Levels of Bilingualism and Levels of Linguistic Awareness

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Research investigating the effects of bilingualism on a variety of academic, linguistic, and intellectual achievements has traditionally led to conflicting results. Many of the early studies that warned of disastrous effects of bilingualism on cognitive development (see Darcy, 1963, for review) were later found to lack proper controls, undermining any interpretation of those findings. Later work revealed a more promising intellectual prognosis for bilingual children. Peal and Lambert (1962), for example, showed how careful selection of subjects in the bilingual population could produce evidence of bilingual superiority on some intelligence tests. The relation between bilingualism and intelligence depended on factors such as social class, degree of language proficiency, and type of bilingualism (Cummins, 1976).

A similar debate surrounds the examination of the relation between bilingualism and linguistic awareness. Evidence for a facilitating effect (Ben Zeev, 1977; Cummins, 1978; Ianco-Worrall, 1972), an inhibiting effect (Palmer, 1972), and no effect (Rosenblum & Pinker, 1983) of bilingualism have been reported. Some investigators have found effects in both directions when studying different samples of bilingual children. Peal and Lambert (1962), for example, showed how careful selection of subjects in the bilingual population could produce evidence of bilingual superiority on some intelligence tests. The relation between bilingualism and intelligence depended on factors such as social class, degree of language proficiency, and type of bilingualism (Cummins, 1976).

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Regarding the definition of bilingualism, two sets of studies have identified level of bilingualism to be a critical factor in determining the effects of bilingualism on other aspects of development. First, Cummins (1979) proposed the threshold hypothesis as a partial account of inconsistencies in the literature. He argued that those aspects of bilingualism that positively influence cognitive growth are unlikely to emerge until the child has attained a minimum, or threshold, level of competence in the second language. By reviewing a large number of studies that reported discrepant findings, he posited a dual threshold in which the lower level provides the necessary linguistic skill (in either language) to prevent damaging effects on cognition and the higher level provides the linguistic skill (in both languages) to allow acceleration in cognition.

Second, Hakuta and Diaz (1985) and Diaz (1985) considered the role of the second language as it determined the degree of balance between the two languages. Thus, the issue is the relative knowledge of the two languages. These studies examined differences in a variety of metalinguistic and cognitive tasks for children at different levels of Spanish (first language)/English (second language) proficiency. The degree of balance (operationalized as level of English proficiency) was a significant factor in determining performance on some of these measures for children who were overall very low in English skills. No effect was found for children higher in English skills. Using causal modeling, the results showed that bilingualism had a greater role in predicting metalinguistic and cognitive performance for children whose language skills were less balanced, that is, for children in the earlier stages of second-language learning.

Level of bilingualism, then, seems decisive in determining the effects that bilingualism will have on other achievements. For Cummins (1979), the relevant factor was absolute levels of first language/second language proficiency; for Hakuta and Diaz, the relevant factor was relative levels of first language/second language proficiency. The first description, in absolute terms, provides an account of the tasks children should be able to perform; the second description, in relative terms, provides a statistical description of sources of variance in solving the tasks and suggests the time in second-language learning at which bilingualism is most likely to influence cognitive development. Combining these two descriptions, it could be claimed that the cog-
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native advantages shown by early, or unbalanced, learners in the relative account depend on learners having at least passed the lower threshold identified by the absolute description. In addition, the kind of task used to measure the cognitive or metalinguistic performance is also relevant in determining the effects of level of bilingualism.

Types of linguistic awareness can be distinguished by considering processing differences involved in different metalinguistic tasks. Our claim, elaborated elsewhere (Bialystok & Ryan, 1985), is that two skill components can be identified as part of the processing requirements for metalinguistic (and other language) tasks and that specific tasks depend differentially on these two components. The two components are analysis of linguistic knowledge and control of linguistic processing.

