What's in (a) Label? Neural Origins and Behavioral Manifestations of Identity Avoidance in Language and Cognition

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The present work defends the idea that grammatical categories are not intrinsic to mergeable items, taking as a departure point Lenneberg's (1967, 1975) claim that syntactic objects are definable only contextually. It is argued that there are four different strands of inquiry that are of interest when one seeks to build an evolutionarily plausible theory of labels and operation Label: (i) linguistic constraints on adjacent elements of the same type such as Repetition/Identity Avoidance ([*XX]), (ii) data that flout these constraints ([XX]), (iii) disorders that raise questions as to whether the locus of impairment is a categorial feature per se, and (iv) operation Label as a candidate for human uniqueness. After discussing categorial identity through these perspectives, this work first traces the origins and manifestations of Identity Avoidance in language and other domains of human cognition, with emphasis on attention orienting. Second, it proposes a new processing principle, the Novel Information Bias, that (i) captures linguistic Identity Avoidance based on how the brain decodes types and tokens and (ii) explains the universal fact that generally the existence of adjacent occurrences of syntactically and/or phonologically identical tokens is severely constrained.

Keywords: attention; categories; Label; repetition avoidance/blindness

1. Introduction

Over the last five decades, linguists have observed a very interesting phenomenon: Elements of the same type are unlikely to occur in immediately adjacent positions; instead, they are usually mediated by other elements. This observation has been described in different, yet similar ways, in the linguistics literature: Obligatory Contour Principle (OCP; Odden 1986, Yip 1988), Identity Restrictions/Avoidance

(Berent et al. 2012), Similarity Avoidance (Frisch et al. 2004), or Repetition Avoidance (Walter 2007) in phonology, Identity Avoidance (van Riemsdijk 2008), Distinctness (Richards 2006, 2010), or absence of X-within-X structures in syntax (Arsenijević & Hinzen 2012). In the syntactic domain, this is also the basis for anti-locality relations (Grohmann 2003). All these different designations essentially describe various versions of the same observation: adjacent elements of the same type or category are either constrained or prohibited (henceforth [*XX]), depending on how strong the ban is argued to be. The ban spans across not only domains of grammar, but languages too. As Berent et al. (2012) note, constraints on identity have been shown to generalize across both natural languages (Berent & Shimron 2003, Berent et al. 2001, 2004) and artificial ones (Marcus et al. 1999, Nevins 2010).

At the syntactic level, the postulation of such a ban that constrains or prohibits identity-adjacency requires *granting an identity* to X in [XX]. In other words, it requires the existence of categories. It has been recently argued that linguists today are in a position to observe how functional elements such as auxiliaries and determiners consistently appear in specific configurations that grant grammatical identity, but still our theory about them can *merely stipulate* the attested orders, with the hope to derive this stipulation in the future (Adger 2016 based on Grimshaw 1991). This is not the first time that this point is raised. Breheny & Adger argued that in

> the context of the current research programme the nature, number and order of functional projections is a descriptive explanandum rather than the explanation. It is a goal of current research to discover reasons why functional categories are structured as they appear to be in terms of interface properties.   (Breheny & Adger 2005: 1674)

Overall, it seems that not adequate progress took place in the last decade for us to fully develop a theory of categories that has replaced stipulations and explananda with explanations.

Against this background, it will be argued that it is important to approach the process of 'granting identity' from different perspectives in order to understand what it corresponds to and how it is manifested cross-linguistically across cases of typical and atypical language development. The present work defends the idea that grammatical categories are not intrinsic to Mergeable Items (henceforth, MIs), building on Lenneberg's (1975) claim that syntactic objects are definable contextually. For Lenneberg, linguistic categories are to be understood as relationships, not as absolute constructs; an idea compatible with Ross' (1972) graded continuum of categories. If categorial features are not intrinsic to MIs, they can be eliminated from the Universal Grammar (UG) inventory. Eliminating them and subsequently approaching Label as an extrasyntactic operation that falls within the 'third-factor'

domain would give rise to a picture that is compatible with a highly desirable, according to Chomsky (2007), bottom-up approach to UG. This, in effect, will result to a reduced degree of linguistic specificity that needs to be explained from an evolutionary perspective.

The aim of this work is twofold. First, to construct a theory of labels (understood for the purposes of the present work as containing only categorial information) and operation Label through bringing together different strands of inquiry: (i) linguistic constraints on adjacent tokens of the same type (e.g., van Riemsdijk's 2008 'Identity Avoidance'), (ii) data that flout these constraints (Leivada 2015), (iii) neurolinguistic arguments for category-specific impairments that raise questions as to whether the locus of the impairment is a categorial feature per se or parts of the information attached to the category at different levels of linguistic analysis (Barner & Bale 2002, Tsimpli 2013), and (iv) the operation Label as the key evolutionary novelty that distinguishes human language from the communication systems of other species through the development of grammatical categories which provided "a new mode of cognizing" (Hinzen & Sheehan 2013: 73; see also Hornstein 2009, Hornstein & Pietroski 2009, Murphy 2015a, and Goucha et al. 2017 on labelling as a candidate for human uniqueness). The second aim of this work is to show that cross-linguistic constraints on identity-adjacency are neither syntactic, nor linguistic in nature. They are the linguistic reflection of a general, cognitive bias that filters out multiple tokens of the same type when these occur in adjacent positions. In other words, it is true that elements of the same type do not generally appear in adjacent positions, but not because this would cause a derivation crash as it has been argued in the literature (Perlmutter 1971, Ross 1972, van Riemsdijk 1998, Grohmann 2000, Richards 2010), as the examples provided in section 2.2 show.

The next section deals with labels and operation Label. After defining [*XX] and analyzing counterexamples, the last two subsections will approach Label from a neurological and an ethological perspective respectively. Section 3 traces the origins of Identity Avoidance (also known as Repetition Avoidance) in cognition, linking anti-identity to how the brain decodes identical tokens, and presents the Novel Information Bias together with the rationale behind it.[1]

2.   Labels and Operation Label

When reading Lewis Carroll's *Jabberwocky* for the first time, speakers of English understand that 'gyre' and 'gimble' in 'Twas brillig, and the slithy toves/Did gyre and gimble in the wabe' are verbs. Even if they do not know the meaning of these words, they are still able to determine their category based on grammatical context. It seems that these MIs became verbs the moment they were placed in the right environment. They can become nouns too (e.g., 'Did wabe and gimble in the gyre') and English speakers would immediately interpret them as such, if they see them appearing in a 'nouny' context.[2]

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[1]   The terms 'Identity Avoidance, 'Repetition Avoidance' and 'anti-identity' are used interchangeably throughout this work. The first term is more prominently used in linguistics, whereas the second is mostly used in the neurocognitive literature.

