Multiple property models of lexical categories[1]

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Abstract

In multiple property models of lexical categories, the assignment of a word to a lexical category is determined by a set of properties associated with that category. Specifically, if a word displays a sufficient number of properties associated with a given category, it will be assigned to that category. The current article critically evaluates multiple property models of lexical categories. In particular, it focuses on a multiple property model recently developed by Aarts (2007b) and a variety of other such models. It is argued that multiple property models encounter problems in four key areas. Firstly, they struggle to determine an appropriate set of lexical categories and to provide coherent accounts of the nature and function of such categories. Secondly, they encounter difficulties in determining the properties that define categories and in determining features of properties such as whether they should be weighted or not. Thirdly, a variety of problems arise when multiple property models combine words, properties and categories together. Finally, multiple property models fail to account for crosslinguistic data. It is concluded that multiple property models do not provide viable accounts of lexical categories.

1. Introduction

Although a number of recent studies have argued that lexical categories can be defined in terms of a single syntactic or semantic property such as case, referentiality or time stability (e.g., Baker 2003: 15; Givón 1979: 320–321; Haegeman 1991: 178–180; Hengeveld 1992: 58; Stassen 1997: 15–16; Wunderlich 1996: 4–6), there has also been a strong contemporary trend towards defining lexical categories in terms of multiple properties (e.g., Aarts 2007b: Ch. 8; Bhat 1994: 12–15; Crystal 2004 [1967]: 204; Culicover 1999: 60; Gross 1979: 860; Hopper and Thompson 1984: 709; Huddleston 1984: 318; Onnis and Christiansen 2008: 184–188; Pullum 1991: 779; Quirk 2004 [1965]: 333;

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Plank 1984: 496–509; Ramat 1999: 166; Ross 2004 [1973]: 373; Schachter 1985: 6; Stassen 1997: 14; Thompson 1988: 181; Wetzer 1992: 225). A key virtue of models which define lexical categories in terms of multiple properties is that they can cope with the varying patterns of properties that the words within a language exhibit. As an example of this, consider the adjective category in English. As Aarts (2007b: 209–210) has observed, the adjective *happy* displays a number of key adjectival properties such as the ability to occur in attributive and predicative positions, the ability to take the prefix *un-* and the ability to be intensified and graded, e.g.,

(1) a. *a happy woman* (attributive position)
b. *She is happy* (predicative position)
c. *very happy* (intensification)
d. *happy|happier|happiest* (gradedness)
e. *unhappy* (*un-* prefixation)

However, these five properties are not exhibited by all English adjectives as Aarts demonstrates with the following table (adapted from Table 8.2. in Aarts 2007b: 210):

Table 1. *Adjective criteria*

	Attributive	Predicative	Intensification	Gradedness	*un*-prefix
happy	+	+	+	+	+
thin	+	+	+	+	−
afraid	−	+	+	+	+
alive	−	+	+	?	−
utter	+	−	−	−	−

As Table 1 indicates, each of the five adjectives exhibits a different pattern of properties from the other adjectives. Moreover, none of the five properties is a necessary property of adjectives since all five properties fail to be exhibited by one or more of the words. Clearly, any account which defined the adjective category in terms of a single, necessary property would wrongly exclude one or more of the five adjectives from the category. Thus, an account which stipulated that it was necessary for all adjectives to be able to occur attributively would wrongly exclude *afraid* and *alive* from the adjective category. In contrast, an account which stipulated that adjectives need only display some combination of the five properties would include all five adjectives. In this way, then, defining the English adjective category in terms of multiple, non-necessary properties allows the category to include a wide range of adjectives

even though such adjectives may differ greatly in terms of the patterns of properties that they exhibit. Moreover, the variation demonstrated in Table 1 is not confined to the English category but is present in most categories in most languages (on this point cf. Bhat 1994: Ch. 2; Bloomfield 1933: 269; Crystal 2004 [1967]: 209; Culicover 1999: 63; Goldberg 2006: Ch. 3; Gross 1979: 860; Hunston and Francis 2000: Ch. 5; Pinker 1989: 126–127; Plank 1984: 510–511; Quirk 2004 [1965]: 333; Ross 2004 [1973]: 373). The French verb *ravoir* 'to get back', for instance, cannot occur as a finite verb but only as an infinitive, e.g.,

(2) *Je lui ai prêté un livre, je veux le ravoir*.[2]

Indeed, the only categories likely to be immune from such variation are extremely small categories such as the adjective categories of languages such as Chichewa (Baker 2003: 247) and Jarawara (Dixon 2004: 177).[3] As a result, multiple property approaches to lexical categories may be required not only for English adjectives but also for most lexical categories in most languages.

As well as allowing lexical categories to accommodate the variation observed within individual languages, multiple property models allow lexical categories to accommodate the variation observed between languages (e.g., Anward et al. 1997: 168; Bhat 1994: 13; Croft 1991: 42; Dik 1989: 162; Haspelmath 2007: 119; Hengeveld 1992: 50; Plank 1984: 510–512; Ramat 1999: 169; Sasse 1993: 647; Schachter 1985: 5). Thus, just as no one property tends to be exhibited by all of the members of a category within an individual language, so no one property tends to be exhibited by all instances of a category throughout the world's languages. A common nominal property such as occurring with definite and indefinite articles, for instance, is not a necessary property of nouns from a crosslinguistic perspective since it is not exhibited by nouns in languages such as Latin as the following example from Blake (2001: 9; cf. also Hudson 2004: 8–9) indicates:

(3) *Mīlitēs vident urbem*
'The troops see the city.'

Similarly, a typical verbal property such as tense marking is not a necessary property of verbs from a crosslinguistic perspective since it is not exhibited by verbs in languages such as Mandarin Chinese as the following example from Tiee (1986: 97) demonstrates:

(4) *Zuótiān tā xiě zì*
yesterday he write word
'He wrote yesterday'

Defining nouns in terms of the single property of co-occurrence with articles or verbs in terms of the single property of tense, therefore, would wrongly suggest that Latin lacked nouns and Mandarin Chinese lacked verbs. Consequently, just as multiple, non-necessary properties may be needed to encompass all of the members of a category within an individual language, so multiple, non-necessary properties may be needed to encompass all examples of a given type of category in the world's languages. For this reason, Bhat (1994: 12–15) defines the adjective category in terms of a set of non-necessary properties such as allowing degree modification. On Bhat's view, all languages which possess an adjective category will exhibit some pattern of properties from this set even if no one property is exhibited by all such languages.

In the current article, multiple property models of lexical categories will be critically assessed. The article will focus on one such model, namely that recently developed in a book and a series of articles by Aarts (2004; 2007a; 2007b). Aarts' model is focused on because it is the most comprehensive, detailed and explicit multiple property model of lexical categories that has so far been developed. A second reason for focusing on Aarts' model is that it is close to an optimal design for a multiple property model in terms of its power and elegance. However, the overall aim of the article is not to assess Aarts' model but the class of multiple property models of lexical categories in general. For this reason, the article will not restrict itself to an evaluation of Aarts' model but will also consider a wide range of other multiple property models which diverge from the design of Aarts' model in key respects. Doing so is particularly important because Aarts (2004; 2007a; 2007b) applies his model almost exclusively to English. The current article also focuses largely on English data as a result of its emphasis on Aarts' model. However, Section 3.4 considers how the problems raised in relation to data from English in previous sections might apply to other languages and what distinctive problems arise when multiple property models such as Aarts' are applied to crosslinguistic data. The article begins in Section 2 by outlining the key features of Aarts' model and in Section 3 a variety of different problems associated with multiple property models such as Aarts' are evaluated. In particular, Section 3 considers the problems that are involved in determining the components of multiple property models such as lexical categories and the sets of properties associated with them and also the problems that are involved in combining these components together. It is argued that Aarts' model is afflicted by a number of severe problems. It emerges that many of these problems are shared amongst multiple property models in general. Moreover, where changes to Aarts' model serve to ameliorate a given problem they will also typically exacerbate other problems associated with Aarts' model or introduce novel problems. As a result, the current article concludes that a wide range of severe problems are associated not only with Aarts' model but with multiple property models of lexical categories in general.

2. Features of Aarts' model

Aarts (2004; 2007a; 2007b) argues that in order to ascertain the lexical category of a word we first need to determine the properties possessed by that word. These properties all act as clues to the lexical category of a word because they are all themselves associated with a particular category. Once we have determined the properties that are associated with our given word, we simply need to count them up. We then assign the word to a specific category on the basis of the Best Fit Principle (Aarts 2007b: 213–214; Hudson 1990: 45; 2006: 48; Plank 1984: 499–501). This states that we should assign a word to whichever category it possesses the most properties of. Thus, if a word has more properties associated with the noun category than with any other category, then we assign it to the noun category. One effect of the Best Fit Principle is that it allows us to assign a word to a category even if it does not possess all of the properties associated with that category. This point can be illustrated in relation to Table 1 above. Crucially, all five of the words in the table are categorized as adjectives in Aarts' (2007b: 209–210) model even though none of them apart from *happy* possess all five adjectival properties because they all possess more adjectival properties than properties from any other category. Thus *utter* only possesses a single adjectival property but because it does not exhibit any other properties it still possesses more adjectival properties than properties from any other category. As a result, it qualifies as an adjective via the Best Fit Principle. While stating that all five words are unambiguously members of the adjective category, however, Aarts (2007b: 210) does also acknowledge that *happy* possesses the most adjectival properties and is thus the most prototypical adjective within this set while *utter* possesses the fewest adjectival properties and is thus the least prototypical adjective in the set. Aarts refers to this tendency of words to differ in prototypicality using the term subsective gradience (for a critique of the view that lexical categories are subsectively gradient cf. Newmeyer 2004 [2000]: 487–491).

Another notable feature of Table 1 is that no one property is possessed by all five adjectives. That no property is necessary for category membership is a typical feature of multiple property models (e.g., Aarts 2007b: Ch. 8; Bhat 1994: 12–15; Crystal 2004 [1967]: 204; Culicover 1999: 60; Ramat 1999: 166; Schachter 1985: 6; Wetzer 1992: 225). However, multiple necessary properties are sometimes employed in models of categories which combine properties from other categories together such as gerunds. Thus, Hudson (2003: 599–602) and Pullum (1991: 779) argue that certain nominal properties such as occurring in argument positions and certain verbal properties such as taking arguments will necessarily be exhibited by all gerunds. Such models could be termed Aristotelian since they define their categories in terms of multiple necessary properties (on this point cf. Braisby [2005: 169]; van der Auwera and Gast

[2010]). Clearly, if this Aristotelian approach were applied to the adjective category and all of the five adjectival properties listed in Table 1 were necessary then only *happy* would gain entry to the adjective category. Because it would exclude so many words from categories such as the adjective category, an Aristotelian model would need to create many more categories in order to accommodate them. Thus, just accommodating the four excluded words from Table 1 might require as many as four new categories since each word displays a different pattern of properties. By rendering properties non-necessary, then, Aarts makes his categories highly inclusive in the sense that they are able to contain a much wider range of words than an Aristotelian model. This in turn allows Aarts' model to avoid splitting categories into a large number of very small categories. Defining the adjective category in terms of a single necessary property rather than multiple necessary properties would also render the category more inclusive and thereby reduce the need for category splitting (for examples of single property models cf. Baker 2003: Ch. 1; Hengeveld 1992: 58; Wunderlich 1996: 4–6). Thus if a word needed only to occur in predicative position to count as an adjective then most of the adjectives in Table 1 would gain entry to the adjective category. Yet while such a single property model would be fairly inclusive (although not as inclusive as Aarts' model), the decision to select one property as the sole determinant of category membership while excluding others from this role is necessarily arbitrary, or as Croft (2001: 31) puts it, "methodologically opportunistic". In contrast, multiple property models do not necessitate the arbitrary exclusion of properties and base membership of a category on a comprehensive survey of the properties of category members. Thus, in Table 1, Aarts' model takes account of five adjective properties and at other points his model takes account of a range of other adjective properties as well (cf. Aarts 2007b: 156–158).

A further effect of the Best Fit Principle employed by Aarts is that it allows his model to assign a word to a category even if that word possesses some properties associated with a different category. Aarts (2007b: 210) illustrates this point via some sentences featuring the gerund *painting*:

(5) a. *Brown's deft painting of his daughter is a delight to watch.*
b. *I dislike Brown painting his daughter*.

Aarts (2007b: 210) argues that *painting* in Example (5a) has five nominal properties: (1) it co-occurs with a genitival determinative; (2) it is modified by an adjective; (3) the string which it heads is in a typical nominal position; (4) it takes a PP complement; and (5) it can be followed by a restrictive relative clause, e.g.,

(6) Brown's deft painting of his daughter that I bought is a delight to watch.

Aarts also claims that *painting* in Example (5a) has a single verbal property, namely its *-ing* ending. For Aarts, the fact that *painting* in Example (5a) possesses more noun than verb properties shows it is a noun rather than a verb. He also acknowledges that since it does possess a verbal property it should be regarded as a noun which approaches or, as he puts it, strongly converges on the verb class. Aarts (2007b: 211) further argues *painting* in Example (5b) has seven verbal properties: (1) it co-occurs with a nongenitival subject; (2) it takes a verbal ending; (3) it has an NP object; (4) it can be preceded by a manner adverb as in Example (7a); (5) it can be preceded by the negative particle *not* as in Example (7b); (6) it can be passivized as in Example (7c) and (7) it can co-occur with auxiliaries as in Example (7d), e.g.,

(7) a. *I dislike Brown deftly painting his daughter*.
b. *I dislike Brown not painting his daughter*.
c. *I dislike his daughter being painted by Brown*.
d. *I dislike Brown having been painting his daughter*.

