L2 successively. In contrast to IA children, successive L2 learners continue to use and to be exposed to their L1 and experience reduced exposure to each language. As already suggested, the language and verbal memory abilities of L2 learners are often associated with their age-of-acquisition, with older ages at acquisition being associated, usually, with lower language and verbal memory abilities. Delays in comparison to native speakers have been reported in this group on measures of vocabulary, word association, and listening recall (i.e. verbal WM) (Bialystok, Craik, & Luk, 2008; Thordardottir, 2011; Vejnovic et al., 2010). Lastly, in terms of morphosyntactic competence, L2 learners of French have been found to have particular difficulties acquiring and mastering accusative object clitics (Grüter, 2005; Paradis, 2004; White, 1996). The fact that L2 learners, who do not experience L1 attrition, and IA children share a similar profile of language difficulties suggests, albeit indirectly, that IA children's lags might indeed be linked to delays in exposure rather than attrition.

These similarities between IA children, children with SLI, children with CI, and L2 learners are particularly interesting because the difficulties in language learning experienced by these different groups are not due to the same factors. To be more specific, while the difficulties experienced by IA children are, arguably due to delayed acquisition to the “second first language” or attrition of the birth language, the difficulties of children with SLI are likely due to genetic factors, those of children with CI are due to sensory deprivation and, in turn, to delayed L1 acquisition, while the difficulties experienced by L2 learners are due to delayed language exposure without attrition. Although the underlying causes and the severity of the difficulties experienced by these different types of learners might differ, the common profiles that they share with respect to language outcomes suggests the hypothesis that common mechanisms are affected by different conditions, but to a different extent. More research is needed in order to enhance our theoretical understanding of whether the same aspects of language and verbal memory are vulnerable in children with different learner profiles.

The link between memory and language. Study 3 is the first study to show that the IA children experience lags in verbal memory. Moreover, as mentioned earlier, it may be these verbal memory lags account for their lags in language. As reviewed in detail in Study 3, several studies have suggested that underlying verbal memory ability contributes to language learning in diverse situations (except see Moll, Hulme, Nag, & Snowling, 2013). To reiterate briefly, research has shown that, in TD language learners as well as in children with SLI, verbal STM capacity is closely related to vocabulary knowledge, the acquisition of grammar, and reading abilities (Baddeley, Gathercole, & Papagno, 1998; Dufva, Niemi, & Voeten, 2001; French & O'Brien, 2008; Gathercole, Willis, Emslie, & Baddeley, 1991; Masoura & Gathercole, 2005). Similar relationships have been found between verbal WM abilities and several language-related outcomes, such as the conceptual component of vocabulary acquisition (Daneman & Green, 1986), language comprehension (Daneman & Carpenter, 1980), reading (Gathercole, Alloway, Willis, & Adams, 2006), and the ability to make associations between sound and print, which is important for the ability to read and spell (e.g., Gathercole et al., 2006). These associations have been found in both L1 and L2 learners.

In this regard, Gathercole et al. (1991) examined the association between verbal memory and language outcomes in typically-developing monolingual children at 4, 5, 6, and 8 years of age. They found that, while verbal STM was a significant predictor of vocabulary acquisition until 4 to 5 years of age, the association between verbal memory and vocabulary acquisition shifted when vocabulary knowledge became a better predictor of verbal STM. At 8 years of age, no association between verbal STM and vocabulary knowledge was found. This pattern of relationships between verbal memory and vocabulary knowledge was maintained even when variables such as age, non-verbal IQ, reading ability, and prior vocabulary knowledge were taken into account (Gathercole et al., 1991). The authors argue that, prior to 4-5 years of age, verbal STM predicts vocabulary knowledge because verbal STM capacity limits the amount of unfamiliar linguistic information that can be maintained in memory to be transformed into long-term knowledge, such as vocabulary and grammar (Pierce, 2011). They further argue that the change in the direction of the association is due to the fact that, with increasing age and changes in the capacity of verbal STM, children become better able to retrieve and use phonological structures from the lexicon to decrease the demands placed on verbal STM and, thus, to alleviate the demands of having to maintain unfamiliar sequences of phonemes.

