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Colors in French, American and British Dictionaries

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Abstract: Colors have senses specific to particular fields such as physics and printing, in addition to senses used in everyday life. This article examines the specialized information found in color definitions in French, American and British dictionaries. We explore whether specialized and non-specialized definitions are lumped or split, how much scientific information is included, if the information included varies diachronically and/or geographically and if dictionaries are consistent in their labeling of colors as members of a group (primary, spectral, etc.). We found that specialized and non-specialized senses of colors are typically lumped, rather than split. This is contrary to the treatment of other words with both specialized and non-specialized senses in the same dictionaries, suggesting that the line between these senses is not clear for colors. We also found that more specialized information has been included over time in French, American and British dictionaries, but that American dictionaries still include the most. Additionally, American dictionaries are more consistent than dictionaries of the other two nationalities in their labeling of colors as members of a group, both in the labels themselves and in labeling all members of a group. Based on our findings, we make suggestions for defining colors in general use dictionaries.

Keywords: COLOR DEFINING, LUMPING AND SPLITTING, SCIENTIFIC INFORMATION IN DICTIONARIES, FRENCH, FRENCH DICTIONARIES, ENGLISH, AMERICAN DICTIONARIES, BRITISH DICTIONARIES, USER EXPECTATIONS

Opsomming: Kleure in Franse, Amerikaanse en Britse woordeboeke. Buiten die betekenisse wat kleure in die alledaagse lewe het, beskik kleure ook oor betekenisse wat spesifiek is aan bepaalde velde soos die fisika en die drukkerswese. In hierdie artikel word die gespesialiseerde inligting wat in kleurdefinisies in Franse, Amerikaanse en Britse woordeboeke gevind word, ondersoek. Daar word gekyk of gespesialiseerde en nie-gespesialiseerde definisies saamgevoeg of geskei word, hoeveel wetenskaplike inligting ingesluit word, of die inligting diachronies en/of geografies varieer en of woordeboeke konsekwent is in hul etikettering van kleure as deel van 'n groep (primêr, spektraal, ens.). Ons het bevind dat gespesialiseerde en nie-gespesialiseerde betekenisse van kleure eerder saamgevoeg as geskei word. Dit is teenstrydig met die hantering van ander woorde met beide gespesialiseerde en nie-gespesialiseerde betekenisse in dieselfde woordeboeke, wat daarop dui dat die skeidslyn tussen betekenisse nie duidelik is vir kleure nie. Ons het ook bevind dat meer gespesialiseerde inligting met verloop van tyd in Franse, Amerikaanse en Britse woordeboeke ingesluit is, maar dat Amerikaanse woordeboeke steeds die meeste insluit. Boonop is Amerikaanse woordeboeke ook meer konsekwent as die woordeboeke van die ander twee nasionaliteite betreffende hul etikettering van kleure as deel van 'n groep, sowel in die etikette self as in die etikettering van alle groepslede. Op grond van hierdie bevindings maak ons voorstelle vir die definiëring van kleure in algemene gebruikerswoordeboeke.

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Sleutelwoorde: KLEURDEFINIËRING, SAMEVOEGING EN SKEIDING, WETENSKAPLIKE INLIGTING IN WOORDEBOEKE, FRANS, FRANSE WOORDEBOEKE, ENGELS, AMERIKAANSE WOORDEBOEKE, BRITSE WOORDEBOEKE, GEBRUIKERSVERWAGTING

1. Introduction

Colors are a semantic domain with both specialized and non-specialized senses. For instance, when a child asks for a red train, he/she is not using the word *red* to mean "the hue of the long-wave end of the visible spectrum, evoked in the human observer by radiant energy with wavelengths of approximately 630 to 750 nanometers" nor is he/she likely to be interested in the fact that red is an additive primary color. Both of these pieces of information, however, can be found in some lexicographic definitions of *red*. This illustrates the difference between defining a color as a *word* and defining it as a *term*. Defining a word involves describing its usage in attested contexts, such as the child asking for train. Defining a term, however, is typically based on the advice of some authority on the subject (science, math, art, etc.).

While ignoring specialized senses would both disappoint the user and leave out significant semantic portraits (Béjoint 1988), the language used to describe the scientific meaning must be accessible to the average user. As Atkins and Rundell (2008: 450) state, "A definition that provides the necessary content in technically precise language is of no value if it is unintelligible to the users it is aimed at". Color defining is obviously only one semantic domain for which this challenge presents itself. Colors, are, however, considerably more commonly used by the average person than many other scientific terms (phylum names, atomic particles, etc.). Lexicographers defining colors must therefore decide how to treat both specialized and non-specialized senses. This article examines the division of said senses.

Additionally, as dictionaries of different nationalities include varying amounts of specialized information, is there a difference in their treatment of colors? Has the amount of such information changed over time? Before presenting our research to answer these questions, it will first be useful to discuss the inclusion of specialized information in French, American and British dictionaries, the specialized terminology used to label colors as members of a group and how lexicographers treat words with multiple senses.