[2]   The connection between Jabberwocky and an exocentric interpretation of categories à la Lenneberg is due to Laka (2013). In her words,

Eric Lenneberg has repeatedly argued that the categorization process is flexible and linguistic categories are not absolute constructs, but relationships that are definable only contextually (1967, 1975). In his words,

> I think it is a mistake to look at categories such as noun phrase, noun, verb, adjective, and so on, as absolute constructs. Instead, these terms are the names of *relations between concatenated words*. A word such as 'green' is no more an adjective, a verb, a noun, or a noun phrase when it appears in isolation than it is a subject or a predicate.
>
> (Lenneberg 1975: 24; emphasis added)

> Let us consider more closely the process of categorization that underlies semantics. Is it possible to characterize this cognitive activity any further? For instance, if the classification criteria are not usually physical dimensions, what are they? *The most outstanding feature of the "criteriality" is its great flexibility*. Sometimes the criterion is primarily one of "use that man makes of the objects"; sometimes it is a given aspect; sometimes a certain emotional state that all objects in that class may elicit in the viewer. *Any one category is not definable by only one, consistently applied criterion.*   (Lenneberg 1967: 332–333; emphasis added)

In Minimalism, Label is defined as the operation that grants identification of the category of an MI (Chomsky 2013): Following the union of two MIs through Merge, Label gives an identity to the newly formed MI. The syntactic configurations between non-atomic, complex MIs are often viewed as *relational* and interpretable at the interfaces (Hornstein & Nunes 2008, Chomsky 2013). The important question is whether this identity is intrinsic to atomic, non-complex MIs. In other words, is a noun something that is interpreted in a 'nouny' way at the interfaces (Narita 2011) or does it have the 'nouny' feature already grafted on to it in syntax? Also, is Identity Avoidance at the syntactic level the result of a ban that operates within narrow syntax proper or are the attested constraints on identity-adjacency the result of the low information value that repeated instances of 'nouny' elements would have once they are 'read' at the interfaces? These questions will be dealt with in the next two subsections.

2.1.   *Where Does Identity Avoidance Come From?*

When discussing labeling, many linguists have put forth the existence of a process or algorithm that interprets MIs contextually, at the interfaces (Pesetsky & Torrego 2004, Hornstein & Nunes 2008, Chomsky 2013). Others have argued in favor of certain MIs entering the derivation already endowed with categorial features (Cinque 1999, Rizzi 1997, Panagiotidis & Grohmann 2009, Panagiotidis 2011) or acquiring

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[t]he full meaning of those words eludes us, but the grammatical scaffold set by the recognizable function words allows us to make sense of the propositional structure of the poem, identifying nonsense words that speak of entities, properties and events. Very importantly, function words tell us how they are related.

(Laka 2013)

them in the course of the derivation through 'inheriting' them from the material they are attached to (e.g., the 'Categorial Identity Thesis' according to which functional heads that extend the projection of a lexical head share the categorial status of that lexical head; van Riemsdijk 1998, Grimshaw 2005).

When it comes to Identity Avoidance in language, the precise target of the anti-identity ban (i.e. whether the ban and its haplological effects target items that are morphophonologically *and* vs. or syntactically identical) is elusive and varies across proposals (cf. (1)–(9)). Roughly, the relevant proposals can be split into three groups. In the first group, the interface that figures more prominently in the discussions of the ban on adjacent elements of the same syntactic and/or morphophonological type is the articulatory-perceptual one (Phonetic Form, PF), as in (1)–(5).

(1) I take it that at least some instances of haplology are purely morphophonological. For example, Bošković [(2002)] and Bošković & Nunes (2007) provide evidence that the ban against identical wh-phrases in multiple wh-fronting languages is a purely PF-matter.   (Boeckx 2008: 113)

(2) In our account, haplology is either phonological or motivated by independent syntactic principles having to do with the size of the complement of a lexical head or with the functional hierarchy.   (Fábregas 2014: 37)

(3) The Syntactic OCP: Multiple elements with an identical morphophonological specification are disallowed in the same Spell-Out domain at PF.

(Hiraiwa 2010)

(4) Double Determiner Filter: *[D1...D2] where no lexical head intervenes between D1 and D2. Determiner Deletion: Delete one of two phonologically adjacent determiners.   (Davis 2010: 23)

(5) Falling again within the realm of reduplication that 'accidentally' creates an exact copy—without intending to—are cases of consonantal fixed segmentism and spontaneous 'avoidance' that occur with echo word formation and related phenomena. For example, English *shm*-reduplication results in a reduplicant whose onset is *shm-*, e.g. flowers, shmowers. Nonetheless, as a large-scale survey by Nevins & Vaux (2003) shows, speakers do not tolerate such reduplication when the base itself begins with this sequence. Thus, the name *schmidt* must undergo alternate attempts, such as *schmidt-shpidt*, *schmidt-flidt*, etc. Surprisingly, this phenomenon extends to practically every case of echo reduplication that exists [...].   (Nevins 2012: 109)

In the second group, the role of PF is diminished and [*XX] is described as a purely syntactic/grammatical constraint ((6)–(9)).

(6) *XX sequences of identical functional heads are ill-formed.

(Grimshaw 1997: 170)

(7) Data concerning complementizer substitution in Dutch show that in syntax, as in morphology, a condition that bans adjacent identical heads can have the effect that one head is replaced by a counterpart that has the wrong fea-ture specification for the syntactic context.   (Ackema 2001: 725)

(8)   If a linearization statement $<\alpha, \alpha>$ is generated, the derivation crashes. [...]
      Distinctness effects are crucially sensitive to syntactic structure, and are not
      about linear adjacency.   (Richards 2006: 4, 12)

(9)   [T]here is a grammatical (non-semantic) constraint in English that prohibits
      double negation, dubbed *NEG NEG [...].   (Collins 2016)

The third group is the smallest one and consists of few studies that do not ap-
proach the ban on identity as linguistic (either syntax- and/or PF-induced), but as
the outcome of a more general principle of human cognition that may find applica-
tion in language, the way it finds application in other cognitive domains ((10)–(13)).

(10) [...] Identity Avoidance is a general principle of biological organization: its
      effect can be detected at both interfaces, PF and LF.

                                                             (van Riemsdijk 2008: 242)

(11) It seems, then, that repetition avoidance is universal in the sense that it seems
      to occur in virtually every human language, in every grammatical subdo-
      main, and in other cognitive domains as well.   (Walter 2007: 6)

(12) Rather, identity is created in a number of ways [...] but in some cases, it may
      be disfavored for reasons that range from perceptual difficulty to articulatory
      fatigue.   (Samuels 2014: 357)

(13) Richard's (2010) Distinctness Condition, prohibiting the presence of multi-
      ple lexical units of the same label within a single phase complement, may
      be the consequence of how many distinct rhythms it is possible to couple in
      specific actions (Boeckx 2013). These XX-like structures (e.g., structures con-
      taining multiple phase-internal nouns such as *John Mary ate apples) may be
      ungrammatical because of the oscillatory patterns local language regions can
      sustain.   (Murphy 2015b: 13)[3]

In line with the main claim of the third group, in this work I will defend
the idea that Identity Avoidance is not linguistic in origin, but boils down to gen-
eral cognitive architecture, and more specifically to a bias that I call *Novel Informa-
tion Bias*. In what follows, I present grammatically licit, [*XX]-violating structures.
Then, I approach labels and labelling from different perspectives with the aim to
bring together all the necessary pieces in order to evaluate Novel Information Bias
and the rationale behind it in section 3.

2.2.   *Licit [XX]: Flouting Identity Avoidance*

Identity Avoidance is a well-observed condition that operates at different levels of
linguistic analysis. At the syntactic level, many studies analyze the mechanics of
Distinctness through which anti-identity is achieved in a number of cases (e.g., by
adding structure in nominalizations: the destruction of the city vs. *the destruc-
tion the city; Alexiadou 2014). However, despite the fact that languages indeed
employ a range of grammatical options in order to avoid [XX], it would be wrong

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[3]   For another detailed analysis of anti-identity captured in terms of oscillatory brain rhythms,
      see Ramírez Fernández (2015).

to conclude that [XX] patterns do not exist in various spoken and signed languages (Leivada 2015).

