Abstract
This paper reviews evidence for strong interaction between lexical aspect and grammatical aspect in the area of language acquisition, language processing, and language disorders. It is argued that this type of frequency-based bias must be taken into consideration not only in research on temporality but also in any areas of language sciences.

1. Introduction
Situations unfold over time. When we talk about them, we often specify how they unfold over time (or not). There are many ways language conveys such temporal information. While tense specifies location of an event in relation to other points in time (e.g. past, present, future, pluperfect), aspect specifies the internal temporal structure of a situation; e.g. whether it is ongoing or completed. This is important information to convey for our linguistic communication to be successful, and various languages convey it by various means—lexical, grammatical, or pragmatic. English grammatically marks tense (-ed, -s, will), while Chinese does not, relying instead on lexical and pragmatic means. English also grammatically marks aspect (progressive ‘be V-ing’) while Hebrew does not.

Grammatical marking of aspect, often encoded in auxiliaries and inflections, is known as grammatical aspect, or viewpoint aspect. It is called viewpoint aspect because it signifies the speaker’s viewpoint on a particular situation being referred to. For example, when one chooses to say “He ran a mile”, the speaker is viewing the situation from outside, disregarding its internal structure (perfective aspect) while if one says “He was running a mile” the beginning and end of this situation are disregarded and the speaker is focusing on the internal structure of this situation (imperfective aspect) (Comrie, 1976; Smith, 1997). Perfective aspect is often used to push the narrative storyline forward (foreground) while imperfective aspect is associated with background information (Hopper, 1979).

Also important in conveyingaspectual information is lexical aspect – also known as inherent (lexical) aspect, situation aspect (or situation type), aktionsart, event type, etc. This is defined by the temporal semantic characteristic of the verb (and its associated elements) that refers to a particular situation.

Although there are numerous proposals for classifying lexical aspect,
the best-known is the classification proposed by Vendler (1957). Vendler’s semantic categories of verbs are State, Activity, Accomplishment, and Achievement. These are schematically represented below (Andersen, 1990):

<table>
<thead>
<tr>
<th>Category</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>State</td>
<td>love, contain, know</td>
</tr>
<tr>
<td>Activity</td>
<td>run, walk, play</td>
</tr>
<tr>
<td>Accomplishment</td>
<td>make a chair, walk to school</td>
</tr>
<tr>
<td>Achievement</td>
<td>die, drop, win the race</td>
</tr>
</tbody>
</table>

State terms (e.g., love) describe a situation that is viewed as continuing to exist unless some outside situation makes it change. Activity terms (e.g., run) describe a dynamic and durative situation that has an arbitrary endpoint; i.e., it can be terminated at any time. In contrast, accomplishment terms (e.g. make a chair) describe a situation that is dynamic and durative, but has a natural endpoint after which the particular action cannot continue. Finally, achievement terms describe a situation that can be reduced to a point on a time axis, i.e., instantaneous and punctual. In the above schematization, the solid line is used to represent states, which last timelessly, without a beginning point or endpoint in its focus. The wavy lines for activities and accomplishments indicate the dynamic duration of an action, while x for accomplishments and achievements represents the punctual point of change of state, i.e., x signals telicity. In terms of semantic features, states are [-dynamic], [-telic], [-punctual]; Activities are [+dynamic], [-telic], [-punctual]; Accomplishments are [+dynamic], [+telic], [-punctual]; Achievements are [+dynamic], [+telic], [+punctual] (Andersen, 1991).

Lexical aspect has proved to be important in research on tense and aspect. In linguistic analysis, Smith (1997) proposed the two-component theory, a system in which the aspectual meaning of a sentence is determined by the interaction between lexical aspect and grammatical aspect.

For example, imperfective aspect (e.g. progressive in English) takes an internal view and therefore it is compatible with durative predicates of activity and accomplishment, and yields progressive meaning. In contrast, achievement, since it is non-durative, is not so compatible with imperfective aspect and such pairing is often anomalous (e.g., *He is noticing the error) or results in “preliminary stages” meaning (e.g., He is dying).