Although Gathercole et al.'s (1991) results differ from those of Study 3, their explanation of their results provides the basis for explaining why verbal memory continues to predict language ability in the case of IA children even at 9-12 years of age. More specifically, we know that, to date, evidence suggests that age-of-acquisition influences both verbal memory and language development and, thus, that both systems will be delayed in IA children. However, the fact that during early childhood it is verbal memory capacity that constrains the acquisition of long-term language knowledge, such as vocabulary and grammar, means that it is IA children's memory lags that constrain their language acquisition. In turn, because of these constraints, older IA children will have trouble retrieving and using long-term language knowledge to decrease the demands placed on verbal memory. These enduring demands might explain why IA children's performance on tests of verbal memory has been found to be lower than their performance on tests of language as well as why verbal memory continues to predict their language abilities. If this hypothesis seems plausible with the evidence available so far, further studies are needed to document IA children's development of verbal memory and how their memory abilities relate to their language abilities through the years.

Future directions

Researchers' increasing interest in the language development of IA children has resulted in a greater understanding of the consequences of their unique pattern of language acquisition. While the present studies clearly established that IA children experience long-term language and verbal memory difficulties, they also suggest that these children's lags are unlikely due to insufficient exposure to the adopted language. Apart from the advances made possible by these results, Studies 1, 2, and 3 also suggest that other studies should be undertaken to have a better understanding of IA children's language and memory lags, explanations for them, and possible links between their language and memory abilities.

First, further research should be done to evaluate IA children's morphosyntactic competence in more detail. Now that Study 2 has shown that these children experience long-term difficulties with accusative object clitics, it would be useful to investigate the acquisition of other linguistic features that might be difficult to acquire in at-risk learners of French, such as verb morphology (Paradis, 2008). Such research would contribute to further document the possibility that certain linguistic structures are inherently difficult to acquire and create the same selective vulnerability across different learning groups.

Second, a study looking at IA children's performance on tests of sentence recall should be done in order to identify the type of errors they make on this test, the type of words that might be more difficult for them to repeat, and to determine the predictors of these children's performance on this test. Because it was found by Riches (2012) that children with SLI have difficulty repeating small words, such as *by*, *that* or past tense -ed, on tests of sentence recall, the study proposed above would make it possible to examine if the IA children and children with SLI share similar linguistic difficulties even on measures hypothesized to recruit memory abilities. Such research would also be useful in order to examine the extent with which performance on sentence recall correlates differentially with other measures of language and memory abilities.

Third, longitudinal studies that investigate IA children's abilities on tests of language, memory, non-verbal cognitive abilities, socio-emotional development, and other variables of interest, from the time of adoption into school age, would be particularly valuable. Longitudinal data from such studies including the same children would make it possible to document the development of their abilities consistently through the years, but also to determine the associations between language, memory, and general development. Unfortunately, IA children's memory abilities were not evaluated from Study 1 to Study 3. Longitudinal evaluation of the same learners from Study 1 to Study 3 would have made it possible to investigate the development of their abilities through the years and to come up with more definitive conclusions about the association between verbal memory and language abilities. Similarly, that IA children's reading abilities were not evaluated consistently until 9-12 years of age means that it was not possible to explain why they experienced difficulties on verbal memory but not on reading comprehension despite the fact that several studies have established that verbal memory abilities are linked with reading abilities (e.g., Gathercole et al., 2006). Because reading abilities were not evaluated in Study 3, we can only infer that, since the IA children had access to texts while they answering reading comprehension questions in Study 1, the task placed minimal memory demands and allowed IA children to perform well.

In a related vein, longitudinal studies that compare the development of IA children to other population of language learners, with or without language difficulties, would be of great interest. In recent years, child language acquisition researchers have been interested in individual differences in child language learning outcomes and have sought to document and explain such variation by looking at children who are at risk for language difficulties for various reasons,