Aarts also claims that *painting* in Example (5b) has a single nominal property in that the string which it heads is in a typical nominal position. For Aarts (2007b: 211), the fact that *painting* in Example (5b) possesses seven verbal properties and one nominal property means that it is a verb which strongly converges on the noun class.

Aarts refers to this tendency for the words within a category to possess properties associated with other categories as intersective gradience. Were a word to possess equal numbers of properties from different categories, it would thwart the process of categorization within Aarts' model since the Best Fit principle would be unable to assign the word to one category or another. However, Aarts (2007b: 228–233) argues that words which possess an equal number of properties from two different categories (or as he terms them, hybrids) are extremely rare and cites evidence from van der Wurff (1997) in support of the notion that the diachronic evolution of English has tended to resist hybrids. Thus, in almost all cases, gerunds such as *painting* are not hybrids but can successfully be assigned either to the noun category or to the verb category using the Best Fit Principle. Aside from hybrids, the Best Fit principle ensures that there are sharp boundaries between categories and that words are firmly assigned to one category or another. Were a word to possess six category α properties and five category β properties, for instance, the fact that it possesses one more category α property would be sufficient to place it firmly in category α according to the Best Fit Principle (Aarts 2007b: 226). In Aarts' model, there is no fuzzy middle ground between categories for a word to inhabit.[4] Aarts also notes that intersective gradience is a source of subsective gradience. Specifically, Aarts (2007b: 208) claims that if a word possesses all of the properties of

category α and also a property of category β it will not be a prototypical member of category α (in contrast to a word which possesses all of the properties of category α and none of category β). Thus, *painting* exhibits subsective gradience in Example (5a) since it possesses a single verbal property and is therefore a less than prototypical member of the noun category.

In Aarts' (2007b: 225) model, all of the properties which are used to determine both subsective and intersective gradience are "strictly morphosyntactic in nature" (Aarts 2007b: 225). In particular, neither phonological nor semantic properties determine whether a word or phrase is a member of a category or how prototypical a member of their category they are. Aarts (2007b: 207) states that words and phrases can be said to "weakly converge" on a category when they possess semantic properties belonging to that category but this has no real impact on the issues of subsective or intersective gradience in his model. In Aarts' model, properties are also subject to the following constraint (on this point cf. Aarts 2004: 39; 2007b: 227–228; Culicover 1999; 38):

(8) Uniqueness Constraint: Each property is associated with a single lexical category only.

Thus, because the ability to occur attributively forms part of the set of properties associated with English adjectives it cannot also form part of the set of properties associated with English nouns. Consider, for instance, the following example from Aarts (2007a: 436):

(9) a. *barrier system*
b. *red barrier system*
c. *barriers system*

Aarts (2007a: 436–437) argues that the word *barrier* in Example (9a) exhibits predominantly noun properties in that it can be modified by an adjective as in Example (9b) or pluralized as in Example (9c). Even though it is a noun, however, the property of occurring attributively which it also exhibits is only associated with adjectives and not with nouns in Aarts' model. As a result, the fact that *barrier* occurs attributively gains it a single adjective property so that it is regarded as a noun converging on the adjective class in Aarts' model. A further important aspect of Aarts' model is that it does not weight properties. To determine the score for each of the adjectives in Table 1, for instance, we simply count up the number of properties that each adjective possesses. No property contributes more to the final score than any other (on this point cf. Aarts 2007b: 225–227).

In order to determine the set of the lexical categories and the sets of properties that feature in his model, Aarts (2007a: 432–433) begins by aprioristically

assuming both a set of lexical categories and a set of properties for each lexical category. Aarts (2007b: 154; cf. also Crystal 2004 [1967]: 194) repeatedly constrains the set of categories and properties in his model by means of Ockham's Razor so that we might describe his model as being subject to the following constraint:

(10) Economy Constraint: Models employing fewer categories and properties are preferable to those employing a greater number of categories and properties.

One example of this is Aarts' (2007b: 213) elimination of the gerund category by placing all gerunds such as *painting* in either the noun or verb category.[5] Aarts also proposes to eliminate a range of other lexical categories for reasons of economy by subsuming their members under other lexical categories. Thus, Aarts (2007b: 154) follows Emonds (1976) in subsuming members of the conjunction category under the category of prepositions and observes that this leads to "a more streamlined (and hence more learnable) grammar". The economy of Aarts' model is also enhanced through the elimination of syntactic properties. As noted above, for instance, Aarts (2007b: 225) excludes phonological and semantic properties from the sets of properties determining category membership. Aarts also effects the elimination of syntactic properties by means of subcategorization. In subsuming conjunctions under prepositions, for instance, Aarts (2007b: 154) suggests that the syntactic property of taking a clausal complement formerly associated with conjunctions should form part of a subcategorization frame associated with the newly expanded category of prepositions so that prepositions can take either nominal or clausal complements. This subcategorization frame, however, does not form part of the set of syntactic properties determining membership of the new preposition category and so does not bear on issues such as subsective gradience (Aarts 2007a: 439). As such, it further streamlines the set of syntactic properties associated with prepositions. The drive towards economy in Aarts' model is counterbalanced by other principles. Thus Aarts (2004: 38–39) argues that modification by a manner adverb or by a negative particle should be regarded as separate properties rather than being merged together into a single property "because adverbial modification and negation can be instantiated on their own as well as conjointly". Finally, in Aarts' model a process of falsification can act to counterbalance economy. Thus Aarts (2007a: 435) falsifies the claim that words such as *this* and *that* should be subsumed under the class of adjectives by observing that they possess several properties which distinguish them from adjectives (e.g., they cannot be modified by adverbs). Consequently, they should be placed in a distinct category of determinatives according to Aarts.

3. Problems with multiple property models

3.1. *Categories*

3.1.1. *Using categories.* Of what use to a language user could a model of lexical categories be? This question is most commonly answered from the perspective of language acquisition. The categories of words, it is argued, form a crucial part of a language user's knowledge of language and it is a model of lexical categories which allows such knowledge to be acquired (e.g., Mintz 2002: 678). Language acquisition researchers would be liable to be dismissive of a multiple property model of lexical categories such as Aarts' however. In particular, recent language acquisition research has criticized models of lexical categories which assume grammatical knowledge on the part of the child on the grounds that such an assumption involves circular reasoning (cf. for instance Cartwright and Brent, 1997: 126; Croft, 2001: 45; Crystal, 2004 [1967]: 192; Mintz, 2003: 111; Maratsos, 1999: 207; Pinker, 1987: 400). Effectively, such models assume the child already knows the information it is trying to discover. Multiple property models such as Aarts' are particularly vulnerable to such a criticism because they assume a comprehensive knowledge of the grammatical properties associated with lexical categories. Thus, a child would be unable to discover the lexical categories of a language such as English using Aarts' model because such a model would require the child to already know about the lexical categories of English and their associated properties in order to acquire such knowledge. It is in order to avoid such circularity that models of language acquisition emphasize that lexical category information can only be discovered on the basis of pregrammatical forms of information such as semantic information (e.g., Grimshaw 1981: 174–176; Pinker 1984: 40–43; Russell 2004: 473–476) or distributional information (e.g., Cartwright and Brent, 1997: 132–138; Mintz 2003: 92–95; Redington et al. 1998: 431–432). Since categorization in multiple property models is primarily based on grammatical information, however, the use of such models to acquire knowledge of lexical categories would inevitably involve circularity.

A second answer to the question is that models of lexical categories enable learners to generalize about the properties of words and thus to acquire their properties more rapidly. Along these lines, Pinker (1994: 286) states: "There are many benefits to using a small number of innate categories like N and V . . . By calling both the subject and object phrases 'NP' . . . the child automatically can apply hard-won knowledge about nouns in subject position to nouns in object position". The key problem with this view has been outlined by Culicover (1999: 61–68) in an analysis of English nominal specifiers (e.g., *every*, *each*, *this*, *our*). According to Culicover (1999: 67–68), we cannot determine the properties of an English nominal specifier by figuring out its category and

then generalizing the properties associated with that category to it because each nominal specifier tends to be associated with an idiosyncratic pattern of properties. Thus, the ability to appear without an overt head is exhibited by certain nominal specifiers such as *this* but not by others such as *every* (Example (11a) is taken from Culicover 1999: 62):

(11) a. *I'll take this*.
b. **I'll take every*.

Similarly, the ability to float to the right is exhibited by certain nominal specifiers such as *all* but not by others such as *our* (Example (12a) taken from Culicover 1999: 62):

(12) a. *The women have all left.*
b. **Women have our left*.

Because certain nominal specifiers fail to exhibit these properties, then, it would be a mistake to generalize this property to the entire class of nominal specifiers. As a result, Culicover (1999: 67) maintains that rather than using lexical categories to generalize about the properties of English nominal specifiers, we must simply learn through experience the idiosyncratic properties of each specifier. Crucially, such idiosyncratic variation is not confined to English nominal specifiers but can be observed in any lexical category (for evidence of this cf. Bhat 1994: Ch. 2; Bloomfield 1933: 269; Crystal 2004 [1967]: 209; Goldberg 2006: Ch. 3; Gross 1979: 860; Hunston and Francis 2000: Ch. 5; Pinker 1989: 126–127; Quirk 2004 [1965]: 333; Ross 2004 [1973]: 373). As Table 1 demonstrates, moreover, Aarts is himself aware of such idiosyncratic variation. Indeed, as observed in the introduction, the fundamental raison d'être of multiple property models is to allow such subsective and intersective gradience to be captured. As is typical for a multiple property model, Aarts' model avoids generalizing about the properties of words but rather bases its categorization of them on a comprehensive assessment of the idiosyncratic properties of each individual word. Consequently, it cannot be argued that the function of multiple property models such as Aarts' is to enable generalization.

The problem of determining the purpose or function of multiple property models is heightened by the fact that such models appear to render categories superfluous. Such models base their categorization of a word on a comprehensive assessment of the properties of that word. However, if a language user has already determined all of the properties of a word, we might wonder whether there is any further benefit to be derived from categorizing it. If, for instance, a language user already knows the various properties of *happy* illustrated in Table 1 above (e.g., occurs attributively, is gradable, takes an *un*-prefix etc) what will he or she gain from also knowing that it is an adjective? To put it another way, if one language user knows all of the properties of the words in

his or her lexicon and another language user knows both the lexical categories and the properties of the words in his or her lexicon would we expect there to be any difference in the way that they use language? In particular, will the former be at any kind of a disadvantage with respect to the latter? Culicover has himself also remarked upon the apparent superfluity of categories. In relation to the categorization of English nominal specifiers, for instance, Culicover (1999: 67) observes: "the categorization does not produce any additional knowledge that is not determined by experience". That is to say, attaching a lexical category to words such as *every* and *this* does not provide us with any knowledge beyond that which we acquired in learning about their properties (on this point cf. also Plank 1984: 498). Aarts himself nowhere speculates on this question of the function or purpose of lexical categories.[6] Such a question is hardly redundant however. Indeed, it becomes particularly pertinent in relation to multiple property models. The calculations needed to turn a set of properties into a category assignment in a multiple property model may be complex and effortful. Thus, they may involve the application of all manner of different frequency estimates, thresholds and weightings to the data derived from a large corpus (for more on this issue cf. Section 3.2.3 and Section 3.3.1). To justify all of this effort there must surely be some considerable benefit for the language user in knowing what the lexical category of a given word is. However, Aarts does not explain what the value of assigning a lexical category to a word is and, in the context of a multiple category model, it is very difficult to imagine what it could be.

Such considerations begin to suggest that lexical categories may be superfluous in multiple property models of lexical categories.[7] This problem of superfluity, moreover, is exacerbated by words whose category is indeterminate. Familiar examples of such words in English include *worth*, *like*, *unlike*, *due*, *near*, *close* and *far* which combine properties associated with both adjectives and prepositions and, as a result, occupy a grey area between these two categories (Hunston and Francis 2000: 195–197; Pullum and Huddleston 2002a: 606–610). Huddleston (1984: 348), for instance, observes that *near* displays prepositional properties in Example (13a), adjectival properties in Example (13b) and both adjectival and prepositional properties in Example (13c):

(13) a. *He buried it near the fence*
b. *his nearest relative*
c. *the one which he had buried nearest the fence*

As a result, Huddleston (1984: 348) concludes that "Its classification thus remains somewhat indeterminate". Other examples of indeterminacy include "syncategorematic" words whose behavior is so idiosyncratic they cannot be situated either within or between lexical categories. Hudson (2000: 14; cf. also Culicover 1999: Ch. 2; Tomasello 2003: 105), for instance, characterizes *that*,

if and *for* in these terms, "*that* is simply a word, and so are *if* and *for*; they are recognized as lexical items, but have no grammatical features and belong to no categories." Moreover, in some multiple property models, category indeterminacy is not confined to a few distinctive words such as *worth* and *that* but extends to cover most words. Bhat's (1994; cf. also Wetzer 1992) model of lexical categories, for instance, does not employ any method such as the Best Fit Principle for determining sharp boundaries between categories. As a result of its fuzzy boundaries, it does not clearly assign a determinate lexical category to any words other than maximally prototypical members of a category. Words of indeterminate category can also be found in Aarts' model even though Aarts' model is largely successful in counteracting indeterminacy via the Uniqueness Constraint. Thus, as is observed in Section 3.3.4 and Section 3.3.5, gerunds such as *painting* and words such as *pipe* are indeterminate between nouns and verbs in Aarts' model. Such indeterminate words exacerbate the superfluity problem because they suggest language users can handle words perfectly adequately even when their lexical category is not known. Thus, if we know all of the properties of a word such as *near* (e.g., that it can occur as the head of a locative PP, that it can occur attributively, that it is gradable etc) we should still be able to use it perfectly adequately even if we are unable to decide whether it is an adjective or a preposition. If we can handle such words effectively in the absence of lexical category knowledge, there would be seem to be in principle no reason why we cannot handle all words effectively in the absence of lexical category knowledge.