In acquisition, this interaction of lexical and grammatical aspect has been observed since the 1970s. Crosslinguistically, when children acquire tense-
aspect markers, they show strong association between (perfective) past tense marking and telic verbs (achievements and accomplishments), between general imperfective marking (such as French imperfect) and atelic verbs (states and activities), and between progressive (i.e. dynamic imperfective) marking and activity verbs (see Li & Shirai, 2000 for review). Psychologists and linguists alike have tried to explain this observation. One important proposal relies on innateness (the Language Bioprogram Hypothesis, Bickerton, 1981), while an alternative proposal is based on input frequency (Shirai & Andersen, 1995).¹

This paper discusses and evaluates the explanations that are offered for this semantic bias observed in language acquisition, focusing on the role of innate predisposition vs. input. Crucial in the discussion is the compatibility of lexical aspect with grammatical aspect. I will review how this semantic bias plays a crucial role in our understanding of language processing and language disorders.

2. Lexical and Grammatical Aspect in Language Acquisition

Bickerton (1981, 1984) proposed the Language Bioprogram Hypothesis, based primarily on his research on the genesis of creole languages. Observing that even genetically unrelated creole languages share common linguistic features in domains as varied as the causative construction, nominal specificity, and tense-aspect morphology. Bickerton hypothesized that these commonalties must come from a bioprogram—i.e., knowledge that is innately specified for all human children. Bickerton's argument is that the commonalties among genetically unrelated creole languages can be explained only if we postulate that children modify the pidgin input they are exposed to in ways that are compatible with the bioprogram.

In support of this hypothesis, Bickerton also discussed studies from first language acquisition, and claimed that the acquisition data support the bioprogram hypothesis. His general hypotheses regarding first language acquisition were:

(1) Children mark the distinctions that the bioprogram tells them to mark, even if these distinctions are not marked in the input language.

(2) Children do not have difficulty—i.e., they do not make errors—in acquiring the distinctions that are part of the bioprogram.

¹ In the first language acquisition literature, two other major explanations have been offered for this semantic bias: (1) cognitive limitation on the part of children (i.e. they cannot refer to remote past, and thus comment only on resultant state), (2) primacy of aspect over tense as linguistic categories (see Shirai 2009 for a detailed discussion).
Recent studies on the role of input in children's acquisition of tense-aspect morphology, however, offer an alternative explanation—namely, that the distribution pattern in the input influences children's category formation. In what follows, I will discuss these studies as an alternative to Bickerton's proposal that children's acquisitional patterns can only be explained by assuming that children are equipped with these distinctions.²

Bickerton (1981) postulated two types of distinctions that human children are innately endowed with in the domain of aspect: the SPD (the State-Process Distinction) and the PNPD (the Punctual-Non-Punctual Distinction), both of which he claimed are grammatically marked in all "true" creole languages as defined by him. He reviewed studies in the acquisition of French (Bronckart & Sinclair, 1973) and Italian (Antinucci & Miller, 1976) in support of the PNPD, and studies in English (Brown, 1973; Kuczaj, 1978) and Turkish (Slobin & Aksu, 1980)³ in support of the SPD.

Regarding the PNPD, it was observed that children acquiring French and Italian tend to attach past marking to 'punctual' (i.e., telic) verbs, but not to 'nonpunctual' (i.e., atelic) verbs (Bronckart & Sinclair, 1973; Antinucci & Miller, 1976). Based on this observation, Bickerton claimed that children are marking 'punctuality' (i.e., telicity) rather than pastness when they use past morphology. This, according to him, then supports hypothesis (1) above: namely, children mark the distinction that the bioprogram tells them to mark, even if the distinction is not marked in the input language.