The very fact that such patterns are possible suggests that, contra what has been repeatedly claimed in the relevant literature, *there is no [*XX] ban in syntax* that prevents two MIs of the same category from being merged together. More importantly, if Lenneberg's theory is on the right track, then syntax/Merge *cannot* even 'read' whether the two MIs that it puts together belong to the same category or not, because a category is only defined *post*-syntactically, in relation to the grammatical or discourse context.[4] I argue that this explains why [XX] patterns like the ones in (14)–(16) are licit and eventually surface cross-linguistically, even despite the fact that repeated occurrences of the same item obviously carry low information value.

(14)   *European Portuguese*

Acho   **que** amanhã **que** a Ana **que** vai conseguir acabar o   trabalho.
think.1SG that tomorrow that the Ana that will manage   finish   the assignment

'I think tomorrow Ana will manage to finish the assignment.'

(Mascarenhas 2007: 10)

(15)   *Greek*
   a. **Kapçi** (**kapçi**) kala ϑa   kanun na   citun   ti ðulia tus.
      some   some   well FUT do.3PL SUBJ see.3PL the work POSS
      'Some people would do well to mind their own business.'

(Leivada 2015: 54)

   b. **Merici** (**merici**) ðen   katalavenun   tipota.
      some   some   NEG understand.3PL nothing
      'Some people don't understand a thing.'

(16)   *Dutch*

Ik heb   het anders   eens epresteerd   om mijn   schoenen
I   have.1SG it   otherwise once manage.PTCP to   POSS shoes
verkeerd-**om**-**om**   aan te   trekken.
wrong-around-around on   INF put.INF

'I once managed to put my shoes on the wrong way around.'

(Aelbrecht & den Dikken 2013: 41)

These examples show adjacent occurences of functional heads, not mediated by other functional categories. (14) features adjacent complementizers, (15) indefinite articles, and (16) prepositions. The syntactic analyses of these structures have

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4   This idea is also compatible with standard assumptions about the contextual definition of categories within the framework of Distributed Morphology. Consider, for instance, the following claim by Marantz:

[r]oots like √DESTROY and √GROW (to borrow notation from Pesetsky 1995) are category neutral, neutral between N and V. When the roots are placed in a nominal environment, the result is a 'nominalization'; when the roots are placed in a verbal environment, they become verbs.   (Marantz 1997: 215)

been already discussed in detail elsewhere (Mascarenhas 2007, Aelbrecht & den Dikken 2013, Leivada 2015), hence they will not be presented any further here. However, it is important to note that the repeated elements in (14)–(16) are not subject to analyses that treat the two identical tokens as belonging to different syntactic categories. In this sense, Identity Avoidance violations concern syntactic categorization. Similarly, Lenneberg's (1967) argument about the great flexibility and contextual definition of categories does not concern only semantic categories. This is evident in his later work:

> Although words are discrete entities, they represent or are the product of underlying continuous cognitive and physiological processes. These deeper continuities are reflected *in the "fuzzy" nature of semantic, syntactic, and phonological categories, making sharp, formal distinctions and decisions difficult*.   (Lenneberg 1975: 17; emphasis added)

In relation to the examples in (14)–(16), the important conclusion that can be reached is that depending on which version of the ban in (1)–(9) one assumes, these examples should be illicit, as they flatly violate Identity Avoidance on both the syntactic and the phonological level, yet they are perfectly well-formed in the languages in which they belong.

Although these examples suggest that Identity Avoidance is not a syntactic ban, there is no doubt that generally the existence of adjacent occurrences of syntactically and/or phonologically identical MIs *is* severely constrained. Therefore, one can still assume that Identity Avoidance is indeed operative in language, but crucially not in the form that most studies suggest. More specifically, first it is not a *hard constraint* or a *ban*, but a *flexible bias*. [XX] tends to be infrequent in languages, but it is realized in a cross-linguistic manner, regardless of modality of externalization (see Leivada 2015 for more examples of [XX] in spoken and signed languages). Second, it is not a syntactic or linguistic bias. It may find application in language, but it has parallels in other domains of human cognition (Walter 2007). If one adopts Chomsky's (2005) proposal about the existence of three factors in language design, then Repetition Avoidance, not being specific to language, would fall in the third factor.[5]

Insofar, the above examples have shown that licit [XX] patterns can flout Identity Avoidance across languages and levels of analysis. However, they have not revealed much about labels and operation Label. Is X endowed with categorial features in syntax proper? The fact that syntax can put [XX] together can be taken to suggest that syntactic objects acquire their label contextually, at the interfaces, as Lenneberg (1975) and Chomsky (2013), among many others, have suggested. However, it could equally be the case that precisely because the anti-identity bias is a bias and not an absolute ban, it can ignore the categorial features that X is endowed with in syntax. In other words, [XX] patterns do not suffice to answer questions about whether nouns and verbs are interpreted as such at the interfaces or they have the corresponding 'nouny' and 'verby' features already grafted on to them in syntax. Moreover, [XX] patterns cannot provide alone a complete understanding of the op-

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[5]   Chomsky (2005) argued that there are three sets of factors in language design: 1) biological endowment specific to language (UG), 2) experience, and 3) principles of general cognition that are not specific to language.

eration Label. For these reasons, the next two subsections will approach labels and Label from the neurolinguistic and the ethological perspective, respectively.

2.3.   A Neurolinguistic Approach to Categories

Neurolinguistic arguments for category-specific impairments raise questions as to whether the locus of impairment is a categorial feature per se or parts of the information attached to the target form at different levels of linguistic analysis. For instance, in the literature on aphasia and other pathological phenotypes, one finds many case studies that show disproportionate impairment of noun vs. verb retrieval since the mid-1980s (Crepaldi et al. 2011, Kambanaros & Grohmann 2015). One wonders whether this differential performance can be the result of a type of "feature blindness" (Gopnik 1990) that is sensitive to categorial features.

Barner & Bale (2002) were among the first to address the issue of categorial identity from a neurolinguistic perspective. Asking,

> [h]asn't it been shown that certain patients are selectively impaired for nouns or verbs? Doesn't this evidence mean that nouns and verbs must be marked in the lexicon?   (Barner & Bale 2002: 775)

Barner & Bale (2002) adduced two important arguments in order to give a negative answer to the last question. First, they observed that even in pathologies that typically involve a noun-verb dissociation, it is usually seen that patients do not omit target forms altogether. For example, if the deficit is mainly found in verbs, what happens is that patients commonly produce a target verb in its bare infinitive form rather than the inflected, target form. This suggests that the locus of impairment boils down to morphological markers and not to categorial features. In other words, failure to produce the inflected form entails an impairment in accessing the *surface* representation of this form, at the level where morphophonological specification takes place. This explains why patients that are unable to produce a fully inflected form can still access and correctly report information on its grammatical features (for example, gender in the case of the patient with Alzeimer's disease reported in Hernández et al. 2007).

Defining the different levels of access, models of language processing have proposed that word retrieval is a process that can be divided into discrete phases: (a) lemma selection and (b) lexeme retrieval (Levelt 1989). The lemma is an abstract conceptual form without morphophonological specification. After lemma selection, lexeme retrieval takes place: the lexeme that corresponds to the selected lemma is morphophonologically specified. Levelt's (1989) model has been highly influential in neurolinguistics precisely because findings across pathologies suggest that a lemma/lexeme distinction is necessary. Mapping this model to what looks like a category-specific impairment, the difficulty lies in lexeme retrieval, not lemma selection. The noun-verb dissociation that is found in many studies usually boils down to atypical morphology manifested through impaired lexeme retrieval.