In sum, multiple property models cannot enable the acquisition of lexical category knowledge and nor do they allow for generalizations based on lexical categories. Moreover, in determining all of the properties of a word before assigning a category to it, such models render lexical categories superfluous. This problem is exacerbated by words of indeterminate category which arise in multiple property models. If language users can handle words of indeterminate category adequately, then there would seem to be no need to assign a category to any word.

3.1.2. *Defining categories.* What is a noun? What is a verb? In a multiple property model such as Aarts', the Uniqueness Constraint ensures that each lexical category is associated with a distinct set of properties. As a result, such models can define lexical categories by pointing to the distinct sets of properties associated with each category. Yet while the categories in such a model can be distinguished in this way, it does not follow that the members of those categories will be similarly distinct. In particular, the members of a given lexical category will often exhibit properties associated with a different category — in Aarts' terminology, they will often exhibit intersective gradience. Nouns, for instance, can exhibit properties associated with the adjective category such as

the ability to occur prenominally. Such intersective gradience inevitably diminishes the distinctiveness of categories within multiple property models. Consider, for instance, a scenario in which there are two gerunds — one which possesses five nominal properties and six verbal properties and one which possesses six nominal properties and five verbal properties. As a result of the Best Fit Principle, Aarts' model would assign the former to the verb category and the latter to the noun category. However, given the high degree of similarity between these two words, our instinct, as Martin Haspelmath (cf. Aarts 2007b: 226) has suggested, would be to question whether these two words really are so different from one another. Clearly, if highly similar words are being assigned to distinct noun and verb categories this may cause us to doubt whether there is a real difference between these two categories in Aarts' model and thus whether his model yields a coherent explanation of the distinction between them (for further discussion cf. Plank 1984: 501).

Category coherence is also eroded in multiple property models because they allow subsective gradience — that is, they allow words to be members of a category even if they do not exhibit all of the properties associated with that category. In Aarts' model, subsective gradience results from the Best Fit Principle. Thanks to this principle, any word which possesses any property associated with a given category in Aarts' model may potentially be assigned to that category (as long as it possesses fewer properties associated with other categories). Because this is such an undemanding threshold, Aarts' model is liable to grant membership of a given category to a very diverse set of words some of which bear little resemblance to prototypical members of that set (on this point cf. also Tomasello 2003: 170). As an example of this, consider adjectives which can only occur in postnominal position (examples taken from Pullum and Huddleston 2002b: 560):

(14) a. *restaurants aplenty*
b. *flowers galore*
c. *the city proper*
d. *Attorney General designate*
e. *the President elect*
f. *a Nobel laureate*

Such adjectives do not exhibit any of the five properties associated with adjectives by Aarts (2007b: 210) in Table 1 above. For these to be included in the adjective category we would have to treat the ability to occur postnominally as an adjective property. This single adjectival property would be enough to gain them entry into the adjective category via the Best Fit Principle. However, as members of the adjective category, they would possess nothing in common with many of the most prototypical adjectives such as *happy* which exhibit all of the five properties in Table 1 but not the ability to occur postnominally e.g.,

(15) ??*the postman happy*

Of course, Aarts' model could exclude atypical words from its categories and thereby increase category coherence by employing stricter category thresholds. The danger with such an approach, however, is that some words might fail to satisfy the stricter threshold for any category and would consequently be left unaccommodated within any category. In contrast, the Best Fit Principle is highly inclusive — it allows every word to be housed within some category or other (on this issue cf. also Plank 1984: 492). The price paid for such inclusivity is that it results in categories with a diverse and incoherent set of members.

This sense that multiple property models provide us with poor explanations of the nature of lexical categories is reinforced by the fact that such models fail to provide us with any explanation of the relation between the various properties associated with a given lexical category. In a single property model, for instance, the diverse properties exhibited by members of a given lexical category will be connected together by a single, fundamental property which underlies them all. Thus, Baker (2003: Ch. 3) claims that the distinctive set of properties which are exhibited by nouns (e.g., their ability to take quantifiers and determiners, their ability to occur in core argument positions, their ability to be counted etc) are exhibited by nouns alone because such properties all involve reference and nouns are the only words that are capable of referring. However, multiple property models must avoid identifying any such fundamental, underlying property. Clearly, if a multiple property model were to claim that a single, fundamental property underlies the various properties associated with a category, it would thereby reduce itself to a single property model.[8] Thus, if the properties associated with a given category in Aarts' model all shared a common underlying property, we could determine whether a word belonged to this category using this property alone and there would be no need to count up its other properties and apply the Best Fit Principle to the resultant score. In this way, then, multiple property models are prevented from explaining what, if anything, links the various properties associated with a given category. They leave us with the task of determining what coherence, if any, there might be to the jumble of properties associated with a given category. The contrast with single property models could not be sharper. Such models straightforwardly explain each lexical category in terms of its underlying property. Thus for Baker (2003: Ch. 3), a noun is simply any word that refers.

In conclusion, multiple property models define categories in terms of a diverse and unstructured set of unconnected properties. Such incoherent definitions of categories are exacerbated in Aarts' model by the Best Fit Principle which allows categories to contain members which have no properties in common with one another. Alternatives to the Best Fit Principle such as the thresholds exhibited by some prototype models are also problematic in that they are

insufficiently inclusive. One possible source of category coherence in multiple property models is the Uniqueness Constraint but this can be compromised by other features of such models such as the Best Fit principle. Overall, multiple property models provide far less coherent definitions of lexical categories than single property models.

3.1.3. *Determining categories.* As Table 1 has suggested, words exhibit different sets of properties to one another. Unsurprisingly, the more properties we take into consideration, the greater the number of distinct sets of properties that words exhibit and the smaller the number of words which exhibit each distinct set of properties (on this issue cf. Crystal 2004 [1967]: 194; Goldberg 2006: ch. 3; Pinker 1989: 126–127). Evidence of this fact has been provided by Gross (1979: 859–860; cf. also Culicover 1999: 63) who built a large scale grammar of French employing 600 morphosyntactic tests and 12 000 words and observed that no two words exhibited exactly the same set of properties and no two properties were exhibited by exactly the same set of words.[9] A model which captured such complexity by creating a distinct category for every distinct set of properties would require hundreds of categories. Moreover, most of these categories would contain only one or two members. Also, its very small categories would fail to capture important generalizations such as the fact that nouns tend to share certain properties in common. As Crystal (2004 [1967]: 194; cf. also Plank 1984: 509) puts it, "the more subclassification one allows, the more points of general similarity become less clear".

Importantly, multiple property models avoid such excessive splitting of categories and the problems associated with them. One feature which allows them to do so is their use of non-necessary properties. A model which formed a distinct category for every distinct property, for instance, would split the words in Table 1 into five distinct categories since they all exhibit different sets of properties. In contrast, as observed in Section 2, Aarts' (2007b: 210) multiple property model is able to lump all of the words in Table 1 into a single adjective category since no one property need be exhibited by all category members. A second feature which allows Aarts' model to guard against splitting is the Uniqueness Constraint. Splitting the noun category into separate common noun, proper noun, pronoun and gerund categories, for instance, would require the ability to occur in nominal positions such as subject position to be associated with multiple categories. Since this would contravene the Uniqueness Constraint such splitting would be blocked. A third feature of Aarts' model which would resist splitting is the Economy Constraint. As a result of this constraint, fewer categories are always preferred to more categories other things being equal. Thus, as noted above in Section 2, Aarts (2007b: 210) assigns gerunds such as *painting* in Example (16a) to the noun category and gerunds

such as *painting* in Example (16b) to the verb category and thereby eliminates the gerund category:

(16) a. *Brown's deft painting of his daughter is a delight to watch*.
b. *I dislike Brown painting his daughter*.

Similarly, Aarts (2007b: 98–101) prefers to lump auxiliary verbs and main verbs together into a single verb category rather than split them apart because such lumping is more economical.

Yet while multiple property models employing non-necessary properties do resist splitting categories apart they are prone to lumping them together. It was noted in Section 2, for instance, that because the Best Fit Principle renders properties non-necessary, it allows words exhibiting contrasting patterns of properties to be grouped under the same category. Thus, Aarts' model is able to lump together the subcategories of common nouns, proper nouns, pronouns and gerunds into a single noun category because no specific nominal property need be possessed by all members of the noun category. For precisely the same reason, Aarts' model is capable of lumping together categories into super categories. In theory, at least, the Best Fit Principle would allow Aarts' model to lump together all of its categories and their properties into a single super category defined in terms of a single, very large set of properties.[10] Furthermore, in Aarts' model, the Economy Constraint would also drive the lumping of categories into super categories since such lumping would result in fewer categories and a more economical model. Obviously, however, such lumping would be problematic. Thus, in lumping together subcategories such as common nouns, proper nouns, pronouns and gerunds, a multiple property model such as Aarts' would fail to capture the important generalization that each distinct subcategory is associated with a unique pattern of properties. Similarly, if a multiple property model were to lump together categories such as nouns and verbs into a single super category it would fail to capture the important generalization that each distinct category is associated with a unique pattern of properties. Moreover, the larger the category resulting from this process of lumping, the more heterogeneous that category would be. In particular, a super category grouping together words from diverse categories would, as Crystal (2004 [1967]: 194) observes, possess "a very uncertain and miscellaneous constitution, lacking any perceivable homogeneity".

Such observations suggest that it is as important to avoid excessive lumping as it is to avoid excessive splitting.[11] According to Aarts, such excessive lumping can be avoided via a process of falsification. Thus, Aarts (2007a: 435) considers the claim that words such as *this* and *that* should be subsumed under the class of adjectives because they exhibit certain adjectival properties. Aarts (2007a: 435) falsifies this claim by observing that such words exhibit properties indicating they belong to the class of determinatives rather than adjectives:

"words like *this* and *that* are not stackable; cannot be modified by adverbs; must be phrase initial; relate not directly to the noun; but to the combined sequence of noun and modifiers, etc." At this point, then, Aarts seems to be advocating something like the following constraint:

(17) Difference Constraint: Words exhibiting different patterns of properties should be placed in distinct categories.

Clearly, however, such a constraint flatly contradicts the Best Fit Principle. Thus, the Best Fit Principle allows category members to exhibit distinct patterns of properties as the adjectives in Table 1 demonstrate. In contrast, the Difference Constraint prevents category members from exhibiting distinct patterns of properties. Where the Best Fit Principle promotes lumping, the Difference Constraint promotes splitting. Aarts does not explain how his model is able to contain two such mutually incompatible forces. Nor does he explain why he chooses to apply the Difference Constraint in certain cases (e.g., *this* and *that*) and the Best Fit Principle in other cases (e.g., common nouns, proper nouns, pronouns and gerunds) which suggests that it is methodological opportunism which determines when they are applied (on this point cf. Croft 2007: 415). Moreover, any attempt to stipulate when they should be applied is likely to be arbitrary. We could, for instance, suggest that the Difference Constraint should apply only when a word differs from another word by a certain amount of properties. But why should it be this certain amount which determines the application of the Difference Constraint rather than any other?

A further possible brake on category lumping is also referred to briefly by Aarts (2007a). Following Pullum and Huddleston (2002b: 537; cf. also Crystal 2004 [1967]: 193–194; Gleason 1965: 130), Aarts (2007a: 436–437) appeals to a criterion of heterogeneity in arguing that the word *barrier* in the NP *barrier system* should be regarded as a noun rather than an adjective because lumping prenominal nouns into the adjective category would render the adjective category "too heterogeneous". In this way, Aarts' account alludes to the following constraint:

(18) Heterogeneity Constraint: The members of a category must not be too heterogeneous.

As noted above, a key problem with lumping is that it leads to heterogeneous categories and super categories. By blocking heterogeneous categories, therefore, the Heterogeneity Constraint would also block lumping. In order to implement such a constraint within a multiple property model, it would be necessary to stipulate that the members of a category should differ from one another by no more than a certain amount of properties. Clearly, however, any such limit would be entirely arbitrary. There is, for instance, no nonarbitrary basis for determining whether a noun category containing common nouns, proper

nouns, pronouns and gerunds is excessively heterogeneous or not (on this point cf. Croft 1991: 41; Crystal 2004 [1967]: 193–194: Schachter 1985: 5–6). A further problem is that the Heterogeneity Constraint would drive splitting. If it was stipulated that adjectives could differ from each other by no more than three properties, for instance, then the five words in Table 1 could no longer be accommodated in a single adjective category since some of them differ from each other by more than three properties (compare *utter* and *afraid* for instance). Thus, even were a nonarbitrary version of the Heterogeneity Constraint possible it would only serve to constrain lumping at the expense of promoting splitting.