Regarding the SPD, Bickerton claimed that, because children rarely (if ever) make the error of incorrectly attaching progressive marking to stative verbs, they must already know the distinction between state and non-state (i.e., process), thus supporting hypothesis (2): Children do not have difficulty—i.e., do not make errors—in acquiring the distinction that is part of the bioprogram.

Bickerton (1981, p. 163) thus suggests that the acquisitional patterns of tense-aspect morphology in these studies can only be explained by assuming an innate bioprogram. He admits that a bioprogram specification may not appear in child language in an explicit form, but argues that if there is some indication of a bioprogram at work, and if the phenomenon cannot be explained by other theories of acquisition, this should be a significant support for the bioprogram hypothesis.

² It should be noted that Bickerton (1999) presents a revised bioprogram. However, since his original proposal was the most influential in motivating subsequent research, and is still cited as important support for the innateness hypothesis of language, even in books written for the general public (Pinker, 1994; Jackendoff, 1994), I will focus on Bickerton (1981) in this paper. See Li and Shirai (2000) for a critique of Bickerton (1999).

³ I will not discuss Turkish in this paper.
Shirai and colleagues (Shirai, 1994, 2009; Shirai & Andersen, 1995; Li & Shirai, 2000) has proposed an alternative account for the acquisitional patterns of tense-aspect morphology which Bickerton had earlier attributed to the bioprogram. The proposal is that the pattern of acquisition is primarily driven by the distribution of the tense-aspect morphology in the input, and by children’s prototype-based category formation.

Bickerton (1981) evidently assumed that the distribution in the input has no significant consequences in the acquisitional patterns of tense-aspect morphology. In reviewing the acquisition of Italian (Antinucci & Miller, 1976), which shows that perfective past forms (referred to as ‘participials’) are only attached to ‘punctual’ (i.e., telic) verbs, and imperfective past forms only to activity verbs, Bickerton (1981) suggested that in child Italian, participials (i.e., perfective past) and imperfects (i.e., imperfective past) are in complementary distribution, the first being used for punctual (i.e. telic) verbs, the second for nonpunctual (i.e. atelic) ones. He, then, notes:

Note that this does not reflect anything in Italian grammar; all Italian verbs, whether punctual or nonpunctual, activity or change-of-state verbs, have both perfective and imperfective past tenses (p. 147).

But while it may be possible to attach perfective or imperfective past forms to any verb types, not all verb classes are evenly attached to perfective and imperfective past forms in real-life language use. There are natural relationships between perfective past and telic verbs (Bickerton’s punctual verbs) on the one hand, and between imperfective past and atelic verbs (Bickerton’s nonpunctual verbs), on the other. Leone (1990), cited in Andersen (1993), quantitatively establishes this association: in an adult-adult native speech sample (an interview) in Italian, perfective past forms are predominantly attached to telic verbs (see Table 1).

Particularly revealing is the almost exclusive use of perfective past forms for telic verbs (i.e., Bickerton’s punctual verbs). Note that this comes from adult-adult discourse, which generally shows less skewing in the direction congruent with the tendency observed by Bickerton (Stephany, 1981). If such distributional bias is present in the input, it is not surprising that children follow this trend in acquiring tense-aspect morphology. Shirai’s (1991) study, subsequently published as Shirai (1994) and Shirai and Andersen (1995), tested this hypothesis by investigating the use of verbal morphology by three children and their mothers: Adam and Eve (Brown, 1973) and Naomi (Sachs, 1983) from the CHILDES database (MacWhinney, 2000).