Analysis of linguistic knowledge is the skill component responsible for the structuring and explicating of linguistic knowledge (cf. Bowerman, 1982; Karmiloff-Smith, 1986; Reber & Lewis, 1977). In information-processing terms, this analysis component corresponds to the memory base, which becomes organized into networks, schemata, or systems (crystallized ability). Development involves making explicit the structure of the mental representations that had initially been stored in some holistic or implicit form. Different uses of language require different levels of explicitness of the child's linguistic knowledge. Some uses (such as conversation) can be supported by unanalyzed or implicit representations, but other uses (such as literacy and the solving of metalinguistic problems) require a more analytic or explicit knowledge of the same linguistic system used implicitly for other purposes (Bereiter & Scardamalia, 1982; Carpenter & Just, 1981). Thus, although young children can speak in grammatically well-formed utterances without explicitly knowing a single rule of grammar, activities such as writing require more explicit knowledge of those same rules. The ability to analyze language in this way and the knowledge of structure that results from such analysis form the skill component analysis of linguistic knowledge. High levels of analysis allow the child to provide definitions and descriptions of language structure (cf. Chomsky, 1979).

Control of linguistic processing is the executive component responsible for directing attention to the selection and integration of information. In information-processing terms, the control component corresponds to executive processes or meta-components (fluid ability). Different language uses require attention to different aspects of the linguistic input. The usual strategy is to focus on meaning (Hakes, 1980); problems that demand attention to other aspects increase the requirement for control. In conversation, for example, control is required to integrate and monitor the ongoing utterances, determining, for example, how pauses will be filled. Learning to read requires much higher levels of control of processing. Reading requires proper sampling and integration of formal (graphemic, syntactic) and semantic (lexical, discursive) information (Lesgold & Perfetti, 1981). Similarly, metalinguistic tasks typically require children to focus on forms and, sometimes, to ignore or to suppress meaning. The knowledge of procedures for solving a variety of language problems and the ability to execute those solutions through appropriate attentional focus is the function of control of linguistic processing.

Metalinguistic problems typically depend on high levels of one or both of these skill components, although metalinguistic problems differ in which component is most relevant to the solution. Some tasks, such as awareness of syntax, concept of word, correction problems, definition tasks, paraphrase, or judgments of ambiguity, depend primarily on the child's knowledge of linguistic structure. The solution to these problems depends on the child's ability to detect, extract, or articulate some structural property of language. Other tasks, such as Piaget's (1929) sun/moon problem, sentence segmentation, symbol substitution, and repetition of deviant sentences, depend more on the child's control of attention. In this latter set of problems, the child must carry out a simple task while resisting the meaning of the sentences being manipulated. These tasks generally include misleading cues, so that the solution depends on proper selection and integration of information.

The claim in this study is that the ability of bilingual children to solve metalinguistic problems depends on the demands of a given problem for analysis of knowledge or control of processing. Moreover, the extent or degree to which the child is bilingual intervenes to determine which problems may be solved more easily.

On the basis of this conceptualization of language processing, two hypotheses are proposed. First, bilingual children would be more advanced than monolingual children in their level of control of linguistic processing. Because bilingual children have the experience of two linguistic systems that label the same conceptual system, the arbitrary connection between forms and meanings is more readily apparent (Vygotsky, 1934). Moreover, these children have more experience attending to formal linguistic features that may change even though meanings are constant, as in deciding between languages, attending to different phonological systems, and choosing the correct label for an object. Furthermore, bilingual children's clearer representation of linguistic and conceptual information as separate structures makes problems involving selective attention to linguistic features less difficult. Hence, problems that require selectively attending to specified parts of the language—the syntax, the meaning, and the phonology—would be easier for bilingual children than for monolingual children of the same age.

Second, bilingual children who are fully competent in both languages would be more advanced than monolingual or partially bilingual children in their level of analysis of linguistic knowledge. The experience of structuring and analyzing two linguistic systems would accelerate the extraction of abstract linguistic structures, rules, or concepts. This advantage, however, is confined to children whose knowledge of both languages has been analyzed. A second language that remains unanalyzed, such as one used only for conversation (and not requiring much analysis of that system), would not be expected to yield this advantage.

The study of filled and unfilled pauses is an important source of data in analyses of second language use. Languages differ in the way in which pauses are treated, and language learners ability to fill pauses fluently and appropriately is considered to be an aspect of their level of control of processing.

A fuller explanation of how these metalinguistic problems differ in their demands for analysis and control is provided elsewhere (Bialystok & Ryan, 1985). A detailed task analysis for grammaticality judgment problems is provided in Bialystok, 1986b.
advantage. Hence, problems requiring analyzed linguistic knowledge would be easier for bilingual children provided that their knowledge of both languages is advanced, possibly balanced, and perhaps includes literacy skills. Children who have only a little knowledge of a second language would not show an advantage over monolingual children when solving metalinguistic problems requiring high levels of analysis of knowledge.