Aarts' model might also be resistant to lumping insofar as its categories contain one or more prototypical members (on this aspect of prototype theories cf. Braisby 2005: 175–180; Harris 1981: 178–179; Löbner 2002: 174–183). Following Crystal (1967: 46), Aarts (2007b: 105) suggests that a prototypical member of a lexical category will possess all of the properties of the category of which it is a member. Thus, Aarts (2007b: 105) notes that *happy* in Table 1 is a prototypical member of the adjective category because it possesses all five properties associated with this category. From this feature of Aarts' model the following constraint can be derived:

(19) Prototype Constraint: Each category must contain at least one prototypical member which possesses all of the properties associated with that category.

To see how this would constrain lumping, consider Croft's (2007: 416) concern that Aarts' model would allow the formation of a super category combining nouns and verbs. Clearly, the Prototype Constraint would block such a category because there would be no member which exhibited all of the properties associated with both nouns and verbs. As Aarts (2007b: 210–214) demonstrates, for instance, even a gerund could not simultaneously possess all of the properties of nouns and all of the properties of verbs. While it would resist lumping, however, such a constraint would fuel splitting. Consider, for instance, the noun category. If this category contains not only common nouns but also pronouns, proper nouns and gerunds, then there is clearly no member which possesses all of the properties associated with this category. Thus, there would be no member which exhibited both the case marking associated with pronouns and the ability to take determiners associated with common nouns. As a result, the Prototype Constraint would tend to split up the noun category into a number of smaller categories (e.g., pronouns, common nouns etc). However, because such categories would share properties in common (e.g., the ability to occur as a subject) they would be incompatible with the Uniqueness Constraint. Moreover, because the Uniqueness Constraint is so fundamental to Aarts' model (on this point cf. Section 3.3.2), it would inevitably be the

Prototype Constraint rather than the Uniqueness Constraint which would be abandoned in order to avoid giving rise to the clash between them.

In summary, multiple property models featuring non-necessary properties avoid splitting categories but are prone to lumping them. Aarts utilizes the Difference Constraint to resist lumping but this cannot be reconciled with another feature of his model, namely the Best Fit Principle. Other possible constraints on lumping such as the Heterogeneity Constraint and the Prototype Constraint also give rise to a variety of problems such as category splitting. Thus, it is difficult to see how lumping can be constrained in multiple property models.

3.2. *Properties*

3.2.1. *Determining properties.* Just as multiple property models must avoid the excessive lumping and splitting of categories, so they must avoid the excessive lumping and splitting of properties. If a multiple property model were to overestimate the number of nominal properties, for instance, then the number of nominal properties exhibited by words and thus the number of words assigned to the noun category would also be overestimated. In order to avoid excessive property lumping, Aarts (2004: 38–39; 2007b: 227) proposes that we should split properties apart rather than lumping them together if they "can be instantiated on their own as well as conjointly". Thus, Aarts can be said to apply the following constraint in determining properties:

(20) Instantiation Constraint: Distinct properties can always be instantiated independently as well as conjointly.

As an example of this, Aarts (2007b: 227) notes that an anonymous referee has raised the issue that the verbal properties of being premodified by an adverb or by the negative particle *not* should be lumped together as a single verbal property since any element that can be modified by an adverb can also be negated. In contrast, Aarts maintains that these properties should be regarded as forming two distinct properties since they can be instantiated on their own as well as conjointly. However, while the Instantiation Constraint does resist property lumping, it fuels excessive splitting (on this point cf. also Keizer 2007: 256). Aarts (2007b: 210), for instance, identifies the ability to be modified by an adjective as a property of nouns. However, this property can be split according to whether the adjective occupies a prenominal, postnominal, predicative or secondary predicate position. These properties can in turn be split further. Thus, we could split prenominal adjectives into ascriptive and associative adjectives or secondary predicate adjectives into depictive and resultative secondary predicate adjectives. We could even split prenominal ascriptive adjec-

tives according to whether they were restrictive as in Example (21a) or nonrestrictive as in Example (21b) (examples taken from Ferris 1993: 118):

(21) a. *I'll get some German hock for the party.*
b. *The eloquent Dryden is too learned for some tastes*.

Similarly, we could split depictive secondary predicate adjectives according to whether they were subject related as in Example (22a) or object related in Example (22b) (examples taken from Aarts 1995: 77):

(22) a. *Jim left his house angry*.
b. *Jim ate the meat raw*.

Crucially, these more finely split adjectives can occur independently of one another as the adjectives in Examples (21) and (22) demonstrate or they can co-occur with one another as the following example in which *pupils* is modified by prenominal, postnominal and predicative adjectives demonstrates:

(23) *The various pupils responsible are guilty of a misdemeanor*.

Because these more finely split properties can occur either independently or conjointly, they should be recognized as distinct properties rather than being lumped together into more general properties according to the Instantiation Constraint. In this way, while the Instantiation Constraint does prevent property lumping it does so only at the cost of fuelling splitting.

The dangers of such splitting are obvious enough. At least for certain properties, it is difficult to see where the splitting might stop (on this issue cf. Croft 2001: 78–81; Maratsos 1999: 213; Pinker 1984: 49). Consequently, the sets of properties associated with each lexical category might come to contain a vast number of extremely finely split properties and determining the lexical category of a word on the basis of such complex sets of properties would be a difficult and impractical task. Of course, not all properties can be split finely. It is difficult, for instance, to imagine how to split certain other properties of nouns listed by Aarts (2007b: 210) such as the ability to take a genitival determinative. As a result, if splitting were allowed, those properties which could be finely split (e.g., the ability to be modified by an adjective) would give rise to more properties than those that could not and would exert a disproportionate influence on the process of lexical category assignment. The most obvious way to counteract such splitting would be to employ the Economy Constraint. As noted in Section 2, there are numerous instances in which Aarts either lumps together properties or excludes them altogether and thereby creates a more economical model. In the case of the verbal properties of being premodified by an adverb and the negative particle *not*, Aarts (2007b: 227) allows the Instantiation Constraint to override the Economy Constraint. Thus, he splits these two properties in accord with the Instantiation Constraint even though doing so

creates a more complex and therefore less economical set of verbal properties. Of course, we could choose, contra Aarts, to favor the Economy Constraint above the Instantiation Constraint and lump the two verbal properties together. However, the question naturally arises as to whether there is any nonarbitrary basis for deciding between these two alternatives. Aarts' approach has the merit of adhering to the Instantiation Constraint while the alternative approach has the merit of adhering to the Economy Constraint. On what basis can we resolve the choice between these two constraints? We could try to improve matters by abandoning the Instantiation and Economy Constraints and replacing them with some other constraints. It is difficult to see how our predilection for these other constraints could be any less arbitrary than a predilection for the Instantiation and Economy Constraints. Of course, we could appeal to empirical reality to render our choice of constraint nonarbitrary. That is, we could justify our choice of constraint on the basis of empirical evidence that language users actually employ such a constraint. But is it conceivable that we could obtain empirical evidence of language users employing the Instantiation Constraint?

In short, attempts to use constraints to determine the correct sets of properties incur a variety of problems. Thus, Aarts' use of the Instantiation Constraint gives rise to excessive splitting. Moreover, tempering such splitting by combining the Instantiation Constraint with the Economy Constraint is problematic insofar as it involves arbitrary choices. Such considerations indicate that the determination of properties is inevitably an arbitrary process.

3.2.2. *Excluding properties.* Many recent accounts of lexical categories accord a key role to semantic properties (e.g., Croft 1991: 65; Culicover 1999: Ch. 2; Grimshaw 1990: 49–59; Hopper and Thompson 1984: 708; Langacker 1987: 55; Tomasello 2003: 295). Perhaps the primary reason for this is a growing awareness that such properties are essential for crosslinguistic comparison. It is often argued, for instance, that there is so much crosslinguistic variation in morphosyntactic properties that only semantic properties could form an adequate basis for comparing categories from different languages and determining whether they are instances of the same category (e.g., whether they are both instances of the noun category). As Schachter (1985: 4; cf. also Anward et al. 1997: 168: Bhat 1994: 13; Croft 1991: 42; Dik 1989: 162; Hengeveld 1992: 50; Ramat 1999: 169; Sasse 1993: 647) puts it, "the words *boys* and *girls* are assigned to the same parts-of-speech class (and the word *like* to a different class) on language-particular grammatical grounds, but it is on universal semantic grounds that the class to which *boys* and *girls* are assigned is called the class of nouns (while that to which *like* is assigned is called the class of verbs)". A second motivation for according a key role to semantic properties stems from language acquisition research. Thus, as noted in Section 3.1.1 above, language acquisition researchers have argued for a semantic bootstrapping

hypothesis in which lexical categories are initially acquired in terms of their semantic rather than grammatical properties (e.g., Grimshaw 1981: 174–176; Pinker 1984: 40–43; Russell 2004: 473–476). A third reason for granting a primary role to semantic properties within accounts of lexical categories stems from their contribution to category coherence. As noted above in Section 3.1.2, category coherence is achieved in single property models by means of a fundamental property which underlies the set of properties associated with a lexical category. Typically, this underlying property will be a semantic property. Thus, in the single property model of Baker (2003: Ch. 3), the diverse set of properties associated with nouns forms a coherent unity because all the properties in this set involve reference.

Despite the significance of semantic properties for lexical properties, Aarts' model excludes all semantic properties from the process of determining both category membership and subsective gradience within categories. Moreover, Aarts (2007b: 225) offers no justification for this feature of his model other than the statement that "we need to impose some kind of bound on the properties that are to be used". Perhaps Aarts is suggesting here that the exclusion of semantic properties serves to render his model more economical. Yet this in itself does not justify the exclusion of these properties since we could also render Aarts' model more economical by excluding morphosyntactic properties. Thus, in order to justify the exclusion of semantic properties it is necessary not simply to appeal to economy but also to explain why such economy should be achieved by excluding semantic properties rather than morphosyntactic properties. Since Aarts provides no such explanation, his exclusion of semantic properties is arbitrary. Both Croft (2007: 413) and Plank (1984: 496) emphasize, for instance, that there is no valid justification for excluding such properties from accounts of lexical categories.

Moreover, it may be questioned whether Aarts does actually succeed in excluding semantic properties from his model. Aarts (2007a: 434), for instance, considers the claim that the ability to take *un*-prefixes is not unique to adjectives since some verbs appear to take *un*-prefixes as the following example illustrates:

(24) *The magician undid the knot*.

In support of the claim that only adjectives take *un*-prefixes, Aarts cites Plag (2003: 30) who distinguishes between the kinds of *un*-prefixes that adjectives take and the kinds of *un*-prefixes that verbs take on semantic grounds. Specifically Plag (2006: 30) argues that the *un*-prefix in a verb such as *undo* has a "reversative" meaning in contrast to the *un*-prefix in an adjective such as *unhappy* which simply means "not". In using such an argument, Aarts is clearly characterizing the ability of adjectives to take *un*-prefixes in semantic terms. If this ability is characterized in semantic terms, however, it is difficult to see how

Aarts (2007b: 209–210), can maintain that it is a syntactic rather than semantic property of adjectives.

Thus, evidence that semantic properties play a key role in determining lexical categories and the fact that it is often difficult to disentangle semantic and syntactic properties both suggest that multiple property models should include semantic properties. However, including semantic properties in multiple property models is not without its problems. In Aarts' model, for instance, a word is liable to be assigned to the wrong category if the number of properties associated with it is not determined accurately. However, determining the precise number of semantic properties associated with any given word is an uncertain and contentious process because, whereas morphosyntactic properties may be observed directly, semantic properties are intuited indirectly. Thus, it is a simple matter to determine that the word *magician* in the above example displays certain morphosyntactic properties such as co-occurring with a determiner but it is far from obvious how many semantic properties the word possesses. Multiple property models may therefore compel us to exclude semantic properties because such properties are so very difficult to count. Clearly, however, to exclude semantic properties merely because it is not convenient to include them is highly methodologically opportunistic. A further motivation for avoiding semantic properties in multiple property models is that they are liable to form fundamental, underlying properties which connect together the properties associated with a lexical category. As noted above in Section 3.1.2, however, such underlying properties are problematic for multiple property models since they have the unfortunate effect of collapsing multiple property models into single property models.

In conclusion, multiple property models depend on the precise determination of the correct number of properties and it is difficult to count semantic properties precisely. Aarts' model circumvents this problem by excluding semantic properties but such exclusion is difficult to justify given the importance of semantic properties for lexical categories.

3.2.3. *Weighting properties.* In Aarts' model, there is no weighting of properties. As a result, for any given category each property associated with that category will play an equal role in determining both the membership of that category and subsective gradience within the category. In this way, Aarts' model can be described as observing the following constraint:

(25) Equality Constraint: All properties play an equal role in determining subsective and intersective gradience.