2. Background

2.1 Sense division

When a word has multiple related senses, lexicographers must decide how many senses a word has that merit their own definitions. These senses "collectively explain how that word contributes to the meaning of all the individual

events" (Atkins and Rundell 2008: 272). These senses may be divided ("split") or grouped together ("lumped"):

> The "lumpers" like to lump meanings together and leave the user to extract the nuance of meaning that corresponds to a particular content, whereas the "splitters" prefer to enumerate differences of meaning in more detail; the distinction corresponds to that between summarizing and analysing. (Allen 1999: 61)

Splitting and lumping is an issue for lexicographers defining words with both technical and non-technical senses:

> A related problem occurs when words — or senses of words — have a specialist meaning for one group of people as well as a general meaning. To an astrophysicist *space* is a continuum, and the nearest synonym I can think of is *everything*; to most people, *space* is what lies outside the earth's atmosphere. To the former, this planet is part of space: to the latter, it is not. Two senses, or two aspects of the same sense? (Moon 1987: 175-176)

Some scholars have suggested that lexicographers often divide senses too finely (cf. Béjoint 1990 for over-splitting in American dictionaries in particular). Moon (1987: 174-175), for example, states that it is not necessary to split senses so thinly because the context in which a word appears provides the reader with much of the semantic content needed to interpret the word. The meanings of scientific terms, however, are largely independent of the context in which they appear (Béjoint 1988: 358).

2.2 Specialized information in dictionaries

The definitions of scientific and technical terms, both their source and their content, differ from the definitions of most other words, but they make up a large percentage of the wordlist of a dictionary. According to Landau (1974: 241), a conservative estimate would be that forty percent of terms in an unabridged dictionary are scientific or technical. In a smaller dictionary, the percentage may fall to twenty-five to thirty-five percent. In either case, this is a sizeable portion of the dictionary. Although no delineation of the category "scientific and technical terms" has been widely agreed upon, Béjoint (1988: 23) offers his "intuitive" definition, which we will adopt for the purposes of this article: "words that are not used by non-specialists of the science or the technique". Below we refer to scientific and technical terms collectively as "specialized".

Scientific terms are unique in that while most words are defined in modern dictionaries based on their usage in a corpus or citation file, scientific terms are defined based on expert advice. To use Landau's terminology, scientific terms are "imposed," not "extracted" (1974: 242). Landau notes that the concern of these experts is "maintaining the internal coherence of their discipline rather

than faithfully recording how terms are used". This therefore causes a dilemma for lexicographers, whose goal is to represent real usage.

The way in which lexicographers define specialized terms, or whether they include them at all, depends on the amount of encyclopedic information included in their dictionaries. According to Landau (2001: 167), "modern dictionary users expect scientifically precise, somewhat encyclopedic definitions". Many words, including some colors, are used both in scientific terminology and in common usage. Lexicographers encounter a conflict between being true to science or true to common usage. To illustrate this phenomenon, Rey and Delesalle (1979: 24) give the following two sentences:

(1) le soleil est une étoile
'the sun is a star'[1]
(2) le soleil empêche de voir les étoiles
'the sun prevents the stars from being seen'

These two sentences cannot both be true if the same definition of *soleil* is used. Rey and Delesalle therefore propose that a dictionary should define two senses of *soleil*, one corresponding to "an established cultural description," and the other corresponding to "a scientific notion" (1979: 24). The former represents an extracted definition and the latter an imposed definition. This word must therefore have (at least) two separate definitions to satisfy the modern dictionary user.

2.3 User expectations

The amount of specialized information in a dictionary depends heavily on its intended user. This target audience has varied diachronically, the general trend being from an exclusively upper class, well-educated audience to one with various levels of education and socioeconomic status. Consider the intended audience of three French dictionaries, as described in Béjoint (1994: 109):

> *Émile Littré's Dictionnaire de la langue française* (1872): 'erudites, philologists, physicians, and intellectuals in general'.
>
> *Grand Larousse de la langue française* (1960): "users 'whose education is above average, students, teachers, well-read individuals.'"
>
> *Trésor de la langue francaise* (1971): 'the educated person who is part of what was until recently called the élite, but is now preferably referred to as the upper middle or middle middle class, that is to say the most active elements of the main sectors of modern life, and all the people who work with them, not excluding — in fact even giving some special consideration to — all those who write for work or pleasure, those who hold the pens of our culture, or the teachers of all levels who transform all their writings into didactic language so that they can be transmitted to an ever broader section of the masses'.
> (Béjoint's translations)

While the target audience of French dictionaries has become more inclusive, the intended user still has an above average social position and level of education.