Some evidence for these two predictions has been reported. In a variety of metalinguistic tasks, bilingual children consistently performed better than monolingual children on problems requiring high levels of control but not on problems requiring high levels of analysis of knowledge (Bialystok, in press). Yet in some cases a bilingual advantage was also obtained for problems requiring analysis of knowledge. In one study, children were asked to count the number of words in sentences under conditions that demanded increasingly explicit knowledge of word boundaries. In addition to the expected advantage for the bilingual children in the control versions of the problem, there was a weaker but still reliable advantage in the high-analysis versions. These children were both bilingual and biliterate, possessing high levels of skill in both languages (Bialystok, 1986a). Under the present hypothesis, a more detailed definition of the child’s level of bilingualism may account for these findings.

The purpose of the present research was to examine these hypotheses for children who differed in their level of bilingualism. It was expected both that the bilingual advantage for high-control problems would be replicated with a new set of tasks and that a bilingual advantage for high-analysis problems would be evident for children who were fully bilingual.

Study I

The first study was an examination of groups of children who varied in their type of bilingual experience. Two groups of bilingual children were compared with similar children who were monolingual.

Method

Subjects

There were 57 children from Grade-1 classes (6:1 to 7 years of age) involved in the study. These children included 20 monolingual English-speaking children, 20 partially French–English bilingual children, and 17 fluently French-English bilingual children. The partially bilingual subjects were anglophone children studying in a French immersion program. These children had been educated entirely in French for almost 2 years at the time of testing and had been formally taught literacy skills only in French. Nonetheless, these children could generally read English as well, because they tended to come from homes in which literacy was emphasized. Their use of French was largely confined to the classroom, usually in interaction with the teacher. The fully bilingual subjects were children who were attending a French school and therefore were educated in French. These children, too, could speak and read English, most likely because they lived in middle-class families in an English-speaking environment. In most cases, these children had one parent who was French, and there was usually some French spoken in the home. Frequently, their early exposure to French was through extended family, such as grandparents. In this school, just as for the French immersion school, the language of the playground was predominantly English.

The main feature of the sample was that the children in all three groups were similar in socioeconomic factors. All children were middle to upper-middle class. All three schools were located close to each other in a suburb of Toronto.

The different language abilities of the groups were empirically verified by administering the Peabody Picture Vocabulary Test (PPVT) as a rough measure of relative language proficiency. All children were given the standardized English version; the two bilingual groups were also given a French translation of the test. For the bilingual groups, the order of French and English tests was randomized, and at least 1 week separated the administration of the two tests. Different forms of the test were used for the English and French versions, so there was no overlap in the specific vocabulary tested.

Finally, to ensure that there were no major IQ differences among the groups, all children were administered the Canadian Test of Cognitive Abilities and the digit span subtest of the WISC. There were no differences found among the children in the three groups.

Tasks

1. Arbitrariness of language. This task used Piaget’s (1929) sun/moon problem as it was adapted by Lavoie-Worrall (1972) to assess the child’s understanding of the arbitrary connection between linguistic form and reference in the world. There were two parts: (a) The child was asked, “Suppose you were making up names for things, could you then call the sun ‘the moon’ and the moon ‘the sun’?” and was persuaded that this was possible. The child was then asked, “Now suppose that happened and everybody decided to call the sun ‘the moon’ and the moon ‘the sun’. What would you call the thing in the sky when you go to bed at night?” [1 point for sun] What would the sky look like when you’re going to bed?” [1 point for dark].” The two scores (the maximum score for each was 1) were converted by arcsine transformation to scores out of 3.14 and added together for a total out of 6.28. (b) The child was questioned, “Imagine that the names of cats and dogs were changed around. [Child is shown a picture of a cat.] What would this animal’s name be? [1 point for dog] What sound would it make? [1 point for meow].” The same procedure as that used for the sun/moon problem produced scores out of 6.28 for the cat/dog problem.

The primary demands of this task were on control of processing. The children had to ignore their usual experiences with the sun and moon and with cats and dogs in order to manipulate the names for these objects.