Aarts (2004: 38; 2007b: 226–227; cf. also Hudson 1990: 45; Keizer 2007: 255–256; Newmeyer 2003: 695) eschews the use of weighted properties because of the lack of consensus regarding the optimal procedure for assigning

weights to properties. Yet while it is undeniable that the assignment of weightings is problematic, the importance of such weightings is equally undeniable. The lack of weightings in Aarts' model, for instance, means that the ability to occur as a subject and the ability to take nominal suffixes are equally diagnostic of nounhood. Yet nouns which lack nominal suffixes may be highly prototypical (e.g., *car*) while nouns which cannot occur as subjects are far from prototypical (e.g., *dint*). It is a problem with Aarts' model, then, that these two properties play an equal role in determining both the membership of the noun category and subsective gradience within it and that, as a result, the model may rate *car* and *dint* as equally prototypical instances of nouns. Van der Auwera and Gast (2010) make a related point in discussing Crystal's (2004 [1967]: 204; cf. also Aarts 2007b: 101–105) claim that nouns such as *hardship* and *peroration* are more "central" (i.e., prototypical) instances of nouns than *boy* and *girl* because they possess nominal suffixes. As van der Auwera and Gast (2010) argue it seems counterintuitive to claim that derived nouns such as *hardship* and *peroration* are more prototypical than basic nouns such as *boy* and *girl* since they derive from words that are not themselves nouns.

Yet while the case for employing weighted properties is compelling, there are problems with such weighting. The weight assigned to a property will reflect the frequency with which it is observed to occur in a large-scale corpus as Aarts (2004: 38; 2007b: 226–227; cf. also Crystal 2004 [1967]: 203; Newmeyer 2003: 695) notes. But which measure of frequency should we employ? Should the weighting of a property reflect the proportion of category members which exhibit a property or should it reflect the frequency with which the property is exhibited by category members? It could also be argued that the weighting of a property should reflect its diagnosticity. Occurring postnominally, for instance, is a property which is exhibited relatively infrequently by adjectives (examples taken from Ferris 1993: 44):

(26) a. *The bicycles damaged all had red handlebars*
b. *The line defective is the one to the outside*.
c. *A dose strong enough would put him out all night*.

However, since the vast majority of words which occur in this position are adjectives the ability to occur postnominally is highly diagnostic of adjectives in that a word occurring in this position is highly likely to be an adjective. Clearly, these three measures of frequency give conflicting values. Should the weighting of properties reflect one of these measures rather than the others or perhaps some mixture of all three? Such a choice is surely arbitrary.[12] Moreover, even if we were able to decide which measure of frequency to choose, it is difficult to see how such a measure could be converted into weightings in a nonarbitrary way. If one property occurs twice as frequently as another does this mean that this should be weighted twice as heavily as that other property?

Also, the weighting of a property will be more appropriate for some category members rather than others. We might want to reflect the fact that the ability to take a determiner is often exhibited by nouns by strongly weighting it for instance. However, as Aarts (2007b: 104) notes, the noun *fatherhood* occurs only rarely with a determiner in sentences such as the following:

(27) *The fatherhood of my friend Jim is not in doubt*.

Clearly, if we were to strongly weight this property and assign it to *fatherhood*, then on the assumption that weighting reflects frequency of occurrence we would be misleadingly suggesting that *fatherhood* frequently displays this property. To overcome this problem it would be necessary to carrying out a frequency analysis on a large-scale corpus for each property of every word and thereby arrive at an individual weighting for each property for every word. It is unlikely, however, that such an inordinately complex process could be implemented either by language users or linguists developing models of lexical categories.

In summary, the equal weighting of properties in Aarts' model is undermined by examples which indicate that some properties are more diagnostic of the lexical categories they are associated with than others. However, implementing property weighting within multiple property models requires a number of arbitrary choices and is liable to be excessively complex.

3.2.4. *Balancing properties.* Aarts' account often suggests that different lexical categories will have a different number of properties associated with them. In his discussion of gerunds, for instance, Aarts (2007b: 210–211) refers to a set of five nominal properties and a set of seven verbal properties. That different lexical categories exhibit different numbers of properties is unsurprising. It is perhaps inevitable that highly frequent lexical categories which play a variety of important syntactic roles (e.g., nouns and verbs) will tend to display a greater range of syntactic properties than less frequently occurring lexical categories with more circumscribed syntactic roles (e.g., adverbs and determiners). Clearly, however, such differences in the numbers of properties associated with different categories could give rise to problems for a multiple property model of lexical categories such as Aarts'. In particular, such differences would tend to bias the assignment of words in favour of those lexical categories associated with a greater number of properties. Thus, if there are more verbal than nominal properties, it will be inherently easier for a gerund to possess a greater number of verbal than nominal properties simply because there are more verbal properties to be possessed. As a result of this imbalance, then, gerunds would tend to be assigned to the verb category more often than the noun category. It would be entirely reasonable to suspect that this tendency to assign gerunds to the verb category in preference to the noun category is

simply unfair and tells us little about the actual category of each gerund (in the same way that it would be reasonable to suspect that a tug of war competition between two teams of unequal size is simply unfair and tells us little about which is the best team). In order to correct this unfairness, it would be necessary to observe the following constraint:

(28) Balance Constraint: The sets of properties that determine the subsective and intersective gradience of lexical categories must contain an equal number of properties.

However, it seems highly unlikely that all of the lexical categories within a language such as English would be associated with an equal number of properties. A model such as Aarts' could, of course, ensure that each lexical category possessed an equal number of properties simply by selecting a set number (e.g., seven) of the properties associated with each category. However the number of properties selected in this way would necessarily be entirely arbitrary. Moreover, we might struggle to find seven properties associated with certain categories such as adverbs and determiners. We could, of course, reduce the number of properties associated with each lexical category (to four, for instance). Doing so might allow us to obtain enough properties for categories such as adverbs and determiners but it might also require us to exclude important properties from the set of properties associated with lexical categories such as nouns and verbs.

In short, multiple property models would need to assign equal numbers of properties to each lexical category to avoid bias and imbalance in the categorization of words. However, employing the Balance Constraint would require an arbitrary number of properties to be selected. Such a number is liable to be simultaneously too high for some categories and too low for others.

3.3. *Combining words, properties and categories*

3.3.1. *Assigning properties to categories.* As noted in Section 2, properties in Aarts' model are subject to the following constraint (on this point cf. Aarts 2007b: 227–228; Culicover 1999: 38):

(29) Uniqueness Constraint: Each property is associated with a single lexical category only.

Although this constraint determines that a property will be associated with only a single category, it does not determine which single category it will be associated with. For Aarts, which single category a given property is associated with will be determined by the fact that it is frequently exhibited only by the members of a single category. Thus, Aarts (2007b: 227) suggests that the

ability to take a tense ending is a verbal rather than nominal property because "only a verb can take a tense ending" (Aarts 2007b: 227). In this way, the assignment of a property to a specific category in Aarts' model can be said to be determined by the following constraint:

(30) Frequency Constraint: A given property will be assigned to a category if the members of that category alone frequently exhibit it.

However, such a constraint cannot accommodate the many instances of words which display properties associated with categories other than their own. Aarts (2007b: 101–105; cf. also Crystal 2004 [1967]: 204), for instance, argues that the ability to co-occur with an article is one of the properties which determines membership of the noun category. Clearly, however, such an ability is also frequently displayed by adjectives as well. Thus, it is displayed by comparative and superlative adjectives in sentences such as the following (Examples (31a) and (31b) are from Ferris (1993: 153) and Example (31c) is from Ferris [1993: 147]):

(31) a. *The older a violin is, the more valuable it is supposed to be.*
b. *Martin is now the thinnest he's ever been*.
c. *Father came back $500 the poorer*.

Furthermore, common nouns frequently occur attributively and thus display an adjectival property. Thus, Aarts (2007a: 436–437) notes that *barrier* in the phrase *barrier system* is a noun rather than an adjective even though it occurs attributively. As support for the view that *barrier* in *barrier system* is a noun, Aarts (2007a: 437) notes that it can be modified by an adjective and pluralized:

(32) a. *red barrier system*
b. *barriers system*

Thus, it is the case both that certain nominal properties are frequently displayed by adjectives and that certain adjectival properties are frequently displayed by nouns — a fact that runs counter to the Frequency Constraint.[13]

We can, however, accommodate words which exhibit properties associated with categories other than their own while still associating each property with a single lexical category in line with the Uniqueness Constraint by employing the following weaker and more flexible version of the Frequency Constraint:

(33) Weak Frequency Constraint: A property will be assigned to category X rather than category Y because the property occurs more frequently with category X than with category Y.

Unlike the Frequency Constraint, this constraint would be able to tolerate instances of a property being frequently displayed by more than one category.

Thus, even though nouns frequently occur prenominally, such a constraint would assign the ability to occur prenominally to the adjective category rather than the noun category because adjectives occur more frequently in prenominal position than nouns do. However, the Weak Frequency Constraint is problematic insofar as it requires us to specify precisely what is meant by "more frequently". Clearly, any attempt to specify such a frequency difference is likely to be arbitrary. Moreover, the smaller the frequency difference between the two categories, the more arbitrary the decision to assign the property to one category but not the other will seem. Furthermore, it would seem unreasonable to assign a property to one category but not to another if both categories exhibit the property frequently even if one category exhibits the property more than the other.[14] Such observations suggest that something other than simple frequency of occurrence should be used as the basis for determining which properties should be assigned to which lexical categories. It is, however, very difficult to imagine what this alternative basis might be if not frequency of occurrence. Aarts' (2007b) account provides no suggestions in this regard and nor do any other accounts as far as I am aware.

A further problem with the two versions of the Frequency Constraint is that they are circular (on the prevalence of circular reasoning in accounts of lexical categories cf. Cartwright and Brent 1997: 126; Croft 2001: 45; Crystal 2004 [1967]: 192; Mintz 2003: 111; Maratsos 1999: 207; Pinker 1987: 400). Consider how we would determine that the ability to occur prenominally is an adjectival property using such constraints for instance. Both constraints claim that we determine the category that a property is associated with by first determining the category of the words that it is exhibited by. Thus, in order to determine whether the ability to occur prenominally is an adjectival or nominal property it would be necessary to determine whether the words it is exhibited by are nouns or adjectives. Clearly, however, to determine whether prenominally occurring words are nouns or adjectives we would need to know whether the properties that they exhibit are adjectival or nominal properties. In this way, determining which categories properties are associated with requires that we already know which categories properties are associated with. Moreover, this circularity is compounded by a second circularity. Thus, the ability to occur prenominally is a property which assumes a knowledge of nouns in that we must know what a noun is in order to be able to determine whether a word is occurring in front of a noun or not. In this respect also, then, the property requires a knowledge of categories which in turn would require a knowledge of properties and would hence give rise to circularity. Nor is this property unusual in this respect. Most of the five nominal properties that Aarts (2007b: 210) uses in his analysis of the gerund *painting*, for instance, refer explicitly to lexical categories (e.g., "the string which *painting* heads is in a typical nominal position" or "*painting* takes a PP complement").

To sum up, assigning properties to categories on the basis of frequency gives rise to many problems. Thus, the Frequency Constraint cannot accommodate words which exhibit properties associated with categories other than their own. Similarly, the Weak Frequency Constraint involves many arbitrary decisions and is associated with various forms of circularity. However, it is not clear on what basis multiple property models could assign properties to categories if not frequency.

3.3.2. *Assigning properties to multiple categories.* In the previous section, it was observed that associating a property with a single lexical category gives rise to a number of problems. However, allowing properties to be associated with multiple lexical categories also gives rise to problems. Clearly, as soon as we abandon the Uniqueness Constraint and allow properties to be associated with multiple categories, it becomes difficult to determine how such properties should be counted in a multiple property model. Unless we can determine whether a word which occurs prenominally is exhibiting an adjectival or a nominal property or both, for instance, it is difficult to assign a score for that property to the word. To overcome such uncertainty we could simply assume that the word is exhibiting both an adjectival and a nominal property and accord it a score of two points (i.e., one point for a nominal property and one point for an adjectival property) for this single property alone. Doing so would have the unfortunate consequence for Aarts' model of violating the Equality Constraint (cf. Section 3.2.3 above) since it would lead to certain properties being accorded more points than others. Moreover, in according such a score, a multiple property model would effectively be returning a "don't know" response with regard to the issue of whether the word is exhibiting a nominal or adjectival property. The more such a model returned such "don't know" answers, the greater the number of words which would be assigned equal scores for both noun and adjective categories (or, to use Aarts' (2007b: 228–233) term, hybrids). In effect, the model would become increasingly indecisive and there would be an increasing number of words which it would be unable to assign definitively to one category or another via the Best Fit Principle. This indeterminacy would be particularly prevalent amongst words which exhibited few properties. Table 1 above, for instance, indicates that the word *utter* possesses only a single property — namely the ability to occur prenominally. Clearly, a model which was unable to decide whether this property was adjectival or nominal but accorded a point for both would have no way of deciding whether *utter* was a noun or an adjective and would instead have to conclude that its category was indeterminate. Furthermore, it might also be difficult to determine exactly when a property is non-unique. Thus, how frequently does a property have to be exhibited by a second category for that property to be treated as non-unique and accorded points for two categories? Clearly, we

would need to set up some kind of a threshold to decide between unique and non-unique properties but such a threshold would be arbitrary and vulnerable to methodological opportunism.

Abandoning the Uniqueness Constraint would also lead to the formation of new categories which would further exacerbate the problem of indeterminacy. Imagine, for instance, a variant of Aarts' model which lacked the Uniqueness Constraint. Such a model would be able to feature a gerund category in which membership was determined by a large set of properties shared in common with the noun and verb categories. Consider how such a model would determine the category of proper nouns such as *Martin* in the following sentence:

(34) *Martin is now the thinnest he's ever been*.