The second argument of Barner & Bale (2002) is that selective impairments that affect one category are often shown to be modality-specific too. They cite the case report of Caramazza & Hillis (1991) that involves a patient who, although impaired in her spoken production of target verbs, showed no problem writing

the same words. This dissociation between modalities would not be possible if the locus of the impairment was the Verb category, as Caramazza & Hillis (1991) also note. If a categorial feature was truly impaired or inaccessible in this patient, how is it possible that in some modalities it appeared completely unaffected?

It has been recently argued that the question as to whether the category distinction itself is the driving force of the selective impairment of some categories or whether semantic and perceptual distinctions in nouns and verbs are responsible for the attested effects is not resolved yet (Tsimpli 2013). For this reason, I will review below three case studies that show selective impairment of some category with the aim to show that the attested impairment is not due to a category deficit, but to morphophonological realization at the surface level (i.e. lexeme retrieval).

Hernández et al. (2007) present the case of a Spanish-Catalan bilingual woman (LPM) with Alzheimer's disease whose linguistic production shows a category-specific deficit. In naming tasks, her performance was significantly better for verbs compared to nous. Hernández et al. (2007) present this as a case of a category-specific impairment, but it is important to highlight three crucial aspects of their results before evaluating the 'category-specific' nature of the deficit. First, LPM has access to semantic representations for both verbs and nouns as evidenced by her high performance in a word-picture matching task that used the same material as the naming task. Second, she does not show the noun-verb dissociation in comprehension tasks. Third, some of her errors consist of circumlocutions that reveal intact access to both verbs and nouns, although not always the target ones (e.g., target response: *tostadora* 'toaster', actual response: *sirve para tostar el pan* 'used to toast bread'). In this example, LPM makes a naming error in the 'noun' condition. The target noun is not produced, but another noun *is* used in the circumlocution she employs. How is it possible that LPM can produce this noun in a grammatical way if the N feature is missing from her repository due to a category-specific feature blindness? In sum, LPM seems to have trouble accessing the target lexemes. Her naming errors involve morphological paraphasias (e.g., target response: *planxa* 'iron', actual response: **planxadora*, a neologism) and this suggests that the locus of the impairment is not a categorial feature, but impaired access to morphophonological specification at the lexeme level. As verbs and nouns involve different morphological markers, different degrees of disruption are possible, hence the attested verb-noun dissociation. Similar results have been robustly found in other impaired phenotypes too (e.g., anomic aphasia; Kambanaros 2008).

Laiacona & Caramazza (2004) present two cases that show verb-noun dissociation: EA, a man suffering from herpes simplex encephalitis and MR, a woman who has suffered a stroke. EA showed a better performance in naming actions, whereas MR was better in naming objects. Laiacona & Caramazza argue that their results suggest that "a possible grammatical-specific deficit could be detected" (2004: 110). In these cases, too, there are indications that the locus of impairment is not a categorial feature. First, both EA and MR performed at ceiling (above 98 %) in the picture-word matching task. This suggests that they had access problems: they were not able to retrieve and produce the target word, but they were able to correctly select it and match it with a picture, once presented with it. Also, both EA and MR had problems with morphology: EA with irregular noun morphology (mainly producing the plural forms) and MR with verbal morphology both regular and ir-

regular. Finally, notice that the lowest accuracy performance in the picture naming task was 42 % (EA: actions: 82 %, objects: 42 %; MR: actions: 70 %, objects: 90 %); a strikingly high percentage for somebody that has a deficient N feature. Overall, it seems that in these case studies too, one cannot straightforwardly witness a missing or impaired categorial feature.

To claim a neural basis, one needs to refer to case studies that show (semantic) category dissociations because of a discrete lesion in a specific brain area. This does not imply the need to find a one-to-one mapping (i.e. a linguistic primitive that corresponds to a unique disorder or maps onto a single brain area). Some loci of impairment at the neural level are, however, expected to be consistently present. Indeed, certain category-specific semantic deficits *have* been associated to brain regions. However, these refer to highly specific semantic distinctions, such as vegetables vs. fruits, and not to broad semantic distinctions that are based on *lexical category*, such as nouns vs. verbs. For instance, the case study presented in Levin et al. (2005) is that of a man who exhibited a language impairment following a left anterior thalamic infarction. His naming abilities were selectively impaired with some categories (e.g., tools, clothes, transportation, fruits) being better preserved than others (e.g., vegetables, toys, animals and body parts) in the visual modality. Crucially, much like the comprehension-production dichotomy observed earlier, here too a dichotomy is found between naming in animate and inanimate categories in the visual and tactile modalities, but not when the patient responded to auditory stimuli. In Barbeau & Giusiano (2003), another patient showed lesions located primarily in the left inferior temporal lobe, and his linguistic behaviour involved a dissociation between the manufactured vs. natural objects category. In other research, a specific type of nouns, that of manipulable objects, has been linked to lesions in the posterior middle temporal gyrus (Campanella et al. 2010).

The message that emerges is clear: Topographical differences in brain activation are *not* driven by broad semantic distinctions that are based on lexical category (e.g., nouns vs. verbs), but by finer semantic distinctions (e.g., concrete noun/verb vs. abstract noun/verb; Moseley & Pulvermüller 2014). These results suggest that categories that are based on lexical class are *theoretical constructs* and *not discrete primitives* that drive brain representation as such. A variety of different reasons support this claim. First, there is no confirmed discrete lesion pattern for a noun-verb dissociation; the attested dissociations are based on finer semantic distinctions and a categorial feature such as 'noun' is never consistently impaired. Second, the dissociation is not preserved across modalities, and it should be if the locus of impairment truly was a categorial feature. Third, apart from modality effects, task effects have also been observed (e.g., see Kambanaros 2014 on how the vulnerability of verbs in children with Specific Language Impairment shows up in naming tasks but not in connected speech).

The discussion has so far revolved around nouns and verbs because this dissociation has been the focus of attention in the relevant literature. However, if categorial feature blindness existed, it could conceivably apply to functional categories. Yet, there is no known case of a patient with a developmental or an acquired disorder that has suffered a total loss of a category (e.g., no nouns can be produced/comprehended) or that consistently misapplies labels in a way that results to the use of complementizers where one expects to see determiners or clitics

when one expects modals, due to categorial feature blindness. Also, a sharp difference is consistently found between affected production and intact comprehension across patients and pathologies. These observations suggest that in studies that report a category-specific deficit, the locus of impairment is not the categorial feature per se, but part of the information attached to the target forms at the various phases of lexical access.

The conclusion to be drawn is that the neurolinguistics literature does not seem to offer cases in support of missing or damaged categorial features. This absence can raise concerns as to whether categorial features exist at all as separate entities in a feature inventory. Going back to Narita's (2011) question, seeing that an impaired noun feature does not exist as such in the findings of neurolinguistics paves the way for arguing that a noun is something that is interpreted in a 'nouny' way in relation to the environment in which it is encountered. This conclusion supports Lenneberg's (1967, 1975) claim that nouns, verbs, and other categories, are not absolute constructs, but *flexibly established* and *contextually defined relations* between words.