2. Concept of word. This task, adapted from Papandropoulou and Sinclair (1974), contained two parts that jointly assessed the child’s knowledge of the abstract concept of a word: (a) The first part was judgement, in which the child was presented with a list of 10 words and phrases, 1 at a time, and asked if each one was a word. The list included concrete objects, numbers, verbs, conjunctions, and phrases. The child was asked to justify each response. (1 point for correctly identifying all words on the list.) (b) The second part was definition, in which the child was asked, “What is a word?” “How can you tell if something is a word?” The definitions were scored according to their degree of formality. Three categories were used: formal definition, identifying the properties or uses of words (e.g., referring to letters and sounds that have a meaning) (1 point); semantic definition, referring to the physical properties of the

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1 Because these children were in Grade 1, however, their reading ability in any language was limited.

2 Winer (1971) argued that the distribution of variance for proportion scores is skewed and should be corrected by arc sine transformation prior to applying statistical analyses. The arc sine transformation converts the scores to radians, numerically expressed as scores out of 3.14.
Table 1
Mean Score per Group on Language and Metalinguistic Tasks

<table>
<thead>
<tr>
<th>Task</th>
<th>Monolingual (M) (N = 20)</th>
<th>Partially bilingual (P) (N = 20)</th>
<th>Fully bilingual (F) (N = 17)</th>
<th>Differences</th>
</tr>
</thead>
<tbody>
<tr>
<td>PPVT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>English</td>
<td>97.30</td>
<td>87.10</td>
<td>84.94</td>
<td>M &gt; P, F</td>
</tr>
<tr>
<td>French</td>
<td>—</td>
<td>10.50</td>
<td>13.51</td>
<td>P &lt; F</td>
</tr>
<tr>
<td>Arbitrariness*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sun/moon</td>
<td>2.51</td>
<td>4.24</td>
<td>4.25</td>
<td>M &lt; P, F</td>
</tr>
<tr>
<td>Dog/cat</td>
<td>3.76</td>
<td>3.45</td>
<td>4.06</td>
<td></td>
</tr>
<tr>
<td>Analysis of knowledge</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Judge</td>
<td>1.41</td>
<td>1.73</td>
<td>2.40</td>
<td></td>
</tr>
<tr>
<td>Define</td>
<td>1.09</td>
<td>1.41</td>
<td>2.12</td>
<td>M &lt; F</td>
</tr>
<tr>
<td>Syntax*</td>
<td>7.15</td>
<td>7.25</td>
<td>9.94</td>
<td>M, P &lt; F</td>
</tr>
</tbody>
</table>

Note. PPVT = Peabody Picture Vocabulary Test.

word's referent or vague formal definition (5 point); and no definition, in which the child either did not provide an answer or provided no relevant information (no points).

This task relied on analyzed knowledge of the concept of word. The child needed to have a clear idea of the boundaries that are relevant for determining what a word is. Furthermore, the justifications required for Part a and the definition elicited in Part b demanded an explicit knowledge of those constraints.

These scores, each out of 1, were converted by arc sine transformation, yielding scores out of 3.14 for each of the two subparts of the task.

3. Syntax corrections. A set of 12 sentences, each containing a grammatical error, was presented to the child orally, 1 at a time. The child was told to say each sentence the right way after it had been read by the experimenter (1 point for each properly corrected sentence). The score was the number of correct repairs produced, to a total of 12.

The task was mostly dependent on analysis of knowledge to locate and correct grammatical errors. The errors involved verb tense, negation, particle placement, agreement, and word order.

For the arbitrariness-of-language task, there was a group effect for the sun/moon version of the problem, F(2, 54) = 3.71, p < .03, with the two bilingual groups scoring higher than the monolingual groups. There were no differences among groups for the cat/dog version of the problem.

On the word-concept task, there was no difference among groups for the judge problems. The definitions problems were scored by two raters and achieved an interrater reliability of 0.93. There was a significant difference among groups for this task, F(2, 54) = 4.22, p < .01, with the fully bilingual group scoring better than the monolingual group (p < .05) and the partially bilingual group not differing reliably from either of these.

The syntax task revealed a group effect, F(2, 54) = 7.45, p < .001, in which the fully bilingual group scored higher than the other two groups.

Discussion

Scores for the two versions of the PPVT confirmed that the groups differed in their language proficiency and degree of bilingualism. The monolingual English group demonstrated the highest level of English competence when measured by a standardized vocabulary test. The two bilingual groups were both slightly less proficient in English than was this monolingual group, but did not differ from each other (cf., Rosenblum & Pinker, 1983). Because all testing was in English, any advantage in performance would be expected for the monolingual group.