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4 See Shirai (1991) and Andersen & Shirai (1996) for a comprehensive review of the issue of distributional bias in the input in the use of tense-aspect morphology.
Table 1. Distribution of past forms and lexical aspect in Italian adult-adult speech (based on Leone, 1990)

<table>
<thead>
<tr>
<th></th>
<th>token count (%)</th>
<th>type count (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>elic</td>
<td>atelic</td>
</tr>
<tr>
<td>Perfective past</td>
<td>97</td>
<td>3</td>
</tr>
<tr>
<td>Imperfective past</td>
<td>28</td>
<td>72</td>
</tr>
</tbody>
</table>

Shirai and Andersen (1995) report that children’s early past marking is predominantly restricted to achievement verbs (see Table 2). This supports one of the predictions of Bickerton’s bioprogram hypothesis. At the earliest, emergent stage of past tense verbs, most of the past inflections are attached to achievement verbs (i.e., [+punctual], [+telic]). In the acquisition of English verbs, children use the bare stem as the all-purpose verbal form at the earliest stage (Brown, 1973). Then gradually they begin to attach verbal morphology on selective verb forms. What happens here is underextension of past morphology; children rarely overextend past tense morphology to inappropriate contexts (Brown, 1973; Kuczaj, 1976). Then gradually children extend the application of past tense morphology to contexts that deviate from this initial verb class—i.e., they attach past morphology to atelic (Bickerton’s non-punctual) verbs, thus approximating the adult norm. Bickerton would argue that this provides further support for the bioprogram hypothesis.

At the same time, however, Shirai and Andersen (1995) also found that the caretakers’ past marking is likewise skewed in a direction congruent with the children’s nearly absolute trend: approximately 60% of past-tense markers in the caretakers’ input occurred with achievement verbs. It may have been this high correlation of punctuality with past morphology that resulted in the near absolute tendency observed in the children’s output (see Table 2, adapted from Shirai, 1991):

Table 2. Distribution of past tense morphology and lexical aspect in children’s and mothers’ speech at the earliest stage (percentage based on token count)

<table>
<thead>
<tr>
<th></th>
<th>state</th>
<th>activity</th>
<th>accomplishment</th>
<th>achievement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Children</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>98</td>
</tr>
<tr>
<td>Mothers</td>
<td>17</td>
<td>10</td>
<td>13</td>
<td>60</td>
</tr>
</tbody>
</table>

5 Children’s earliest use of past morphology is associated with situations with clear end results, although this will not be discussed to simplify the discussion. See Shirai and Andersen (1995) for details.
Let us now turn to the acquisition of progressive marking, which concerns both the PNPD and the SPD. First, Bickerton (1981) claimed that children acquiring English first mark ‘non-punctuality’ (i.e., imperfective) using -ing, and then later mark ‘punctuality’ (i.e., telicity) by using irregular past. Shirai and Andersen (1995) showed that the earliest use of progressive marking by the three children is predominantly on activity verbs, which is in line with Bickerton’s claim that children acquiring English mark ‘nonpunctuality’ (i.e., lack of telicity) by -ing. This again, however, can be attributed to input: Approximately 60% of the mothers’ uses of progressive –ing are with activity verbs (Shirai & Andersen, 1995).

Regarding the SPD, Bickerton’s prediction was that children will not make the error of incorrectly attaching progressive marking to stative verbs; this is because children know in advance the distinction between states and non-states (i.e., what Bickerton calls processes). Shirai (1994), however, showed that children do incorrectly attach progressive marking to stative verbs. It was found that one of the three children studied (Naomi) used progressive marking with state verbs, and some of the uses were obviously ungrammatical from the adult’s point of view (e.g., *seeing light, *needing).

The study further showed that the pattern of error may be guided by parental input: the child who made frequent errors of this type (Naomi) was exposed to maternal speech in which the ratio of progressive used with stative verbs (a usage that is not necessarily ungrammatical; see Smith, 1983) is higher than observed in the speech of the caretakers of the other two children in the study (see Table 3). In fact, the other two mothers never used progressive with stative verbs in the samples analyzed.