2.4. *Operation Label as the Key Evolutionary Novelty?*

The main aim so far was to show that labels are not intrinsic to MIs and constraints on identity-adjacency do not have a linguistic —much less syntactic—origin. Instead, these constraints have been described as language-external and deriving from a general cognitive bias. In addition, it has been argued that nothing attests to categorial features having the status of individual primitives in the neurolinguistics/clinical linguistics literature. Based on what has been reviewed so far, it seems that Label is an extra-syntactic operation and that MIs are granted their identity contextually.

Switching to an ethological perspective, the picture somewhat changes. Several studies have suggested that the operation Label is the locus of human uniqueness, the novelty that distinguishes human language from the communication systems of other species (Hornstein 2009, Hornstein & Pietroski 2009, Murphy 2015a, Goucha et al. 2017). If a labelling algorithm that forms asymmetric hierarchical structures in syntax is indeed the key evolutionary novelty, Label belongs to the core of the language faculty (FL) and should fall in the first factor in language design (UG, according to Chomsky 2005) or FLN(arrow), if one adopts the distinction between narrow and broad FL (Hauser et al. 2002). Yet the theses reviewed so far suggest the opposite. More concretely, going back to how categories are treated in Lenneberg (1967), the difference between human language and systems of communication in other species is *quantitative*, not qualitative. Lenneberg has argued that most animals organize the world by some process of categorization which is not formally different than man's concept formation, but only differs in terms of the number of total possibilities for categorization that exist (1967: 331-332). If the categorization process is not peculiar to man—and it is not per Lenneberg—, we can employ a bottom-up approach to animal and human cognition(de Waal & Fer-

rari 2010) by discussing the shared properties of categories in human language and those in other species' 'language'.

   Comparing human language to animal communication, Berwick et al. (2013) highlight the *flexibility of labels* in the latter, but not in the former, when they write that

> [a]s an example of this gap [between the two], Laura-Ann Petitto, one of the leading researchers of primate communication and early language acquisition, observes that a chimpanzee uses the label for 'apple' to refer to 'the action of eating apples, the location where apples are kept, events and locations of objects other than apples that happened to be stored with an apple (the knife used to cut it), and so on and so forth—all simultaneously, and without apparent recognition of the relevant differences or the advantages of being able to distinguish among them' ([Petitto 2005:] 86).   (Berwick et al. 2013: 92)

However, it is precisely this great flexibility of categories that Lenneberg (1967) has called the "most outstanding feature of human 'criteriality' in the context of *human language*. Data from languages that are not heavily grammaticalized suggest that he is right. Riau Indonesian in (17) is one such case.

(17)   *Riau Indonesian*

   ayam   makan
   chicken eat

   (an association of CHICKEN and EAT)

                                                    (Gil 2009: 23)

The MIs in (17) receive their grammatical identity post-syntactically, depending on the context. (17) can thus mean that 'the chicken is/was eating' or 'the chickens that were eaten' or 'the reason chickens eat'. Overall, it seems that a great degree of flexibility is involved when interrelating the MIs that make up (17). If categories are defined post-syntactically, there are no 'nouny' or 'verby' features per se in syntax, which would then explain why such as a feature inventory fails to show up as atypical in the neurolinguistics literature.

   One could observe at this point that Lenneberg talks about *broad* semantic distinctions when he argues that nouns and adjectives are not absolute constructs, whereas Berwick et al. (2013) talk about *narrow*, individual labels (e.g., apple to refer to APPLE, instead of the broader label 'noun'). However, flexibility characterizes both types of labels in human language. Data from Riau Indonesian paint only half of the picture in showing that broad distinctions—such as noun, verb, and tense—can be flexibly established as context-dependent relations between MIs (granting support to Lenneberg's claim). Data from recently emerged sign languages paint the other half, providing unique insights into how narrow labels are flexible too. Importantly, these data defy one of the design characteristics (in the sense of Hockett 1960) of human language: signifier-signified consistency. This term refers precisely to the (synchronically) inflexible nature of the association between apple and APPLE in human language. Unlike other species (see Berwick et

al.'s earlier point), humans that speak English will form this association in a consistent fashion, without changing 'apple' into another string of sounds for denoting APPLE and without attaching to this string of sounds a different concept. Yet, studies on different 'newborn' sign languages have noted the *absence* of this consistency in the early stages of the development of a language (figure 1). Washabaugh (1986) on Providence Island Sign Language and Sandler et al. (2011) on Al-Sayyid Bedouin Sign Language give similar reports on how consistency *gradually* improves over new generations of speakers.
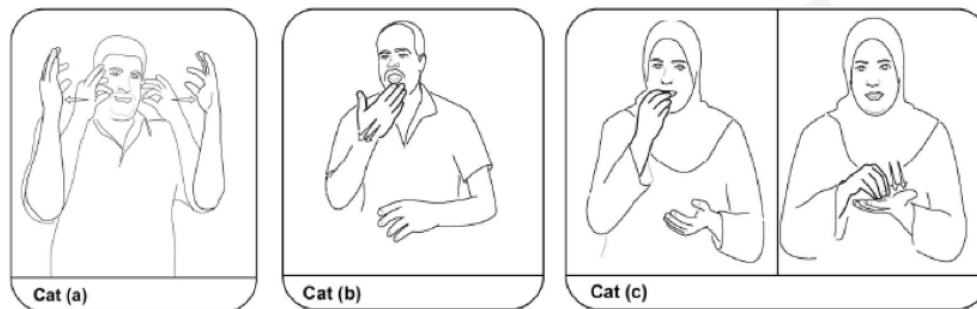

Figure 1: Absence of signifier-signified consistency in Al-Sayyid Bedouin Sign Language—three variants of CAT (Meir et al. 2010: 19).

Gradual development entails that the fact that some languages do not employ a verb-noun distinction (see Tkachman & Sandler 2013 for examples) does not mean that the speakers or signers of these languages cannot employ it. Absence of use does not entail absence of ability; the former may depend on many environmental factors. Crucially, the same argument can be evoked for other species. Consider, for instance, how Bengalese finches, the long-domesticated strain of white-rumped munia, have developed a phonologically and syntactically richer repertoire in comparison to their wild relatives (Okanoya 2012). White-rumped munia songs *could* have been equally complex, but they are not, because of the different environmental needs that drive their performance (e.g., strength of sexual selection; Okanoya 2015). In this context, other species may lack—*to the best of our knowledge*—a range of semantic categories that is quantitatively comparable to ours, but this speaks about actual use, not ability.[6]

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[6]   Green & Marler (1979) raise a similar point for primate languagelike behavior, when discussing the linguistic abilities of chimpanzee Sarah (Premack 1971):

Within her repertoire of about 130 words were not only many nouns, verbs, and adjectives but also more complex constructions, such as *same*, and *different*, questions, and the conditional *if-then*. [. . .] The accomplishments of chimpanzees using languagelike systems of signaling to converse with an experimenter are surely the highest animal attainments demonstrated so far. Yet, they also raise a curious dilemma. If a chimpanzee can indeed achieve some elementary competence with language when provided with an appropriate vehicle, why is the evidence for symbolic usage in nature so limited? It may well be that the paucity of our knowledge of natural communication in animals is such that *we can hardly judge whether such abilities are demonstrated in nature or not*. However, it is also possible that in most social interactions, *animals have little use for languagelike patterns of communication* [. . .].