The French scores for the two bilingual groups were very different, the fully bilingual group scoring almost twice as high as the partially bilingual group.

Where there were group differences in metalinguistic performance, the fully bilingual group always scored the highest and the monolingual group, the lowest. On tasks requiring high lev-
els of control of processing, the partially bilingual group scored about the same as the fully bilingual group: on tasks requiring high levels of analysis of knowledge, the partially bilingual group scored about the same as the monolingual group.

The hypothesis concerning performance on tasks demanding high levels of control of processing was that any experience or level of bilingualism would be sufficient to raise the performance of these children above that of their monolingual peers. This was tested using two versions of the sun/moon problem. The predictions were confirmed for the standard version of this problem, but there were no differences among the groups for the altered version that used cats and dogs. For the two bilingual groups, the cat/dog problem was more difficult (although not significantly so for the fully bilingual children) than the sun/moon problem, whereas for the monolingual group, the cat/dog problem was easier than the sun/moon problem. Thus, for the majority of the children, there was greater resistance to changing the names of familiar animals than the names of celestial bodies, and the cat/dog problem seemed not to have been treated with the same level of abstraction as the sun/moon version. Because all three groups responded in the same way to the cat/dog version, it is possible that the task is not equivalent to the sun/moon problem. The cat/dog task is more concrete in that the child was looking at a picture of one animal and expected to name the kind of sound made by the other. Hence, the task was not strictly metalinguistic but included elements of a concept-formation problem. It would be interesting to pursue this difference by exploring children's ability to change the names for other familiar properties of concrete objects (such as size or shape) and see if performance on these tasks corresponds to other metalinguistic abilities and if there are interactions with the child's bilingualism.

The hypothesis concerning performance for tasks depending primarily on analysis of knowledge was that the fully bilingual group would be superior to the other two groups. Three tasks of this type were used, and, for all three tasks, the fully bilingual group achieved the highest scores. The partially bilingual group, however, did not always behave exactly as the monolingual group. For the word-judgment problem, although the ordering of scores for the three groups was consistent with the hypothesis, the differences were not reliable.

The word-definition problem was solved best by the fully bilingual children. Their responses indicated the most sophisticated knowledge. These effects, then, are more subtle than those obtained in Study 1 but have the advantage of greater control over variability from factors such as schools, background, and individual differences.

The third test of analysis of linguistic knowledge was syntax corrections. Here the pattern was as predicted: The fully bilingual group was more successful than were the other two groups. Although the monolingual group demonstrated the highest level of English language proficiency on the PPVT, that advantage was not evident on this more metalinguistic test.

The results for tests of analysis of knowledge were in the predicted direction but included some inconsistencies for the partially bilingual group. One reason may be that analysis of knowledge is a continuous process, so that at any point in time different aspects of the child's representations of linguistic knowledge occupy different positions along this continuum of explicitness. Some notion of the units of language (i.e., word boundaries) is a rather early achievement and, when control of processing barriers are removed, can be demonstrated to some extent by 4-year-olds (Bialystok, 1986a). It is possible that limited experience with literacy is sufficient to bring children to this level of analysis of language. Access to the structure of those units to identify the properties that determine items to be words requires greater analysis of those same concepts of word. The monolingual children, it appears, had not yet analyzed the system to this extent. The partially bilingual children had more insight here than did the monolingual children, but were not as sophisticated as the fully bilingual children. Finally, analysis of syntactic structure was the most abstract property of language investigated in these tasks. Although children's language was clearly controlled by grammatical rules from early on, the extraction of those rules at any level of explicitness was a late achievement. Indeed, even in metalinguistic tasks comparing children's ability to detect ungrammatical sentences with the actual correction of errors in those sentences, the detection problem was easier (Bialystok, 1986b). Reber and Lewis (1977) reported a similar finding for adults learning an artificial language. Analysis of the rules of syntax was the most sophisticated achievement of analysis examined in these tasks, and only the fully bilingual children showed an explicit understanding of this aspect of language.