Table 3: The percentages of stative verbs used with progressive marking by the children and their mothers (token frequencies in parenthesis)

<table>
<thead>
<tr>
<th></th>
<th>Child</th>
<th></th>
<th>Mother</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Adam</td>
<td>0.2%</td>
<td>(1)</td>
<td>0%</td>
<td>(0)</td>
</tr>
<tr>
<td>Eve</td>
<td>1.7%</td>
<td>(5)</td>
<td>0%</td>
<td>(0)</td>
</tr>
<tr>
<td>Naomi</td>
<td>3.4%</td>
<td>(23)</td>
<td>3.8%</td>
<td>(20)</td>
</tr>
</tbody>
</table>

In sum, the evidence from language acquisition that Bickerton discussed to support his bioprogram hypothesis can be accounted for by input-based learning. The strong initial correlation between punctual/telic verbs and past marking, and that between progressive/imperfective marking and atelic verbs, which Bickerton interpreted as children’s bioprogram-based marking of the punctual-nonpunctual distinction, can instead be attributed to the skewed distribution in the input. The lack of overextension of stative verbs, which supports Bickerton’s state-process hypothesis, was not observed in
Shirai (1994), and the (incorrect) use of stative progressive by children was attributed to input. In the next section, a possible mechanism behind such a learning pattern is discussed.

3. Distributional Learning and Prototype-based Initial Representations

Although the importance of input and particular organizations of target linguistic structures for acquisition studies has been stressed by many researchers (e.g., Bowerman, 1985; Ochs, 1985; Clancy, 1989; Lieben, 1994), the actual analysis of how input contributes to the initial representation of linguistic forms was not systematically attempted for a long time. Budwig (1996, p. 143) notes that although language acquisition research has shown that children link the use of particular linguistic forms with particular meanings/functions in ways not necessarily identical with the adult model, little investigation has been undertaken regarding the basis for such linkage.

Budwig’s studies are particularly relevant to the present discussion in that she started out from the constructivist position that children will associate particular linguistic forms with some conceptual units that are cognitively salient (Budwig, 1986, 1989). It was indeed found that 3 of the 6 children she studied associated the first person nominative pronoun I with low agentivity and control, while associating the genitive my and accusative me with high agentivity and control. More specifically, these children used my/me in situations where they acts as prototypical agent, often by attempting to use language to bring about change (i.e., to control the situation around the child), as in Me open that. On the other hand, I was often used with stative verbs, which are low in agentivity and control, in that stative verbs normally do not refer to agentive actions. Budwig (1989) suggested that these children are marking agentivity and control, which are closely related to the linguistic notion of transitivity (Hopper & Thompson, 1980), by using distinct forms, disregarding the adult model. This is in line with Slobin’s (1985) Basic Child Grammar, which suggests that children use specific linguistic forms to mark a scene involving prototypical agents.

Budwig (1996), however, investigated the input to these three children, and found that 59% of caretakers’ uses of nominative I involved a state verb, such as I like..., I think.... Also, 61% of their use of I functioned as

\[ \text{This distribution is surprising in view of the low frequency of state verbs in child-directed speech generally (and possibly in adult-adult speech as well); only about 35-38% of all verbs used by three mothers in mother-child interaction were statives (Shirai, 1991). In the same vein, it is remarkable that about 60% of past tense markings, and of progressive marking used by the mothers are on achievements verbs and activity verbs respectively when we consider the fact that frequencies of stative, activity and achievement verbs are approximately the same in mothers’ speech to children (Shirai, 1991).} \]
non-control acts. This means that there was a high correlation of stativity, which is low in agentivity and control, with the caretakers’ use of I. Thus, Budwig suggests that the input distribution may be the source of children’s acquisitional pattern.