Clearly, in this example, *Martin* exhibits a single nominal property, namely the ability to occur in subject position. Since this property would also be associated with gerunds, however, *Martin* would be accorded a single noun category point and a single gerund category point. In this instance (and all similar instances), then, the Best Fit Principle would be unable to assign the word to either the noun or the gerund category since it would be an equally good match for both. Once again, the model would grind to a halt and would be unable to do anything but conclude that the category of the word was indeterminate. Thus, while the Uniqueness Constraint is empirically implausible and extremely difficult to implement, it is clear that a multiple property model such as Aarts' simply cannot function without it.

To conclude, abandoning the Uniqueness Constraint creates a number of problems for multiple property models. In particular, a multiple property model which lacked the Uniqueness Constraint would fail to assign many words to a specific category.

3.3.3. *Not assigning properties to categories.* In many cases, it is not the lexical category of a word which determines whether that word can exhibit a given property. In such cases, it may be asked whether it is meaningful to regard the property in question as belonging to a specific lexical category at all. Consider again, for instance, Aarts' (2007b: 101–105) claim, that the ability to co-occur with determiners is a nominal property. As noted above in Example (31), this ability can be observed in the case of superlative and comparative adjectives. In such sentences, the determiner cannot be said to be attached to an ellipsed noun rather than the adjective itself since, as Ferris (1993: 153) has observed, adding in further nouns to such sentences gives rise to unacceptable sentences such as the following:

(35) a. **The older thing a violin is, the more valuable it is supposed to be*.
b. **The older violin a violin is, the more valuable it is supposed to be*.

The ability to take determiners is also exhibited by superlative adverbs as the following sentences demonstrate (Example (36a) is taken from Payne and Huddleston (2002: 395) and Example (36b) is taken from Huddleston [2002: 1169]):

(36) a. *It was Jill who had spoken the most eloquently*.
b. *The system seems to be working the most efficiently that it has ever worked*.

Clearly, there can be no ellipsed noun in such sentences and so the determiner can only be attached to the adverb. It is also the case that certain nouns typically do not occur with determiners. In particular, proper nouns and pronouns rarely occur with determiners. Yet while it is rare to observe proper nouns and pronouns occurring with determiners, they can nevertheless occur with determiners as the following examples demonstrate (Example (37a) is from Hawkins [1978: 286]):

(37) a. *The John that Mary loves is blind in one eye.*
b. *What's inside can make all the difference in the you you turn out to be*.

Such examples suggest that it is not lexical category but some other factor which is driving the determiner marking of words. In the case of definite articles, it has often been suggested that this other factor is referential uniqueness (e.g., Cruse 1999: 315; Ferris 1993: 122–125; Hawkins 1978: 157–166; Lyons 1999; 8–12). Specifically, it has often been suggested that a word — whether noun, adjective or adverb — will be marked with a definite article if that word refers to a unique member of a presupposed set. Thus, a definite article is required in Example (37a) because a set of men named John is presupposed out of which the one that is blind in one eye is uniquely referred to. Similarly, a definite article is required in Example (36a) because a set of speeches is presupposed out of which the most eloquent is uniquely referred to (Ferris 1993: 122–125; Hawkins 1978: 233–236). Yet if it is not whether a word is a noun or not which determines whether it will be determiner marked but a semantic factor such as referential uniqueness, then it is difficult to understand why the property of occurring with a determiner should be regarded as a nominal property. Instead, it would seem more parsimonious to suppose that the property of co-occurring with a determiner is simply a marker of a semantic factor such as referential uniqueness rather than a marker of lexical category.

Such doubts over whether it is meaningful to claim that a property should be associated with a particular lexical category cannot be confined to the ability to take a determiner however. Consider, for instance, the ability to occur prenominally. Aarts (2007b: 214) argues that this ability is exhibited not only by

adjectives and by nouns such as *barrier* in *barrier system* but also by verbs as in the case of the participle *working* in the following example:

(38) *She is a working mother*.

Clearly, in such a position, nouns and verbs function like adjectives to attributively modify the following noun. Moreover, while it is not necessary for a word to be an adjective in order to display this property nor is it sufficient. As Aarts (2007b: 210) notes, there are a number of adjectives such as *afraid* and *alive* which cannot occur prenominally:

(39) **the afraid man*

Yet if it is neither necessary nor sufficient for a word to be an adjective in order for it to occur prenominally, the question arises as to whether it is meaningful to label such a property as adjectival. In particular, it may be more parsimonious to suppose that the property of occurring prenominally is simply a marker of a semantic factor such as attributive modification rather than a marker of lexical category. Similarly, we could agree with Aarts (2007b: 227–228) that the ability to co-occur with intensifying words such as *very* is an adjectival property and collapse adverbs into the adjective category as a result. More straightforwardly, we could suppose that such an ability is simply a marker of intensification rather than an adjectival property and not worry whether we need to lump adjectives and adverbs together.

In summary, it may be doubted whether it is meaningful to associate a property with a lexical category if it is neither necessary nor sufficient for a word to belong to that lexical category in order to exhibit that property. In such cases, it is more parsimonious to suppose that properties mark semantic factors rather than lexical category. Clearly, however, such a view is a problem for multiple property models such as Aarts' which depend on the assumption that every property of a word can be taken to be a marker of its lexical category.

3.3.4. *Assigning properties to words.* As well as determining a set of properties for each lexical category, multiple property models determine a set of properties for each word. Typically, the set of properties associated with a word is determined by surveying the properties exhibited by tokens of that word as they occur in actual utterances (on this point cf. in particular Hudson 2006: 54–57). It is then assumed that the word itself must also possess the properties exhibited by tokens of that word as they occur in actual utterances. Aarts (2007b: 101–105) touches upon this issue in disputing Crystal's (2004 [1967]: 204) claim that the word *phonetics* lacks the ability to co-occur with an article. As evidence against Crystal's claim, Aarts (2007b: 104) cites the following phrase:

(40) *the phonetics of Bulgarian*

For Aarts, the fact that *phonetics* can co-occur with a definite article in a well formed phrase indicates that it does possess the ability to take articles contra Crystal (2004 [1967]). What Aarts is proposing, then, is that if any token of a word exhibits a property in a well formed utterance then the word itself must also possess that property. By surveying enough tokens of a word, moreover, we can determine the entire set of properties associated with it and we can use this to determine its lexical category. In relation to *phonetics*, for instance, Aarts (2007b: 105) also observes that it possesses the ability to occur as a subject in a well formed utterance and that since the word possesses two nominal properties it must be a noun.

One challenge engendered by such an approach is that of determining the range of word tokens relevant to any given word. Consider, for instance, the process of determining the properties of the verb *write*. In order to determine its properties, we would obviously want to include in our range of word tokens forms of the verb such as the infinitive *to write*, the present tense forms *write* and *writes*, the past tense form *wrote*, the present participle form *writing* and the past participle form *written*. Clearly, if we did not include all of these forms in our range of tokens, then we would not be able to attribute key properties to the word itself. However, if we did include such forms in our range of tokens, then it would be very difficult to also exclude participial adjectives and gerunds such as the following:

(41) a. *I want a written apology on my desk by this afternoon*.
b. *The writing of the apology took me all morning*.

Obviously, participial adjectives and gerunds such as those in Example (41) exhibit adjectival and nominal properties such as occurring prenominally and taking a definite article. If we were to draw on such word tokens in determining the properties of *write*, then it would suggest that this word possessed not only verbal but also nominal and adjectival properties and skew or even undermine our attempt to determine its lexical category. It would be difficult, however, to exclude participial adjectives and gerunds such as those in Example (41) from the range of tokens we drew upon in determining the properties of *write*. Any attempt to exclude such word tokens on the basis that they were nouns and adjectives would be circular for instance. Thus, we could only know that it might be inappropriate to base the properties of *write* on nouns and adjectives if we already knew that *write* was a verb. In this way, we would need to know the lexical category of *write* before we could begin to determine its lexical category.

A second problem with Aarts' approach stems from the assumption that a word possesses a property simply because a token of that word exhibits that property. It can be argued, for instance, that definite articles are licensed not so

much by a word but rather by the semantic factor of referential uniqueness which specific tokens of a word may acquire when they occur in particular sentences (Cruse 1999: 306; Lyons 1999: 165–166; Miller 1998: Ch. 2; Morris 2007: Ch. 4; Payne and Huddleston 2002: 399–400). Consider again, for instance, the following sentence:

(42) *It was Jill who had spoken the most eloquently*.

This sentence presupposes a set of speeches of differing degrees of eloquence and, because the token of the word *eloquently* uniquely selects one of these, the definite article is licensed. In this particular context, then, a token of the word *eloquently* exhibits referential uniqueness and, as a result, has the ability to take a definite article. In other contexts, other tokens of the word may fail to exhibit referential uniqueness and, as a result, lack the ability to take a definite article, e.g.,

(43) *Jill spoke eloquently|*the eloquently*.

Yet while it is meaningful to claim that a specific word token exhibits referential uniqueness and possesses the ability to take a definite article, it is not meaningful to claim that a word in general exhibits referential uniqueness and possesses the ability to take a definite article. Thus, stating that the word *eloquently* in general possesses the ability to take articles fails to capture the fact that very few tokens of the word are referentially unique and able to take an article. Similarly, stating that the word *eloquently* in general lacks the ability to take articles fails to capture the fact that a few tokens of the word are referentially unique and able to take an article. By confining ourselves to claims about specific tokens of the word *eloquently*, we avoid such problems and capture all of the facts pertaining to its ability to take definite articles. Note, moreover, that this is true not just for adverbs such as *eloquently* but for other words also. Thus, if we try to determine whether the word *phonetics* in general possesses the ability to take an article, we incur precisely the same problems that were incurred in the case of *eloquently*. Clearly, however, Aarts does not confine himself to discussing whether specific tokens of a word possess the ability to take an article but also discusses whether the word in general possesses such an ability. In so doing, he commits himself to answering questions for which there is no good answer such as whether the word *eloquently* in general possesses the ability to co-occur with articles. He also thereby wrongly attributes the ability to co-occur with a definite article to words in general when it is not words in general which license this property but the semantic factor of referential uniqueness that tokens of a word can acquire in particular phrases or sentences.

One way to avoid these two problems of determining the correct range of word tokens and generalizing from word tokens to words would be to restrict

the assignment of properties and categories to word tokens only. Thus, if we are determining the properties and category of an individual word token, then we need only draw upon that single word token and do not need to draw upon a range of word tokens. Similarly, if we are limiting our analysis to individual word tokens, then we do not need to speculate on what properties may or may not be possessed by words in general apart from the individual word tokens. In fact, Aarts (2007b: 210–214) pursues this strategy of assigning properties to individual word tokens in relation to gerunds such as *painting*. Specifically, Aarts' model assigns those tokens of *painting* which exhibit mostly nominal properties to the noun category and those tokens of *painting* which display mostly verbal properties to the verb category. However, a language user employing such an approach would consult their lexicon on encountering a token of the gerund *painting* and receive the information that *painting* could be either a noun or a verb. In order to resolve this indeterminacy, the language user would then have to count up all of the nominal and verbal properties of their given token and determine on the basis of the Best Fit principle whether to assign it to the noun or verb category. We might imagine that the entire point of storing a word's category in the lexicon would be to spare language users the trouble of having to calculate that word's category every time they encountered it. Clearly, Aarts' model would not spare language users this trouble but would instead necessitate that they determine the category of every token of every gerund that they encounter — an absurdly effortful process. In contrast, a language user employing a model with a gerund category would be spared such a problem. On encountering a token of a gerund such as *painting*, they would simply look the word up in their lexicon, discover that it was a gerund and assign it to the gerund category without first having to determine all of its properties and calculate its category. Unfortunately, however, Aarts' model cannot employ a gerund category since it would share many properties with both the noun and verb categories and would, therefore, violate the Uniqueness Constraint.

To conclude, assigning properties to words involves surveying the properties exhibited by tokens of that word. However, determining the appropriate set of tokens is a circular process. Moreover, the assumption that a property should be ascribed to a word because a token of that word has exhibited that property is contentious because properties are often licensed not by a word but by semantic factors which tokens of a word acquire in actual utterances. Such problems can be avoided by ascribing properties to word tokens rather than to words but such a strategy is itself problematic in that it renders categorization absurdly effortful and leads to category indeterminacy.

3.3.5. *Assigning words to categories.* A key issue in a model of lexical categories is the extent to which word tokens sharing the same form should be

assigned to the same word and thus to the same lexical category (cf. for instance Plank 1984: 492). Aarts (2007b) emphasizes that it is preferable to assign tokens with an identical form to the same word and lexical category. He notes, for instance, that many linguists analyze word forms such as *in*, *on* and *at* as adverbs when they are part of phrasal verbs but as prepositions when they occur in P + NP sequences. Against such an approach he argues that "surely the most attractive position to take is to say that an element like *in* is either always an adverb, or always a preposition". For Aarts (2004: 41; 2007a: 440), the attraction of assigning identical tokens to a single category resides in economy. Clearly, lumping tokens together to create a single word enhances the economy of a model of lexical categories in the same way that lumping categories together to create a single category or lumping properties together to create a single property does. On the basis of such observations, we might take Aarts to be advocating the following principle:

(44) Single Category Constraint (strong version): Identical tokens should be assigned to a single lexical category.