(Green & Marler 1979: 133–134; emphasis added)

The inter- and intraspeaker variability found in 'newborn' sign languages is extensive (Washabaugh 1986), clearly pointing to the fact that both narrow and broad labels can allow for some degree of flexibility in human language. For the purposes of the present discussion, the important conclusion is that data from different spoken and signed languages attest to the fact that "category distinctions do not come ready-made into language" (Tkachman & Sandler 2013: 277). These data grant further support to Lenneberg's (1967, 1975) view of categories as flexibly established and contextually defined relations.

Going back to the ethological literature, despite the line of studies that suggest that Label is the locus of humaniqueness, it seems that other species do have a range of broad, contextually-defined categories (i.e. broad labels) in their repertoire. In animal communication, vocal labeling refers to incidents in which an animal *consistently* uses an acoustic signal when presented with a specific object or class of objects (King & Janik 2013). Primatologists have argued that non-human primates possess a number of calls—alarm calls, copulation calls, moving grunts when foraging, infant handling grunts, contact barks, contest wahoos—that function as *semantic labels* linked both to real-world relations and to other elements in the repertoire itself (Cheney & Seyfarth 1997, 2010).[7] This is reminiscent of human language, where words may refer to real-world entities and be semantically related with other words. Second, similar to how nouns and verbs in human language "represent different viewpoints on concepts" (Panagiotidis 2015: 2), the calls of Diana monkeys seem to represent different viewpoints on the type of stimuli they denote. More specifically, when perceiving a threat, their alarm calls indicate the predator's biological class: they represent *predator category* in a *referential way*,[8] and these calls are interpreted as such by conspecifics regardless of immediacy of threat or direction of attack (Zuberbühler 2000). Third, these alarm calls encode other types of semantic information (e.g., elevation, distance) through vocal tract filtering, another ability once thought to be restricted to human speech (Zuberbühler 2000, Riede & Zuberbühler 2003). Last, as happens in human language, non-human primates may take into account *pragmatic context* when interpreting call meaning (e.g., the peep calls of bonobos; Clay et al. 2015).

Narrow labels are also found in the communication systems of other species. Baboons can process argument structure and reference to the extent of understanding the difference between *Sylvia threatens Hannah* and *Hannah threatens Sylvia* (Cheney & Seyfarth 2007). Even more special is the case of Bottlenose dolphins, which have the *signature whistle* in their repertoire; a unique signal that encodes individual identity independently of voice features (King & Janik 2013). Much like narrow labels in human language, this whistle *labels individuals* in a way that involves a stable association between a signifier and a signified.

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[7]   As Cheney & Seyfarth (1997) clarify, these labels really deserve the designation 'semantic', because they evoke the same responses from recipients as do the stimuli to which they refer.

[8]   Kaplan (2008) and Watson et al. (2015) have also found use of referential calls in the repertoire of Australian magpies and chimpanzees, respectively. With respect to the latter, it was found that the referential vocalizations of chimpanzees were not determined by arousal, leading Watson et al. (2015) to claim that the socially learned aspect of reference in human language has ancient evolutionary origins, uncovering yet another similarity between human language and non-human communication systems.

All these different labels that are scattered in the repertoire of different species beg the question of whether Label is truly the locus of humaniqueness. While it is probably true that other species do not possess as many fine-grained categorial distinctions as humans, this section aimed to show that they have some, in agreement with Lenneberg's (1967) proposal that the categorization process is not peculiar to man. What degree of uniqueness does the description "unique to human language" require then? When a property has parallels in the communication systems of other species, shouldn't some degree of difference be tolerated, given that we deal with quite different physiological implementations of this property across species? If the answer is positive, labels seem to fall in the domain of properties that are shared across different species.[9]

3.   Decoding Adjacent Tokens of the Same Type: The Novel Information Bias

It has been argued that anti-identity derives from a cognitive bias that is diffused across domains of human cognition (Walter 2007, van Riemsdijk 2008, Samuels 2014). Not being specific to language, it would be a third factor bias, if one adopts Chomsky's (2005) proposal about the existence of three factors in language design. Within linguistics, few works have recognized this domain-general character of anti-identity (see ((10)–(13)). Two of the studies that elaborate on its origin are Walter (2007) and Murphy (2015b).

Starting from the latter, Murphy's effort to *derive* linguistic constraints by tracing their origins in the brain is definitely on the right track when the aim is to reach explanatory adequacy. There is, however, a slight caveat to be considered: his background assumptions in (13) seem too strong, given that grammatically licit counterexamples exist. If little verbs count as phase heads, as is standardly assumed, and Collins (2002) is right about serial verb compounds in ‡Hoan adjoining to a little verb *v*, the result is a phase head that has two elements of the same label in its complement. In other words, the presence of multiple lexical units of the same label within a single phase complement is *not* prohibited. Importantly, if Lenneberg is right about the contextual definition of categories, nothing could prohibit it, because an MI does not go into the derivation bearing categorial features such as N, V, or *v*. Put another way, if the labels of the elements that build up the complement of a phase head are (contextually) granted after transfer, how could identity-adjacency be first detected and then prohibited in syntax proper, within the narrow confine of a complement? Data from different languages ((14)–(16), see also Collins 2002 and Leivada 2015) show that it is not.

Walter (2007) offers an extensive analysis of anti-identity, dealing with its behavioral manifestations both in language and other cognitive domains, and identifying various reasons as an explanation of the fact that humans avoid adjacent repetitions of the same element. Her 'Biomechanical Repetition Avoidance Hypoth-

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[9]   Accepting the position that the categorization process is not unique to man does not alter the fact that labelling in humans is implemented through language. One could then ask whether any of the specifics of the labeling algorithm are unique to human language. In sum, labeling has parallels in the communication systems of other species, but this does not change the fact that when manifested in human language, labeling uses some linguistic machinery and inevitably acquires a linguistic dress.

esis' (BRAH) in (18) offers a *physiological* explanation, while she also recognizes the possibility of a *perceptual* motivation (19).

(18)   *Biomechanical Repetition Avoidance Hypothesis*
       Repetition of articulatory gestures is relatively difficult. This difficulty results in phonetic variation.

(19)   *The Repetition Deficit*
       Repeated items are at times not perceived as different occurrences at all. This tendency is a general characteristic of human cognition.

(18) entails that in [XX] sequences, it is likely that the two elements will not be realized identically, in agreement with those studies that highlight the role of PF in deriving anti-identity (i.e. ((1)–(5)). (19) has its roots in a phenomenon called *Repetition Blindness*: It has been shown that in rapid serial visual presentation of words— above normal reading rate but well within limits of accurate reading potential—, subjects have difficulty in detecting repeated words (Kanwisher 1987 et seq.). This phenomenon is not restricted to language. It also occurs between color patches (Kanwisher et al. 1995), pictures of natural objects (Buffat et al. 2013), and visually different items that are phonologically similar and semantically related (e.g., a picture of the sun and the word "sun") or phonologically similar and semantically unrelated (e.g., a picture of the sun and the word "son"; Bavelier 1994).

A concrete illustration of the fact that humans avoid repetitions is the 'apparent motion' illusion: Identical stimuli flashed in different locations are usually perceived as a single moving stimulus. People show a clear preference for perceiving these identical stationary tokens that blink on and off alternatively as one moving token (Vetter et al. 2012 and references therein). Language is not involved in this illusion; a fact that suggests that there is a bias towards anti-identity that is operative across domains of cognition.