The interesting convergence of figures between Shirai’s and Budwig’s studies—60%—is suggestive. Shirai’s study also suggests the possibility that when 60% of a particular linguistic form is associated with one particular meaning or function, then children may associate it as if the association is absolute; about 60% of past tense morphology and progressive morphology was used with achievement ([+punctual, +telic]) and with activity ([+dynamic, -telic]), respectively, in the mothers’ speech, and children initially restricted these morphological markings to those types of verbs almost exclusively.\(^7\)

The mechanism behind this input-driven early restriction is probably that of distributional analysis and prototype formation (see Shirai & Andersen, 1995; Andersen & Shirai, 1996). Children are not just passively imitating what caretakers say. They actively reorganize their linguistic representations based on the distributional information in the input, and create the initial prototype. In the case of tense-aspect morphology, children appear to be guided by lexical aspectual features such as telicity and punctuality in creating the initial prototype, while in the case of Budwig’s pronominal case acquisition, the three children are guided by the notion of agentivity and control. When the initial prototype does not coincide with the adult model, it results in underextension (past, -ing, and I), and/or overextension (My/me).\(^8\)

If we assume this type of learning mechanism on the part of children, we do not need to posit an innate bioprogram to explain the pattern of past tense acquisition in Bronckart and Sinclair (1973) and Antinucci and Miller (1976), which Bickerton used as supporting evidence for his bioprogram hypothesis.

The lack (or presence) of stative progressive (i.e., progressive marking used with state verbs) can also be accounted for by distributional analysis and prototype formation. As noted above, the English progressive shows

\(^7\) It should be noted that in the case of Italian, perfective past is used with telic verbs more than 95% in adult speech (see Leone 1989, discussed above), which surely would contribute to the initial restriction of perfective past to telic verbs by children in Antinucci and Miller (1976).

\(^8\) There are many studies that have investigated how prototypes of natural and artificial categories are formed, which have shown that people form prototypes based on the exemplars they encounter (e.g. Posner, 1969), although the frequency alone cannot determine the prototype formation (Rosch, Simpson, & Miller, 1976). However, the study of how prototypes of polysemous linguistic forms are acquired is still quite limited, and is an area that needs further investigation (but see Johnson, 1999; Rice, 1999; Kid & Cameron-Faulkner, 2008).
the case of underextension at the early stages, and therefore overextension of ANY type is rare. Furthermore, stative progressive was non-existent\(^9\) in the speech of two mothers, which would give their children no association between -\textit{ing} and stative verbs. The child (Naomi) whose mother frequently used progressive with stative verbs likewise produced stative progressives, including incorrect use (i.e., overextension). It appears that the prototype scenario accounts for the observed data very well.

Further, this input-based prototype formation has been tested by a computer simulation utilizing a connectionist network. Li and Shirai (2000, Ch.7, see also Zhao & Li, 2009) report a simulation of the acquisition of English as a first language by exposing a self-organizing network to realistic input taken from the CHILDES database, which showed a pattern of acquisition very similar to that observed in human children. This is important in that the network did not use “back-propagation” in which the network is ‘taught’ how its output differs from the target. Thus, by using unsupervised learning for this simulation, Li and Shirai (2000) bypassed the no-negative evidence problem. The fact that this input-based prototype formation model can be implemented on a connectionist network without negative evidence suggests that it is a realistic and viable model of grammatical development.

One caution needs to be given regarding the universality of the initial prototype created through distributional learning: the initial prototype may differ depending on various factors, such as input frequency, learner characteristics, and the nature of the linguistic category to be acquired. Let us consider learner characteristics, or individual differences. Of the six children studied by Budwig (1996), three of them did not show any association of \textit{I} with low agentivity/control and of \textit{my/me} with high agentivity/control, even though the caretakers’ speech to all six children had a similar distributional bias with regard to the relationship between first person pronoun use and agentivity/control. Shirai (1993, 1998) investigated Japanese tense-aspect acquisition, and some children showed association of the -\textit{te i-} form (durative aspect marker which mainly refers to progressive and resultative situations) with activity at the earliest stages, but there was also a child who showed no preference for activity verbs. This child, when he started using -\textit{te i-} in the nonpast form (i.e., -\textit{te i-ru}), also used it in the past tense form -\textit{te i-ta}, which appears much later than the present form in other children. The child also used it with verbs of various lexical aspectual values. This child can be regarded as a conservative learner (at least in this

\(^9\) Stative progressives do occur in adult-adult speech. Robison (1995) reports 5.4% (22 out of 407) of the progressive forms used in his data sample (adult native speech in American English) were stative progressives. See Shirai (1994) for further discussion.
particular linguistic domain) and therefore did not produce this form until he was comfortable with it. This kind of conservatism may result in linguistic behaviors that are comparable to the adult model right from the beginning. (It is therefore possible that the three children in Budwig’s study who did not show any semantic/functional bias may have been conservative in this particular linguistic domain.) In any event, given all these factors, it is not realistic to predict that all children will go through the same prototype formation.