Croft (2007) observes that a danger with such an approach is that it is liable to lump together identical tokens which belong to different lexical categories and thus are tokens of distinct words. As an example of this, Croft (2007: 416) provides the following sentences:

(45) a. *This* pipe *is six inches thick*.
b. *They will* pipe *natural gas across Daghestan*.

Croft suggests that an approach such as Aarts' is liable to assign the two tokens of the word *pipe* to a single category and thus treat them as tokens of a single word. In contrast, Croft suggests that *pipe* in (45a) is a noun while *pipe* in (45b) is a verb and thus that they should be treated as tokens of two different words. Responding to Croft's criticism, Aarts (2007a: 441) rejects the view that his model would lump together the two tokens of *pipe*: "Equating identity in form with identity in word class is a reasonable initial hypothesis, and should be adopted only if the distributional facts confirm the analysis . . . In Croft's . . . *pipe* examples the distributional facts do not warrant the conclusion that these words belong to the same class". Such comments indicate that Aarts actually subscribes to the following weaker version of the Single Category Constraint:

(46) Single Category Constraint (weak version): Identical tokens should be assigned to a single lexical category only if the distributional facts allow it.

According to this weak version of the Single Category Constraint, then, we determine that *pipe* in Example (45a) is a noun by establishing that it exhibits more nominal properties than properties associated with other categories.

Similarly, we determine that *pipe* in Example (45b) is a verb by establishing that it exhibits more verbal properties than properties associated with other categories. In this way, the weak version of the Single Category Constraint effectively replaces the Single Category Constraint with the Best Fit Principle. Thus, rather than guaranteeing that the various tokens of *pipe* will all belong to the same lexical category as the Single Category Constraint does, the weak version of the Single Category Constraint simply states that the various tokens of *pipe* will belong to whichever lexical category they exhibit the most properties of.

Clearly, by using the Best Fit Principle to determine the lexical category of individual word tokens, Aarts is able to avoid assigning a single lexical category to word tokens which clearly belong to distinct lexical categories such as the two tokens of *pipe* in Example (45). However, such a strategy creates for words such as *pipe* the same problems that Aarts' model created for gerunds such as *painting*. Thus, in the previous section, it was observed that Aarts' (2007b: 210–214) model cannot assign a single lexical category to all tokens of the gerund *painting* but requires that the lexical category of every token of *painting* be determined individually via the Best Fit Principle. As a result, language users employing Aarts' model would not be able to determine the category of a gerund such as *painting* by consulting their lexicon but would be required to determine its category afresh every time that they encountered it — an absurdly effortful process. Similarly, the weak version of the Single Category Constraint would require language users to calculate the lexical category of words such as *pipe* via the Best Fit Principle every time they encountered them. In effect, it would render the category of words such as *pipe* as indeterminate as that of gerunds such as *painting*. In so doing, it would spread the onerous task of determining the lexical category of individual word tokens beyond gerunds to a much larger set of words.

Yet if Aarts' approach is problematic, it is not obvious that there is any adequate alternative. We could, for instance, insist that *pipe* is a noun and that *pipe* in Example (45b) is actually a noun being used as a verb. Yet, as both Croft (2007: 416) and Aarts (2007b: 441) would no doubt agree, it seems odd to view *pipe* in Example (45b) as noun when its behavior is clearly that of a verb. Moreover, why assume that *pipe* is a noun and *pipe* in Example (45b) is a noun being used as a verb when we can equally well assume that *pipe* is a verb and *pipe* in Example (45a) is a verb being used as a noun? We could perhaps argue that *pipe* is a noun rather than a verb on the basis that it is used as a noun more frequently than it is used a verb. As Crystal (2004 [1967]: 205) has observed, however, such an approach is problematic in that "for many pairs of homophones, frequency of occurrence is likely to be similar". Deciding the lexical category of words such as *pipe* on the basis of frequency would require us to decide how much more often a word would have to be used in one category

rather than another in order to be assigned to that category and this would inevitably be an arbitrary decision. Moreover, choosing frequency as the basis of our decision would itself be an arbitrary choice when, as Crystal (2004 [1967]: 205) observes, there are so many other possible factors (e.g., etymology, semantics etc) on which to base such a decision.

In short, the Best Fit Principle in Aarts' model would lead to identical word tokens being assigned to a variety of lexical categories. Such an approach is problematic insofar as it would be absurdly effortful. It is unclear whether any better alternatives are available for multiple property models however. In particular, the available alternatives all involve a number of arbitrary decisions.

3.4. *Crosslinguistic issues*

Aarts applies his model almost exclusively to English. A rare exception to this trend is provided by Aarts' (2004: 33–34) discussion of the following example from German:

Category induction from distributional cues in an artificial language

(47)	a.	*ein*	*mehrere*	*Sprachen*	*sprechender*	*Mann*
		a.NOM	several	languages	speaking. MASC.NOM.SG	man.MASC.SG
	b.	*einen*	*mehrere*	*Sprachen*	*sprechenden*	*Mann*
		a.ACC	several	languages	speaking. MASC.ACC.SG	man.MASC.SG

Aarts argues that both *sprechender* and *sprechenden* have more adjectival than verbal properties and must therefore be considered as adjectives converging on the verb class. Specifically, he argues that while the words are adjectival insofar as they occur prenominally and agree with a noun in terms of case and number they only have a single verbal property in that they take a direct object. Responding to this passage from Aarts (2004), Croft (2007: 417) observes that the English words which fit the German criteria for adjectives most closely are not English adjectives but the words *this* and *that* since they agree in number (though not in case) with the noun as the following examples illustrate (examples taken from Croft 2007: 417):

(48) a. this *box*/these *boxes*
b. that *chair*/those *chairs*

As Croft observes, one approach to this fact is to maintain the bizarre assertion that English has only two adjectives, *this* and *that*. A second possible approach is to maintain that the set of properties defining German adjectives differs from the set of properties defining English adjectives. While less bizarre than the

former approach, this second approach is no less problematic. As Croft (2007: 417) observes, if we pursue this latter approach, "then we have no syntactic basis for assuming that the English Adjective class is the same as the German Adjective class. Hence, we have no basis for saying that there is a category 'adjective' in grammatical theory that is valid across languages. English Adjective and German Adjective are just language-specific categories, defined within each language, with no theoretical connection to each other."

In fact, however, there is a third possible approach to crosslinguistic data available to a multiple property model such as Aarts'. Aarts' model could define adjectives in terms of a set of properties which combined all of the properties of English and German adjectives. Of course, English adjectives would fail to display the properties distinctive of German adjectives that this new expanded set of properties would contain. However, Aarts' model would tolerate this since its properties are non-necessary and thus the failure of English adjectives to display the properties distinctive of German adjectives could simply be treated as a matter of subsective gradience. Clearly, however, there are a number of problems that would arise with a model which simply combined the property sets of all the languages it applied to. The expanded set of properties produced by such an approach could, for instance, render a category excessively inclusive. Thus there is the danger that *this* and *that* would be scored as adjectives because the adjective category contained the property of number marking associated with German adjectives. Moreover, as we applied the approach to more and more languages, the set of properties associated with a given category would become progressively larger and categories would become progressively more excessively inclusive. Furthermore, sets of properties would become so complex and diverse they would lack any coherence. There would be no possibility of a category containing a prototypical member which exhibited all of its properties and so there would be no sense in which the category is organized around a prototype. It would also be very difficult to determine how many distinct properties any given category should have. If the gender marking of adjectives in French differs in a number of respects from that in German, should we regard these as two separate properties or just one? Ultimately, the sets of properties associated with any given category would become so large and complex as to be completely unmanageable.

A fourth possible approach to the handling of crosslinguistic data in multiple property models such as Aarts' has been developed by Bhat (1994). Instead of combining all of the properties of the languages it applies to, Bhat's approach combines only some of the properties of the languages it applies to. Specifically, Bhat (1994: 15) defines each of the major lexical categories in terms of a cluster of properties "general enough to cover all languages". Thus, the adjective category is defined in terms of the pragmatic property of modification, semantic properties such as denoting fairly permanent properties and morpho-

syntactic properties such as allowing degree modification. As with Aarts' model, these properties are all non-necessary so that a word can still qualify as a member of a category even if it fails to display some of the properties associated with that category.[15] In contrast to Aarts, however, Bhat does not employ any method such as the Best Fit Principle for determining sharp boundaries between categories. Thus, Bhat's model cannot determine whether a particular gerund is a noun or a verb but only that some gerunds are more nounlike than others and that some gerunds are more verblike than others. At the same time, however, Bhat does state firmly that certain languages lack certain lexical categories. Thus, Bhat (1994: 5) argues that Ancient Greek lacks a category of adjectives since what we might identify as its adjectives display a range of properties associated with nouns. Clearly, Bhat's approach has much to recommend it. It does have a basis for claiming that there are lexical categories such as adjective which are valid across languages and it is not unmanageably complex in contrast to an approach which simply combines all properties from all languages. However, in choosing some properties while excluding others Bhat's approach lays itself open to a charge of methodological opportunism. As Section 2 above suggests, Croft (2007) would regard the exclusion of certain properties as being necessarily arbitrary. Moreover, Bhat's use of general properties may suggest that a language lacks a certain category when an approach which made use of properties specific to that language may indicate that it possesses such a category. Thus, there are many properties which distinguish adjectives from nouns in Ancient Greek such as their ability to occur both before and after the head noun in an NP when that NP lacks a determiner, e.g.,

(49) a. *ει c οικιαν καλην*
into house FEM.ACC.SG. beautiful FEM.ACC.SG.
'into a beautiful house'

b. *περι δεινου λόγου*
about clever MASC.GEN.SG. speech MASC.GEN.SG.
'about a clever speech'

However, because these properties are specific to Ancient Greek, they do not feature in Bhat's property set for adjectives and thus that set fails to pick up on properties which distinguish adjectives from nouns in Ancient Greek.

Moreover, as well as the individual problems that these four approaches to the handling of crosslinguistic data in multiple property models demonstrate, such approaches are also likely to suffer from all of the problems outlined above in Section 3. Some of these problems will not be exacerbated by the inclusion of crosslinguistic data. However, most of these problems will be exacerbated by the inclusion of crosslinguistic data. As Croft (2007: 418; cf. also Haspelmath 2007: 119) has noted, "The problem gets worse across languages.

There is even more variation, hence even more difficulties in applying the same criteria across languages". In Section 3.3.2, for instance, it was argued that a range of severe problems arise when multiple property models fail to adhere to the Uniqueness Constraint. However, crosslinguistic data makes it increasingly hard to abide by the Uniqueness Constraint. Aarts (2007b: 227), for instance, states that "the property of taking morphological tense markers . . . is a uniquely verbal property that does not apply to nouns". Yet the tense marking of nouns has been observed in a wide variety of languages. Nordlinger and Sadler (2004: 780), for instance, provide the following example from Tariana in which a future tense marker is attached to the noun *unyane*:

(50) *kayu-maka* *hi* *waʃipeʃe* *unyane-pena*
so-AFF DEM:ANIM Walipere flood-fut
di-kakwa=pidana
3SG.NF-plan=REM.P.REP
'Thus Walipere was planning the future flood.'

Examples such as (50) indicate that we are liable to find properties associated with a given category exhibited by members of other categories when we look at crosslinguistic data (on this point cf. Ramat 1999: 169; Sasse 1993: 647). As a result, applying a model such as Aarts' to crosslinguistic data will make it increasingly hard to sustain the Uniqueness Constraint.

Applying Aarts' approach to languages other than English may also aggravate the problem of determining the set of lexical categories within a language. It was observed in Section 3.1.3, for instance, that Aarts' (2007a: 436–437) model counteracts the danger of lumping categories together into unwieldy super categories by employing the Heterogeneity Constraint. As also noted in Section 3.1.3, the problem with this criterion is that it is difficult to be certain what constitutes excessive heterogeneity. Crosslinguistic data further complicates the matter by revealing that different languages tolerate different levels of category heterogeneity to English. Consider, for instance, the following examples from Mandarin Chinese taken from Hengeveld (1992: 63–64):

(51) a. *Neige* *nühaizi* *piaoliang*
DEM girl beautiful
'That girl is beautiful.'
b. *piaoliang* *de* *nühaizi*
beautiful REL girl
'a beautiful girl'
c. *Neige* *nühaizi* *liaojie*
DEM girl understand
'That girl understands.'

d. *liaojie* *de* *nühaizi*
understand REL girl
'a girl who understands'

As Hengeveld (1992: 64) observes, such examples indicate that Mandarin Chinese treats both words such as *piaoliang* 'beautiful' and words such as *nühaizi* 'to understand' as verbs when English would split the translational equivalents of these words into separate adjective and verb categories. In this way, the verb category of Mandarin Chinese would appear to be inherently more heterogeneous than that of English. Such crosslinguistic variation suggests that even were we able to determine what constitutes excessive category heterogeneity in English we would not be able to apply this threshold successfully to other languages.