**Study 2**

The results of the first study showed considerable support for the hypotheses using a between-groups design. A more sensitive test, however, would be to use a within-groups design, in which children drawn from the same population could be studied as a function of their individual level of bilingualism. The same predictions could be made: Because all the children were bilingual, measures of control of processing would not differ within the sample; children who were more bilingual, in that they possessed greater proficiency in the second language than did other children in the sample, would show advantages for analysis of knowledge. These effects, then, are more subtle than those obtained in Study 1 but have the advantage of greater control over variability from factors such as schools, background, and individual differences.

**Method**

**Subjects**

The subjects were 41 Grade-1 children (6½ to 7 years of age) attending two different Roman Catholic Separate Schools in Toronto. There were 23 children from the first school and 18 children from the second.

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3 I am indebted to an anonymous reviewer for this suggestion.
All the children selected for the study came from homes in which Italian was spoken to varying degrees. All children could speak some Italian but had different experiences in learning and using the language. The school curriculum is taught in English, so children have learned to read in English. The children were (virtually) unable to read Italian. Italian was spoken to varying degrees. All children could speak some cat/dog version of the arbitrariness-of-language task and the syntax-correction problem. Italian bul had different experiences in learning and using the language. home.

To establish the level of language proficiency, all children were administered the PPVT in English (EPPVT) and a translation of the test in Italian (IPPVT).

Tasks

Two of the tasks used in Study 1 were omitted from this study—the cat/dog version of the arbitrariness-of-language task and the syntax-correction problem.

A new task added to the battery was the grammaticality judgment task (Bialystok, 1986b). Children were asked to make judgments of grammatical acceptability on sentences that were read orally. The sentences were either grammatically correct and semantically correct, grammatically incorrect and semantically correct (called incorrect), grammatically correct but anomalous (called anomalous), or incorrect for both grammar and meaning. The two relevant conditions were the ones for which the value for grammaticality and meaningfulness conflicted, that is, the incorrect and anomalous items. For incorrect, the child had to reject the sentence because it was not well-formed and, to do so, the child had to refer to some principle of language structure. Thus, the item depended on analysis of linguistic knowledge. For anomalous, the child had to accept the sentence because it was grammatically correct. That judgment, however, was difficult because attention normally directed to the meaning of the sentence had to be intentionally suppressed. Thus, the judgment required high levels of control. An example of an incorrect sentence is, "Why the dog is barking so loudly?" and an example of an anomalous sentence is "Why is the cat barking so loudly?"

This task contained three examples each of all four judgment types, although only the incorrect and anomalous items will be reported in the analysis. Two complete versions of the task, one in English and one in Italian, were administered to each child.

Procedures

Children were tested individually by an Italian-speaking experimenter. The session began with some discussion in Italian about the child's use of Italian, including who lived in the home, the extent to which Italian was spoken, and the child's experience using Italian.

The testing included all the tasks in a fixed random order. Each session lasted about 40 min.

Results and Discussion

There were differences between schools for the IPPVT, F(1, 38) = 11.33, p < .001 (with School 1 scoring higher than School 2), for the word-definition task, F(1, 38) = 8.18, p < .006 (with School 1 scoring higher than School 2), and the sun/moon problem, F(1, 38) = 11.41, p < .001 (with School 2 scoring higher than School 1). Because the patterns of correlation were the same for both schools, the data from the two schools were combined in the analyses.

Summary statistics for the tasks are reported in Table 2. The results of the EPPVT and IPPVT showed that these children were more proficient in English than in Italian, although the distribution of the results for both tests was normal. There was no correlation between children's scores on these two measures (Table 3), suggesting that the IPPVT score provided a measure of the child's bilingualism in that it indicated the extent of general vocabulary knowledge possessed by the child. Because schooling and literacy were carried out in English for these children, the IPPVT scores may have reflected to some extent the child's general verbal abilities.

The Italian and English versions of the grammaticality judgment task produced the same results, so they were combined to form overall judge-anomalous and judge-incorrect scores. Judge-anomalous was a measure of control of processing and judge-incorrect was a measure of analysis of knowledge. The total score for the sun/moon problem constituted the arbitrariness-of-language score used as a measure of control of processing. Because there was no difference between the judge and the define questions of the word-concept problem (cf. fully bilingual children in Study 1), they were combined to form a word score, used as a measure of analysis of knowledge.