Another example of repetition avoidance in human cognition outside the domain of language comes from experiments that measure random number generation. It has been consistently found that adjacent repetitions of the same element are avoided in human response sequencing (Towse 1998, Towse & Neil 1998), even if participants were not instructed to not produce them. The tendency is to avoid repetitions among immediately adjacent responses and to repeat after a lag of several responses. The explanation given for this performance is rooted in a general cognitive mechanism that inhibits responses that have been just produced (Towse 1998).

Comparing the different motivations behind anti-identity that are given in (18) and (19), it seems that the former would have trouble explaining the numerous cases where human language licenses multiple adjacent tokens of the same type for specific reasons.[10] For example, there are songs that repeat many times the same word. In telephone closings, a final farewell token such as 'bye' or 'ciao' is often repeated a couple of times (Auer et al. 1999 document cases of extensive repetition), probably serving as a conversation hedge. Reduplications of the same item when cursing are also typical in language (see Corver 2014 for data), strengthening

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[10]   I am grateful to Henk van Riemsdijk and Norbert Corver for bringing various cases of item repetition to my attention.

emotive content (Potts 1997). Moreover, item repetition is often used for achieving contrastive focus (Ghomeshi et al. 2004). Interestingly, even if in all those situations the repeated item is realized just a couple of times, there are occasions where the repetition is considerably broader than what one would expect if articulatory fatigue was the reason that humans avoid repetitions in language.[11]

Observing that there are contexts that call for adjacent repetitions of identical tokens, the next aim is to identify the motivation and exact circumstances that lead to flouting Identity Avoidance in language. The hypothesis put forth in (20) is developed on the basis of Kanwisher et al.'s (1995) observation that the attentional system responsible for integrating information of types and tokens may be unable to bind the appropriate identity (type) to distinct, adjacent representations (tokens). The novelty of this hypothesis boils down to offering an explanation as to why different degrees of Identity Avoidance-violations are realized in different linguistic circumstances, *depending on whether novel information is presented or not*. This explains why in (14)-(16) there are at most two or three repetitions of X—there are no grammatically licit structures that feature five adjacent complementizers—, but in a context where no new information is conveyed (e.g., telephone closings, songs, broadcasting while waiting for the match to resume etc.), five adjacent tokens of the same type are perfectly possible.

(20) *Novel Information Bias (NIB)*
      Subjects avoid tokenizing multiple, adjacent occurrences of the same type, because of a general bias in the cognitive system to provide more attentional resources to novel information, enhancing perception and production processes accordingly.

At the phenotypic level, the applications of NIB are so central to human language that if the process that underlies self-avoidance is consistently disrupted in contexts where new information should be conveyed, the result is an impairment called palilalia. Found in various neurological and psychiatric disorders, such as (early-onset) schizophrenia (Ferrara et al. 2006) and, more generally, in the psychosis spectrum (Geschwind 1974), palilalia involves repetition of entire words or utterances.[12] It is not an articulation-related disorder confined to spoken languages; cases of palilalia in the signed modality have been documented too (Tyrone & Woll 2008). (21) offers an example of palilalia in a patient with schizophrenia.

(21) Doctor: Okay, so [PATIENT NAME], you've been hearing voices.
      Patient: Yes, sir.
      Doctor: Uh, is that, like, every day?
      Patient: Not every day, yeah, every day, every –

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[11] To give one example, presenting the 2015 Champions League final, Lluís Flaquer announced the first goal of the match, producing 'goal' more than 20 times in a row in a time frame of 22 seconds.

[12] Patients with schizophrenia also perform slightly worse than neurotypical controls in tasks that measure Repetition Blindness (Kammer et al. 1998). Interestingly, a disruption in the process that underlies anti-identity at the phenotypic level may occur in parallel to a disruption in self-avoidance at the cellular level. Dysfunction of protocadherins, a group of transmembrane proteins that regulate dentrite self-avoidance, has been repeatedly implicated in schizophrenia and other neurological disorders (Hirabayashi & Yagi 2014, Hayashi & Takeichi 2015).

> Doctor: Every day.
> Patient: Every, every . . .

(Steuber 2011: 19)

Naturally, attention deficits are also fundamental in schizophrenia (Fioravanti et al. 2005), as NIB is directly related to how our system of attention filters incom-ing information, allowing the 'proactive' brain (Bar 2007) to extract the important parts and generate focused predictions about the future.

Kanwisher et al.'s (1995) observation that the attentional system responsible for decoding types and tokens may be unable to link repeated representations of the same type to different tokens can be connected with theories of how our parser deals with received messages and especially to the possibility of interference by various sources. More specifically, according to Shannon's (1948) mathematical theory of communication (figure 2), the transmission of a message can be affected by *noise sources*.
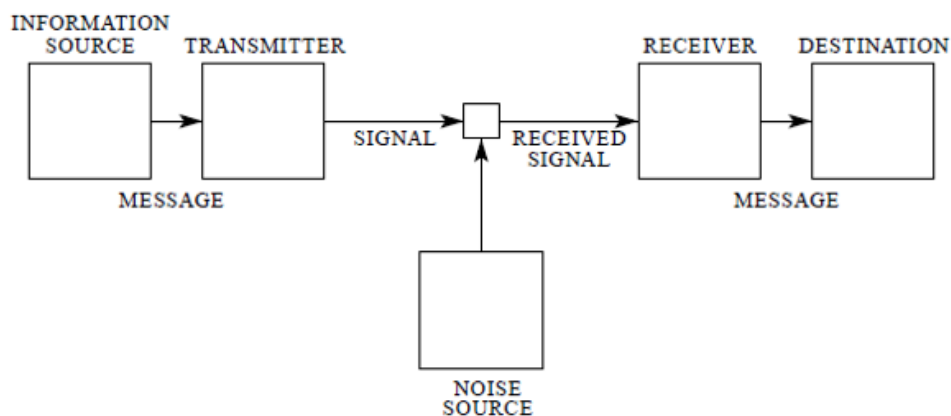

Figure 2: Shannon's (1948) schematic diagram of a general communication system.

The signal that the receiver gets can be corrupted because of noise at both the transmitter and receiver ends, hence the receiver must reconstitute the original message. The crucial part here is what Gallistel & King call one of Shannon's most "profound insights":

> What was essential about a message was not its meaning but rather that *it be selected from a set of possible messages*. Shannon realized that for a communication system to work efficiently—for it to transmit the maximum amount of information in the minimum amount of time—both the transmitter and the receiver had to know what the set of possible messages was and the relative likelihood of the different messages within the set of possible messages.

(Gallistel & King 2009: 6; emphasis in original)

Recognizing that the intended message is subject to noise due to a multitude of production errors that can interfere with its contents (e.g., wrong retrievals, tip-of-the-tongue states, self-interruptions, false starts, phonetic execution errors), the receiver knows that it is quite likely that many adjacent tokens of the same type

would constitute noise. If the parser's goal is to receive the maximum amount of information in the minimum amount of time, the parser must keep track of the key characteristics of noise and orient attention accordingly. Generalizing this effect, one obtains NIB: Receivers reconstitute the message, focusing their attention to *novel* information and filtering out potential noise. Adjacent repetitions are a prime candidate for the latter. In this context, NIB predicts that in situations where no new information is supposed to be conveyed, Identity Avoidance can be flouted to a greater degree (e.g., telephone closings, songs, etc.). Also, since NIB is a cognitive bias and not a syntactic ban, [XX(X)] is possible in grammar (as shown in (14)–(16)), although heavily constrained for obvious reasons. No language would deploy sentences with ten adjacent prepositions, determiners, or complementizers, because a big part of that message would have a very low information value. If such a sentence was realized, the receiver would recognize that repetitions are due to production errors or, in more serious cases, a disorder that affects linguistic performance (e.g., palilalia).