4. Lexical and Grammatical Aspect in Language Processing

The notion of compatibility is crucial when we discuss the interaction of lexical and grammatical aspect because some combinations are more natural, prototypical, and frequent. Telic verbs are more compatible with perfective aspect, while activities are most naturally associated with progressive marking. This is reflected in frequency distribution cross-linguistically (Andersen & Shirai, 1996). For example, about 60% of past tense markers in child-directed speech in English were attached to achievement verbs.

This frequency effect is not yet well-recognized in the area of language processing. Madden and Zwaan (2003) and Feretti, Kutas and McRae (2007) found a strong effect of grammatical aspect in their experiments on aspectual processing, but they did not manipulate the effect of lexical aspect. Although Madden and Zwaan (2003) found a facilitating effect of perfective aspect on processing but not of imperfective aspect, their experiments used only accomplishment verbs, which are telic and therefore more compatible with perfective aspect (i.e. past tense in English, in this case). More recently, Yap et al. (2009) replicated facilitating effects of perfective aspect with accomplishment verbs, and in addition, of imperfective (progressive) aspect with activity verbs in Cantonese. Thus, the interaction of lexical and grammatical aspect is pervasive and cannot be ignored in any research involving aspectual phenomena.

5. Lexical and Grammatical Aspect in Language Disorders

In the area of language disorders, Leonard et al. (2007) provide important data concerning the difference between typically developing (TD) children and children with Specific Language Impairment (SLI). In a production experiment, they compared SLI children with both MLU-matched and age-matched TD children for the accuracy of production of regular past tense and past progressive in English. The following table is adapted from their Tables 1 and 2. The study looked at 16 children from each group, but results here exclude children who scored 100% (because of a ceiling effect), although the trends were essentially the same in both analysis.
What they found for TD children was exactly what the prototype hypothesis predicts: They were more successful in producing past tense with prototypical past tense verbs (punctual, telic, result), while being more successful producing progressive -ing with prototypical progressive verbs (durative, dynamic, atelic). What is interesting was that there was no significant effect of lexical aspect for SLI children. We tend to see children’s initial restriction to prototypes as a limitation—hence defective. However, these results show that TD children’s ability to create semantic prototypes is an important ability for making generalizations concerning form-meaning relationships, which seems to be lacking in SLI children. The ability to create a semantic prototype as “a starting point” (Leonard et al., 2007) seems to be essential for efficient development of adult-like morphological representation.

Table 4: Percentages producing the target item for Children not performing at ceiling (adapted from Table 1 and 2 from Leonard et al., 2007)

<table>
<thead>
<tr>
<th></th>
<th>SLI (N=16)</th>
<th>TD-MLU (N=15)</th>
<th>TD-Age (N=10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>prototypical -ed</td>
<td>37</td>
<td>83*</td>
<td>97*</td>
</tr>
<tr>
<td>non-prototypical -ed</td>
<td>33</td>
<td>69</td>
<td>85</td>
</tr>
<tr>
<td></td>
<td>(N=14)</td>
<td>(N=10)</td>
<td>(N=8)</td>
</tr>
<tr>
<td>prototypical -ing</td>
<td>58</td>
<td>59*</td>
<td>81*</td>
</tr>
<tr>
<td>non-prototypical -ing</td>
<td>64</td>
<td>41</td>
<td>65</td>
</tr>
</tbody>
</table>

(Note) *significant effect of lexical aspect

6. Discourse Motivation

Given that we observe such pervasive prototype effects, one needs to ask where such frequency bias comes from. Why is it that native speakers of a language, for example, universally want to attach past tense marking to achievement verbs more frequently? Is there something innate working here?