The first hypothesis was that bilingualism confers a general advantage on control of processing. Thus, the children's level of performance with the arbitrariness and judge-anomalous task would not be affected by their level of bilingualism. The second hypothesis was that higher levels of bilingualism additionally provide an advantage for analysis of knowledge. Thus, children who were more bilingual would perform better on the word and judge-incorrect tasks. These hypotheses can be tested in two ways: first, by examining the correlation matrix among the tasks and, second, by dividing the sample into high- and low-bilingual children and examining task performance using analysis of variance (ANOVA).

The correlation matrix for the tasks is reported in Table 3. There were four correlations predicted. First, because higher

<table>
<thead>
<tr>
<th>Construct</th>
<th>Task</th>
<th>Max</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Language proficiency</td>
<td>Eng. PPVT</td>
<td>71.49</td>
<td>16.78</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ital. PPVT</td>
<td>25.09</td>
<td>12.67</td>
<td></td>
</tr>
<tr>
<td>Control of processing</td>
<td>Sun/moon</td>
<td>3</td>
<td>1.87</td>
<td>0.76</td>
</tr>
<tr>
<td></td>
<td>Judge anomalous (Ital.)</td>
<td>3</td>
<td>1.45</td>
<td>0.82</td>
</tr>
<tr>
<td></td>
<td>Judge anomalous (Eng.)</td>
<td>3</td>
<td>1.45</td>
<td>0.74</td>
</tr>
<tr>
<td></td>
<td>Total anomalous</td>
<td>6</td>
<td>2.90</td>
<td>1.42</td>
</tr>
<tr>
<td>Analysis of knowledge</td>
<td>Judge words</td>
<td>1</td>
<td>0.30</td>
<td>0.46</td>
</tr>
<tr>
<td></td>
<td>Define words</td>
<td>2</td>
<td>0.68</td>
<td>0.57</td>
</tr>
<tr>
<td></td>
<td>Total words</td>
<td>3</td>
<td>0.98</td>
<td>0.80</td>
</tr>
<tr>
<td></td>
<td>Judge incorrect (Ital.)</td>
<td>3</td>
<td>1.13</td>
<td>0.93</td>
</tr>
<tr>
<td></td>
<td>Judge incorrect (Eng.)</td>
<td>3</td>
<td>1.28</td>
<td>0.90</td>
</tr>
<tr>
<td></td>
<td>Total incorrect</td>
<td>6</td>
<td>2.40</td>
<td>1.42</td>
</tr>
</tbody>
</table>

levels of bilingualism would promote analysis of knowledge, there would be positive correlations between IPPVT and word and between IPPVT and judge incorrect. Second, because word and judge incorrect both measured analysis of knowledge and arbitrariness and judge anomalous both measured control of processing, these pairs of tasks would also correlate. Three of these four predictions were observed in the data; the predicted correlation between word and judge incorrect was not found. Moreover, there was an unpredicted correlation between EPPVT and word. Providing an abstract definition for a word requires very high levels of analyzed linguistic knowledge, and it may be that the children who performed best on the English proficiency test were the children for whom analyzed linguistic concepts were the most developed. That is, at the upper levels the EPPVT measured not only vocabulary but also verbal intelligence.

Subjects were divided into two groups on the basis of a median split for IPPVT scores. The median score of 25 produced a group of 16 children in the high-bilingual group and 23 children in the low-bilingual group. These bilingual classifications were used as a grouping factor in a series of ANOVAs for the variables judge incorrect, word, judge anomalous, and arbitrariness. The first two, being tests of analysis of knowledge, would show differences between the groups, but the second two, being tests of control of processing, would not. The results conformed to this pattern. For the judge-incorrect task, the high group obtained a mean score of 2.73 and the low group a mean score of 1.87, $F(1, 37) = 3.71, p < .05$. For the word-concept task, the high group obtained 1.31 and the low group, 0.74, $F(1, 37) = 5.25, p < .02$. For the judge-anomalous task, the high group obtained 2.62 and the low group, 3.00. $F(1, 37) = 0.99, p < .32$. Finally, for the arbitrariness-of-language task, the high group obtained 2.18 and the low group. 1.74, $F(1, 37) = 3.36, p < .07$.