As noted above in Section 3.2.2, semantic properties play a key role in crosslinguistic comparison but multiple property models struggle to incorporate them because they give rise to very large and complex sets of properties which are difficult to count. Crucially, this counting problem would itself be exacerbated by the inclusion of crosslinguistic data since such data can be expected to increase the complexity of the set of semantic properties associated with the various lexical properties. An example of this is provided by Broschart (1997: 143–151) who explains how semantic properties as diverse as sex, rank, body parts, personal relations, color, time of day and nationality structure lexical categories in Tongan. Thus, Broschart (1997: 144) observes that, "body parts have in common with value — and color expressions that they usually take modifiers in tense constructions (*'oku nifo māsila* lit. 'is sharp toothed', *'oku pa'anga 'e tolu* 'it is worth three dollars' and *'oku lanu pulū* 'is blue colored'), and they have in common with personal relations that they usually requires possessives in constructions such as *ko hoku 'ulú* 'my head' and *ko 'eku tamai* 'my father' ". A further example of the diversity of semantic properties associated with lexical categories is provided by Harvey (1995: 116) who observes that in Warray there is a lexical class which denotes only replaceable things such as "bodily fluids, excretions, hair and leaves". Similarly, Pinker (1994: 127–128) observes that gender markers in Kivunjo divide up nouns into sixteen semantically distinct classes such as body parts, instruments, objects that come in pairs or clusters and abstract qualities. As with syntactic properties, we could reduce the complexity of the set of semantic properties associated with a given lexical category by selecting some semantic properties and excluding others. As with the exclusion of syntactic properties, however, this would necessarily be arbitrary and vulnerable to a charge of methodological opportunism.

Applying a model such as Aarts' to crosslinguistic data may also give rise to entirely novel problems not encountered when the model is applied to English alone. As observed in Section 2, for instance, it is a central feature of Aarts' model that properties are non-necessary. Such a characterization of properties

is plausible in relation to the lexical categories of English. Thus, the English adjective category is so large and diverse that there are no properties which are exhibited by all members of the category as Table 1 demonstrates. There are many languages, however, which possess lexical categories with so few members that all of the members exhibit the same properties. Examples of very small categories include the verb category in languages such as Kalam (Pawley and Lane 1998: 203) but most such examples involve adjective categories in languages such as Jarawara (Dixon 2004: 177) and Toqabaqita (Lichtenberk 2008: vol. 1). Consider, for instance, the following example from Chichewa taken from Baker (2003: 247):

(52) a. *m-kango* *w-a* *u-kulu*
3-lion 3-ASSOC 3-big
'the big lion'
b. *mbidzi* *z-a* *zi-kulu*
10.zebra 10-ASSOC 10-big
'the big zebra'

As Baker observes, the adjective category in Chichewa contains just six members: *kali* 'sharp, fierce', *kulu* 'big', *tali* 'long', *fupi* 'short' *ng'ono* 'small' and *wisi* 'raw, unripe, immature'. As with *kulu* in Example (52), the members of this category without exception exhibit the property of matching their gender marking to that of the head noun. In such a case, then, the variable gender marking is a necessary property of the adjective category and this runs counter to models such as Aarts' which seek to define categories in terms of multiple non-necessary properties.

4. Conclusion

The current article has investigated multiple property models of lexical categories. Section 3.1 explored the problems associated with the categories employed in such models. Specifically, it argued that categories in multiple property models are both superfluous and incoherent and tend to lump together into unwieldy super categories. Section 3.2 looked at the difficulties stemming from the use of properties in multiple property models. Thus, it was observed that such models struggle to avoid generating either an excessively small or an excessively large set of such properties. Moreover, they need to exclude semantic properties but lack an adequate justification for doing so. Also, it is difficult both to weight properties in such models and to ensure that the sets of properties associated with different lexical categories contain equal numbers of properties. In Section 3.3, the problems associated with combining words, properties and categories were investigated. It was observed that multiple

property models assume that a given property will be uniquely associated with a single category. However they lack an adequate basis either for justifying this assumption or for determining which properties should be associated with which categories. Moreover, they cannot afford to abandon this assumption since doing so undermines their ability to assign categories to words. Compounding these problems, are doubts over whether it is meaningful to associate many key properties with lexical categories at all. Just as problematic as assigning properties to categories, however, is the process of assigning properties to words. Thus, as outlined in Section 3.3.4, assigning properties to words is typically a circular process and one which leads to category indeterminacy. Finally, Section 3.4. considered data from languages other than English and argued that such data only makes matters worse. Specifically, such data both exacerbates the problems seen in relation to English and introduces novel problems as well.

There would seem to be three possible responses to the problems that have been outlined in the current article. One response would be to attempt to salvage multiple property models by developing new models incorporating solutions to each problem. However, many of the problems with multiple property models outlined in this article appear to be intractable. Moreover, even when solutions have been found to problems in the current article, their application has typically given rise to novel, equally significant problems with multiple property models. Furthermore, as problematic as Aarts' (2007b) model is, it appears to be close to an optimal design for a multiple property model and thus allows little room for improvement. A further response to the problems outlined in this article would be to abandon multiple property models and define each lexical category in terms of a single property. As noted in the introduction, however, such models generally lack the necessary flexibility to accommodate the variation in the properties exhibited by words both within and between languages. The only exceptions to this are single property models which define lexical categories in terms of pragmatic functions (e.g., Croft 2001: Ch. 2). These achieve the necessary flexibility by virtue of the fact that pragmatic functions such as modification and predication are inherently vague. The problem with such vagueness, as Smith (2010) has shown, is that it fails to maintain an adequate distinction between lexical categories. Thus, lexical categories become indistinguishable from one another in such models because pragmatic functions apply equally well to all lexical categories. A third possible response to the problems discussed in this article would be to seek an alternative to lexical categories. This is the preferred response of the current author and it is to this possibility that I will turn in a subsequent article.

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Notes

1. I would like to acknowledge the support of Bas Aarts (University College London), William Croft (University of New Mexico) and Matthew Pires (Université de Franche-Comté) all of whom provided me with informative comments regarding particular sections of this article. Any remaining errors are of course entirely my own responsibility. Correspondence address: 127 Durley Dean Road, Selly Oak, Birmingham B29 6RY, United Kingdom. E-mail: drmcsmith@hotmail.com
2. Thanks to Matthew Pires for pointing this out to me. Interestingly, this constraint applies to the varieties of French spoken in France but does not apply to French as spoken in parts of Belgium. Thus, a Belgian speaker will find the following acceptable:

   (i) *vous raurez votre argent demain*

3. The most extreme example of a small category is that from the Austronesian language Toqabaqita which possesses an adjective category with only a single member (Lichtenberk 2008: vol. 1). In this case, there is of course no possibility of intracategorial variation.
4. In this respect, Aarts' model contrasts with a number of other multiple property models which do employ fuzzy boundaries such as Ross (2004 [1973]) and Bhat (1994). Plank (1984: 509) argues that the sharpness of the boundaries between lexical categories can be increased by focusing on the behavior of prototypical members of those categories in prototypical constructions.
5. Aarts (2007b: 213) is somewhat ambiguous on his motivation for eliminating gerunds: "One advantage . . . is that we do not need to recognize a category of "gerund" in addition to nouns and verbs". However, in a personal communication to me, he did confirm that he had eliminated the gerund category because it led to a more economical model.
6. An anonymous reviewer suggests that lexical categories could be useful for various forms of automatic language processing systems such as such as tagging and translation systems. However, if a multiple property model were to be employed in this context it would give rise to exactly the same problems as it would in the context of child language acquisition. If a machine translation system knew all of the given properties of words from two different languages, for instance, would the system derive any further benefit from knowing the lexical categories of the words as well? It is as difficult to see how this extra information might benefit the act of translation as it is to see how it would benefit a language learner. A further problem with the view that automatic language processing systems might benefit from the lexical categories provided by multiple property models is that it assumes that multiple property models can successfully provide adequate categorizations of words. This however is precisely the assumption that the remainder of the current article is dedicated to challenging. Insofar as the remainder of the current article is successful in challenging this assumption, it further undermines the view that multiple property models can be of practical benefit to automatic processing systems (or language learners for that matter).
7. Clearly, one way out of this difficulty would be to get rid of lexical categories altogether and assume that words are grouped together not by lexical category but rather by syntactic properties. Applying Ockham's razor to lexical categories is a radical proposal, of course, but something similar has been countenanced by a number of linguists (cf. for instance Davis 2000: Ch. 5; Hoey 2005: Ch. 3; McCawley 1982: 185).
8. In contrast to Aarts, Bhat (1994: 16–17) does lay great emphasis on the interconnectedness of properties in his model. Specifically, Bhat suggests that the various properties associated with a category stem from the pragmatic functions associated with lexical categories. In this respect, Bhat's model resembles Baker's model. Unlike Baker's model (but like Aarts' model), Bhat's model does not stipulate that any property is necessary. Thus for Bhat a word

might still be a noun even if it occurs in predicate position and thereby exhibits the pragmatic function associated with verbs rather than nouns. In this way, Bhat's model can be said to be a mixture of a single and a multiple property model since the properties associated with categories are both interconnected (as with Baker's model) and independent (as with Aarts' model).

9. An anonymous reviewer states that the key issue "is to determine the relationships between the individual grammatically relevant properties found to distinguish any two lexemes in any particular language: Is one property dependent on another property (so that having property X implies having property Y), or independent (hence needs to be learnt individually)". Multiple property models typically assume that grammatical properties are independent of one another. Empirical studies generally support this assumption (e.g., Aarts 2007b: Chs. 3–8; Aarts et al. 2004: Chs. 17–24; Bhat 1994: 12–15; Crystal 2004 [1967]: 204; Culicover 1999: 60; Gross 1979: 860; Huddleston 1984: 318; Onnis and Christiansen 2008: 184–188; Pullum 1991: 779; Quirk 2004 [1965]: 333; Plank 1984: 496–509; Ramat 1999: 166; Ross 2004 [1973]: 373). Specifically, such studies show that most possible permutations of grammatical properties will be exhibited by one or more members of a lexical category (thereby giving rise to the chaotic patterns of properties seen in Table 1 above or in Table 7 of Plank (1984: 508) and denying the possibility of systematic links between grammatical properties). A number of recent studies (e.g., Baker 2003: Ch. 3; Croft 2001: Ch. 2) have, however, claimed that the grammatical properties associated with lexical categories may depend on underlying semantic or pragmatic properties. Such claims are fundamentally incompatible with multiple property models. As noted in section 3.1.2, reducing grammatical properties to semantic properties has the effect of collapsing multiple properties into single property models. As noted in Section 3.2.2, moreover, this is one of the reasons why multiple property models tend to eschew semantic properties.
10. Examples of accounts which lump all lexical categories into a single super category include Allan (1973) and Bach (1968). On this issue cf. Bhat (1994: 245–248) and Plank (1984: 491).
11. Interestingly, Plank (1984: 496) claims that "Aus empirischer Sicht erscheint die Vermeidung einer Oberklassifikation (also der Bildung zu vieler Klassen dank einer Nutzung allzu vieler Klassifizierungskriterien) das dringlichere Anliegen zu sein als die Vermeidung von Unterklassifikationen [From an empirical perspective, the avoidance of overclassification (and thus the development of too many classes thanks to the use of far too many classification criteria) appears to be a more urgent concern than the avoidance of underclassification]". Nevertheless, Plank also emphasizes that lumping (or underclassification) is a significant concern in the development of models of lexical categories.
12. Plank (1984: 500) argues that weightings should reflect the proportion of category members that display a property but does not explain why such a measure should be preferred to other possible measures of frequency. Plank also suggests that phonological properties should be less heavily weighted than morphosyntactic properties but concedes that such a weighting might work better for some languages rather than others. A recent crosslinguistic study by Onnis and Christiansen (2008: 211–212), for instance, has demonstrated that, in the case of English, French, Dutch and Japanese, phonological properties are likely to play a key role in the acquisition of lexical categories by young children.
13. For Bloomfield (1933: 269), the failure of English to adhere to the Uniqueness Constraint was one reason why there could be no adequate model of lexical categories in English: "Form-classes are not mutually exclusive, but cross each other and overlap and are included one within the other, and so on . . . For this reason a system of parts of speech in a language like English cannot be set up in any fully satisfactory way".
14. Crystal (2004 [1967]: 204–205; cf. also Harris 1981: 153; Plank 1984: 508–509) has voiced similar concerns: "A statistical rationale of the criteria for word classification seems to be the

only alternative to the unqualified arbitrariness which Bloomfield stated was implicit in the definition of English word classes. Arbitrariness cannot be eliminated, however, as there remain the questions of how many criteria to apply and how much subclassification to allow. Where one draws the critical demarcation line between criteria which are deemed relevant to the definition of a word class and criteria which are not is a question which is better left open. There may not be an optimum level applicable to all word classes, a statistically definable boundary beyond which the ratio of criteria to members of a class (or exceptions?) goes beyond a statistically significant point. And if this is so, then one is forced to conclude that word classes may be as broad or as narrow as there is need of in a particular situation, and that no one classification is absolutely better than any other."

15. Like Bhat (1994), Plank (1984: 510–515) argues that categories from different languages can be regarded as instances of the same category even if there is only a partial correspondence between the sets of properties exhibited by the two categories. Thus, Plank (1984: 511) states that if a category from one language were to share more than half of its properties with a category from another language, it would be difficult to dismiss this as mere coincidence. A challenge for such an approach would arise if a category from language X were to share one half of its properties with a category from language Y and the other half of its properties with a category from language Z. If the classes from language Y and Z shared no properties in common with each other, then they should be regarded as distinct categories. Simultaneously, however, the fact that they both share half of their properties in common with the category from language X would suggest that they are both the same category as the category from language X and thus as each other.

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