The answer to this question was given by Roger Brown almost 40 years ago. Namely, an achievement verb is used to describe a situation of such a short duration that when we want to comment on it, it is almost always over with, and that is why there exists a strong association between past tense and achievement verbs (Brown, 1973). In the same vein, when we talk about an ongoing situation, it is more likely that an activity verb is used than an achievement verb, because an instantaneous situation cannot normally be ongoing when you want to comment on it, and thus activity is
strongly associated with progressive marking. When we talk about a state of, say, someone being beautiful (*she is beautiful*), we tend to talk about a present state rather than a past state (*she was beautiful*), and hence a strong association between simple present tense and state verbs (see Andersen & Shirai 1994 for further elaboration of these associations; also Bohemier & Swift, 2004). In other words, when we use a grammaticized tense-aspect marker, it is used more frequently in one context than others based on discourse motivation, and since such discourse motivation has some level of universality, tense-aspect marking has similar frequency distribution across languages. This results in universal association in use, acquisition, and processing.

Bickerton’s bioprogram argument from creole genesis can also be countered by the notion of discourse motivation. His main arguments are that creole languages, which are created in a linguistic vacuum, have a lot in common with each other even though they are genetically unrelated. He claims this as important support for his bioprogram hypothesis. As it relates to tense-aspect-modality, creoles have anterior tense markers, non-punctual (imperfective) markers, and irrealis markers (which denote that the situation referred to is non-factual) in common. Givón (1982), however, offers a plausible alternative explanation based on the communicative functions of these markers. Anterior reference, non-punctual situation, and irrealis are all ‘marked’ in narratives, and speakers simply need to give linguistic marking to the listener. This is how these markers have come to be grammaticized in creoles, Givón argues.\(^\text{10}\)

7. Conclusion

In this paper I reviewed research on the association between tense-aspect forms and lexical aspect, and how they are reflected in language acquisition, processing, and disorders. Namely, there are strong associations in terms of frequency bias between past/perfective and telic (achievement/accomplishment) verbs, and progressive marking with activity verbs in discourse, and this results in ease of acquisition and processing. Although it has been argued that such ease of acquisition is due to innate constraints, I

\(^\text{10}\) In fact, Bickerton (1981, pp. 282-286) also gives a similar account which attributes this phenomenon to our ability to make important distinctions such as that between foreground and background, between observable events and unobservable events, and so forth; the difference between Givón and Bickerton is that one attributes it to children’s capacity to create a system of efficient communication (Givón), while the other attributes it to pre-wiring, claiming that it is encoded in our genes through our evolutionary process (Bickerton). The point is that Givón’s functional argument is a good alternative account to Bickerton’s bioprogram account for creole genesis.
have argued that a more reasonable explanation is frequency-based learning/processing principles that language learners/users employ. The frequency bias does not come from innate constraints either; rather, it comes from discourse motivation. The strong association observed is due to how a particular combination is required in the need of communicating what we often describe in discourse.

Although this paper focuses on the domain of tense-aspect, similar discourse-motivated frequency bias can be found in other areas. In the domain of relative clauses, for example, it has been observed that subject relatives are easier than object relatives in acquisition and processing (see, for example, Shirai & Ozeki 2007 for discussion). Although this has been considered to be based on structural complexity (e.g. Keenan & Comrie, 1977; Gibson, 1998), recent research shows that frequency bias (coming from discourse motivation) in fact can alter this subject-object asymmetry (Kidd et al., 2007; Reali & Christiansen, 2007; Mak, Vonk, & Schriefers, 2002). Although this issue is far from resolved, we should at least consider frequency bias in language use as a possible explanation in various domains of universals observed in language acquisition and processing, before attributing them to innate constraints.

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