NIB could also be the source of Towse's (1998) performance bias that is responsible for inhibiting responses that have been just produced in random number generation. Based on the knowledge that repetitions are often filtered out as noise, NIB diffuses across domains of cognition, across comprehension and production tasks, and across settings, effectively establishing optimal conditions for communication at both the transmitter and receiver ends. Support for this claim comes from a recent experiment that involved random number generation, in which it was found that the tendency to avoid repetitions is evident even in dyadic production settings (Towse et al. 2016). In other words, not only were self-generated repetitions avoided, but participants monitored the alternation of responses in the dyadic setting, consistently avoiding immediately adjacent repetitions. Towse et al. (2016) interpreted this finding as showing that repetition avoidance is *not* just an output effect. Since repetition avoidance is shown to be much broader than inhibition of one's own production, its origins should be searched elsewhere. NIB is one possible source.

The literature on the development of different types of attentional mechanisms seems to lend support to NIB. It has been shown that infants display an experience-independent bias which makes words that feature adjacent reduplications (e.g., *neenee*) easier to learn than non-reduplicated words (Ota & Skarabela 2016). This happens because in the course of development, *exogenous* attention, which is driven by salient environmental stimuli, becomes operative earlier than *endogenous* attention, which allows for voluntary, selective control of which stimuli will be attended (Posner & Cohen 1984). It has been even suggested that the register-specific reduplications that one founds in infant-direct speech (i.e. baby talk) possibly evolved as a response to the innate predisposition of infants to segment better words with adjacently repeated phonological elements than words that involve no such repetitions (Ota & Skarabela 2017).

Salient features such as adjacent repetitions function as attentional attractors that may facilitate language learning in the early stages of development (de Diego-Balaguer et al. 2016). For example, infants' ability to generalize the detection of non-adjacent dependencies (e.g., *this chair* vs. *these chairs*) occurs when they are first presented with familiar stems, whereas learning is altered if their attention is drawn

by a *novel*, intervening nonce word (e.g., *this blem* vs. *these blems*; Soderstrom et al. 2002). At later stages of development, the maturation of the endogenous system enables infants to ignore 'salient stimulus'-driven properties of their environment, in favor of orienting their attention to the *relevant* information (de Diego-Balaguer et al. 2016). Relating these findings to NIB, receivers increasingly rely on endogenous attention when reconstituting messages, because the (mature) parser needs to filter out noise and communicate effectively in the least costly possible manner.

At the neural level, it has been argued that *goal-driven* attention (roughly corresponding to endogenous attention), involves the dorsal frontoparietal network, whereas the ventral frontoparietal network, which detects task-relevant stimuli, underlies *stimulus-driven* (i.e. exogenous) attention (Corbetta et al. 2008). The ventral pathway matures earlier than the dorsal pathway (Dubois et al. 2015), explaining why our attentional system is more 'salient stimulus'-driven at the beginning. At the subcortical level, the main structure of interest is the hippocampus. Goal-driven, endogenous attention affects the magnitude of encoding-related activity in the hippocampus (Aly & Turk-Browne 2016), the maturation of which is generally considered to be slower than that of other structures (Østby et al. 2009). Perhaps unsurprisingly then, its modulating signal has been shown to be implicated in repetition suppression and enhancement (Kremers et al. 2014). In recent research, the hippocampus has been directly connected with what one may call 'the neural signature of Identity Avoidance'. More specifically, it was found that when subjects are presented with identical patterns of events, this overlap triggers a 'repulsion' among hippocampal representations, which is resolved by the hippocampus through reducing similarity among representations (Chanales et al. 2017).

In this context, one can predict that the process of identity inhibition will be disrupted in patients with abnormal hippocampal representations, and indeed, repetition avoidance has been reported to be less evident among hippocampal amnesics (Brugger et al. 1992, 1996a). A high incidence of repetitions is also attested in patients with damage in the right frontal lobe (Brugger et al. 1996b). Aberrances in the frontal lobe, the hippocampus, and the parahippocampal gyrus have been often associated with a high risk for developing psychosis/schizophrenia (Du et al. 2017, Hill et al. 2017) and with conditions that involve palilalia (Peterson et al. 2007, Cho et al. 2009).

Overall, one can observe across different levels and types of stimuli that the human brain does not like to process identical representations, hence it employs a number of ways to reduce similarity. At the neural level, protocadherins underlie dentritic self-avoidance and self-/non-self-discrimination, which function as strategies that endow neurons with distinct molecular identities (Lefebvre et al. 2012). At the behavioural level, NIB is operative, leading again to the use of various strategies in order to break identity-adjacency (e.g., in the case of language through the addition of structure among identical nodes). It is important to recognize that the development of these strategies in language is not driven by a constraint that prevents a token from being merged with another token of the same type/category. Instead, the origin is a general bias in the cognitive system to provide more attentional resources to novel information, than to repeated information, given that the latter is a prime candidate for noise. In this context, Identity Avoidance is the linguistic manifestation of a more general, cognitive bias. In the linguistics literature,

the fact that Identity Avoidance is simply a bias and not a hard constraint that leads to crashed derivations and unacceptable sentences, although usually overlooked, has been already recognized in Chomsky's (1967) appendix to Lenneberg's seminal book *Biological Foundations of Language*:

> The normal use of language relies in an essential way on this unboundedness, on the fact that language contains devices for generating sentences of *arbitrary complexity*. Repetition of sentences is a rarity; innovation, in accordance with the grammar of the language, is the rule in ordinary day-by-day performance.

> (Chomsky 1967: 400; emphasis added)

4.   Outlook

The present work defended Lenneberg's (1967, 1974) idea that categories are not absolute constructs, but flexibly established and contextually defined relations between words. A review of categorial identity from the neurolinguistic perspective showed that categorial features lack a status of separate entities in a feature inventory, in agreement with Lenneberg's (1974) claim about categories existing on a continuum rather than being discretely demarcated entities. The review of the ethological literature has suggested that a number of semantic categories is scattered in the repertoire of different species, thus granting support to the claim that the categorization process is not peculiar to man (Lenneberg 1967). Having developed an understanding of what categories are, this work then focused on Identity Avoidance. It was shown that this is a flexible bias, and not a hard constraint or ban, which is why communicative needs can flout it.

Grammatically licit [XX] structures are found cross-linguistically, although it is true that the existence of adjacent tokens of the same type is severely constrained. The reason is that our parser focuses on novel information, avoiding to bind one type to distinct, adjacent tokens (Kanwisher et al. 1995). In relation to language, this hypothesis is formally captured under the *Novel Information Bias*, which predicts that in situations where no new information is supposed to be conveyed, Identity Avoidance can be flouted to a greater degree. The literature on the development of different types of attentional mechanisms grants support to this proposal, explaining why our attentional system is more 'salient stimulus'-driven at the early stages of development. On the contrary, the mature parser relies more on endogenous attention in order to focus on novel information and filter out noise.

All in all, the interdisciplinary take on labels and Identity Avoidance presented here might be a step in the process of developing a theory of categories that has replaced explananda with explanations. In this work, these explanations were based on insights coming not only from the study of language, but also from recent findings in attention, cognitive processing, neurology, and ethology. It is likely that this interdisciplinarity will eventually prove to be instrumental in finally understanding both what a label is and whether it is unique to man.

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