including children with SLI, children with CI, successive L2 learners, and IA children. Thus, comparisons of these groups longitudinally would be useful to further our understanding of the role of genetic factors, early sensory deprivation, and language experience on individual differences in language development. To better understand variation in children language, it is important to identify and understand the ways in which language acquisition can be vulnerable and robust. To date, research on at-risk learner groups has been limited, for the most part, to two-way comparisons between at-risk and TD children. To my knowledge, there have been no multi-group comparisons of the differences and similarities in language learning outcomes of the above groups of children using the same tests (except Paradis & Crago, 2000, on L1 and L2 learners with and without SLI). As a result, we have limited understanding of these diverse groups of at-risk children and, in particular, whether they experience the same areas of vulnerability in development relative to one another and to TD children. A longitudinal comparison of these groups would address this gap in our knowledge and would allow us to answer several questions. For example, comparisons between the SLI group and the IA and CI groups would allow us to examine the possible influence of genetic factors (SLI) versus delayed exposure (CI group) on language development. Comparisons between the IA and CI groups would allow us to compare the effects of delay with sensory deprivation (CI group) versus delay without sensory deprivation (IA group). Comparisons between IA and TD L2 groups would allow us to compare the effects of delay with attrition (IA group) versus delay without attrition (L2 group). By including controls matched to CI groups on exposure to French, it would be possible to examine if the lags experienced by these groups could be caused by their limited language exposure. Some of the studies mentioned above are currently being conducted while others will be part of my postdoctoral research project.

Limitations

Despite the fact that, together, Studies 1, 2, and 3 represent an important advance in the study of language and memory in IA children, they have some limitations. First, although the present studies had sample sizes comparable to most studies of IA children, including more participants would yield more reliable results. Our small sample sizes can be explained by the fact that IA children are generally hard to recruit, but also by the fact that our studies included only IA children who were adopted from China. Several studies with larger sample sizes included children adopted from several different countries (e.g., Eigsti, Weitzman, Schuh, De Marchena,

& Casey, 2011; van IJzendoorn, Juffer, and Klein Poelhuis, 2005). Therefore, if their sample sizes were larger, their data were also less generalizable because children adopted from different countries might experience very different pre-adoptive circumstances.

Another limitation concerns the lack of information about IA children's pre-adoptive experiences. The pre-adoptive backgrounds of IA children can vary greatly, making it difficult to generalize results across different populations of IA children (Gauthier, 2011). However, it is often difficult, if not impossible, to obtain detailed and reliable information about the pre-adoptive environments of IA children from China. Furthermore, the fact that the CTL children did not experience separation from their birth parents can raise questions about whether or not this group is the most appropriate control group for IA children. It would indeed be preferable to include a group of adopted children who were not put into new language learning environments in order to isolate the effects of adoption on language. While there are adoptions within a community such as Montreal and while these children are not required to learn a new language, there are very few such adoptions and these children may be given up for adoption for reasons that might jeopardize their general development.

As mentioned throughout the present dissertation, not all IA children who participated in the study of Gauthier and Genesee accepted to participate in the present studies. As a result, it might be argued that the adoptive parents who were willing to participate in additional research studies were more concerned about their child's language development than parents who decided to not continue to participate. Of relevance here, however, the major reason reported for non-participation by adoptive parents was lack of time. Moreover, the answers provided by adoptive parents in our questionnaires indicate that the parents who accepted to participate in the present studies did not have concerns about their child's general health, including their language development. No major differences were found between the performance of the IA children who had participated in Gauthier and Genesee's study and the newly recruited children who participated in Study 1, 2, and 3 on measures of language ability, non-verbal cognitive ability, and socio-emotional development.

There are, in addition, two important points to consider when interpreting the results of the present research. Because we looked at the effects of language experiences on the development of language and memory in girls adopted from China, the results do not necessarily pertain to children adopted from other countries or to boys. It is also important to note that the results

represent group averages and not individual differences. In other words, the lags that are reported in the present studies reflect group results and do not mean that all IA children have lags in language and memory abilities in comparison to control children.

A last limitation concerns test norms. Because only a limited number of assessments is available to evaluate speakers of French, some of the tests included in the present studies, such as the EOWPVT, do not include norms based on the performance of French-speaking children. This might have possibly influenced IA children's classification as being within age-appropriate levels or not, but this does not impact on the significant differences that were found between the IA and CTL children.

Despite the limitations of the present studies, they gave rise to new and interesting findings that pave the way for additional interesting studies on the language and verbal memory development of IA children. At the same time, this research can inform professionals with research-based guidance on what areas of development need support to improve language learning in IA children. The findings will also inform professional development programs with guidance on how best to train teachers and speech-language pathologists who work with these at-risk learners.

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