**General Discussion**

The results show that children who differ in their level of bilingualism enjoy different advantages in solving metalinguistic problems compared with each other and compared with monolingual children. The interpretation of the relevant difference is consistent with a description of the processing-skill component most involved in the solution of the metalinguistic problem. Moreover, the inconsistencies previously reported in the literature for assessments of the metalinguistic skills of bilingual children are attributed to two methodological problems: the use of metalinguistic tasks in which these skill components are confounded and the comparison of bilingual children who differ in their bilingual experience.

The difference between monolingual and bilingual children is in the control that bilingual children can exert over their processing of language. Monolingual children obviously achieve this control as well, but it comes earlier, and presumably more easily, to bilingual children. This control over the selection and integration of different aspects of language, especially regarding language form, is a central problem in reading. Children must learn to attend to formal graphic information in the right balance with the emerging semantic and contextual information in order to read fluently and to understand what they are reading. Children who can decode but fail to comprehend exhibit deficits of control. The bilingual children in Study 1 had never been taught to read English, but they spontaneously achieved this with very little effort. Mastery of control of processing is an important step toward linguistic proficiency in a number of advanced domains, literacy being a prime example.

Other benefits may accrue from advanced levels of control of processing. If such processing is general to other cognitive domains and not restricted to linguistic processing, certain spatial problems may involve the same skill. One possibility that we are currently pursuing in our research is that control of processing, or an analogous construct, underlies performance on tasks such as the Embedded Figures Test, which is used as a measure of field independence. If isolating and attending to formal constituents of larger meaningful constructs is a generalized ability, bilingual children may perform in a more field-independent way than monolingual children.

The difference between the levels of bilingualism that leads to advances in linguistic analysis is more difficult to characterize. Clearly, the quantitative difference is important: Knowing "more" of the second language is a necessary condition. Hence, the partially bilingual children in Study 1, and the low-Italian-proficiency children in Study 2 were less skilled in the analysis-of-knowledge tasks than were the "more bilingual" children. But what is the role of literacy? Literacy must be an important experience for the child's analysis of language regardless of bilingualism (cf. Bialystok, 1986b). However, evidence to support the claim that biliteracy can enhance and accelerate this analysis is equivocal. As with the relation between literacy and metalinguistic awareness for a first language, the data are primarily correlational, making claims about the existence and direction of causality highly speculative.

The interpretation used in the present studies can be applied to the results reported by Diaz (1985). In his study, children equivalent in their Spanish (first language) proficiency were divided into two groups of high or low English (second language) skills and tested at two points in time. There were three metalinguistic tasks used as dependent variables: grammaticality judgment (corresponding to test of analysis in the present study); language judgment, in which subjects had to detect sentences containing insertions from the other language (corresponding to test of control here); and sentence correction (test of analysis here). Even in the high-proficiency-English group, the subjects in Diaz's study were not very skilled and certainly not balanced. The mean score for English (second language) PPVT in the high-proficiency group of Diaz's study was about the same as
the overall mean score for Italian (second language) PPVT in Study 2 here. Thus, these children may not have achieved sufficient levels of bilingualism for advances in analysis of knowledge to emerge, and, in fact, none were found. The only effect that approached significance was that, at the first testing time, the high-English group performed better than the low-English group on the sentence-correction task, and the regression analysis showed a significant effect for English proficiency on the sentence-correction scores for this group. Children in the low-English group were extremely weak, sometimes knowing only a few words of English. This may not even be sufficient bilingualism for the effects of control of processing to emerge. Indeed, the low-English group showed consistent relations between performance and level of English; that is, as they became more bilingual, the control effects began to emerge. The regression analysis of the low-group performance at the second testing time showed the greatest contribution of English proficiency (degree of bilingualism) to performance on the language-judgment task, the one requiring the most control of processing. Thus, these results fit the pattern reported in the present studies, but find evidence for the emergence of these patterns at the lowest initial stages of bilingualism.

The influence of bilingualism on the development of linguistic awareness demonstrated in these studies not only helps to clarify this specific relation but also has implications for other cognitive skills that have been considered in studies of bilingualism. As was predicted from earlier studies, the level of bilingualism is decisive in determining the effect it will have on development. Minimally, one must consider the extent to which the child knows a second language, the uses for which that language is employed, and possibly the social context surrounding its use, before predictions about its effect on the child's cognitive development can be made. Further research must examine these factors more carefully, possibly using longitudinal study, and certainly developing more rigorous methods for definition and measurement of the relevant factors.

References