The target users for British and American dictionaries likewise tend to be part of "the middle classes and to be fairly well educated" (Béjoint 1994: 110). However, despite the similar socioeconomic status and education level of the target user across France, Great Britain and the United States, the amount of encyclopedic information in dictionaries does vary from country to country, often based on user expectations, societal values and the intended use of the dictionary.[2] Béjoint (1994: 112) summarizes this discrepancy in American, British and French dictionaries. Whereas the British public prefers short definitions with no pictures, French people favor tools related to classical literature and history, such as the Latin translations in the pink pages of the *Petit Larousse*. Americans, on the other hand, want both linguistic and non-linguistic information: encyclopedic facts, usage notes and information such as word-division and etymologies.[3] However, these desires of all three nationalities are being superseded by an interest in science and technology:

> Everywhere, the typical user has changed because the culture has changed. The interest in classical history and literature … is being replaced by an interest in science and technology. Dictionaries reflect the changes in society. (Béjoint 1994: 112)

One notable example of these changes is the amount of technical terminology in subsequent editions of the *Dictionnaire de l'académie française*. Zgusta (2006: 146) notes that the 1694 edition contained virtually no technical terms, the 1762 edition some terms, the 1877 edition over 2,000 terms and the 1932 edition "was delayed because of the sharply increasing number of technical terms …"

More recently, Béjoint (2010: 128) notes the "relative poverty in the representation of scientific and technical terms" in British dictionaries. Their focus is on words rather than on the things they represent. However, in a recent study, Vrbinc and Vrbinc 2013 found a significant rise in the number of words with subject-field labels in three versions of the *Oxford Advanced Learner's Dictionary*, OALD3 from 1974, OALD4 from 1989, and OALD8 from 2010.

These societal changes are also apparent when one examines the color definitions of dictionaries written in different times and places. The results below include evidence of these societal changes.

2.4 Terminology used to label groups of colors

When colors are defined, they are often labeled as belonging to a group of colors, such as spectral colors, primary colors, etc. In this section, we discuss some of these labels commonly found in French and English dictionaries.

To English speakers, both American and British, the solar spectrum, or rainbow, is conventionally divided into seven colors. From longest to shortest

in wavelength, these spectral colors are: red, orange, yellow, green, blue, indigo and violet. Together, light of all the colors of the spectrum composes white light.[4] French speakers divide the spectrum into this same seven-color array: *rouge*, *orange/orangé*,[5] *jaune*, *vert*, *bleu*, *indigo* and *violet*. These seven colors are referred to as *spectral colors* in this article.

A light source of almost any color can be matched by combining red, green and blue light. These three colors are thus referred to as *additive primaries*,[6] meaning they are added together to produce other colors. Each of the additive primary colors, when added to its complementary color, produces white light.

Mixing colors of light produces different results than mixing colors of substances such as paints, dyes or inks:

> The eye gathers and interprets a mix of wavelengths. Add a wavelength and you give the eye an extra morsel of information to work with … On a painter's palette, something different happens. The more pigments are added, the *less* colour information the mix contains. Pigments swallow most wavelengths of light; it is the wavelengths they do not absorb which bounce into our eyes. (Ings 2008: 226)

Physical objects absorb light rather than producing it. This absorption is the reason the primary colors of pigment are called *subtractive primaries*. They are combined in order to subtract colors from being reflected, and the colors that are not absorbed are reflected. As with additive primaries, the choice of subtractive primary colors depends upon the medium, but the three most typically chosen, those used for printing, for instance, are magenta (midway between red and violet), cyan (blue-green) and yellow. These pigments are the complements of the three additive primaries of light. Yellow is complementary to blue, magenta to green and cyan to red. Each pigment absorbs one of the primary lights and reflects the other two (Sobel 1987: 65). In other words, pigments are mixed in order to produce reflected light of the additive primary colors red, green and blue (Sobel 1987: 65). This is why unlike the mixture of red and green light, which produces yellow light, mixing red and green pigments results in a dark color.

French speakers also refer to additive and subtractive primary colors:

> Additive color mixing applies to light whereas subtractive color mixing applies to matter (Bagard 2009: 40).

Bagard uses the terms "*primaires (ou fondamentales)*" for primary colors. As we will demonstrate below, there are various groups of colors that are labeled *fondamentales.* This label may in fact refer to the spectral colors, the additive primary colors (*rouge*, *vert*, *bleu*) or the subtractive primary colors (*cyan*, *magenta*, *jaune*).

The last group of primary colors we will discuss is called *Hering psychological primaries*. Contrary to the three-color systems described above, Ewald

Hering, a 19th century German physiologist, proposed that at a psychological level there are in fact four primary colors (excluding white and black). He claimed that the brain considers some colors to be pure. As Sobel (1987: 66) explains: "It is true that all hues are generated by appropriate mixtures of red, green, and blue, but there is a lack of symmetry in our psychological response to these mixtures". For instance, when we mix blue and green light we get a bluish green, but when we mix red and green light, we do not get a reddish green. We instead get yellow: "We feel yellow as an entirely different sensation, psychologically independent of red, green, and blue (unlike orange, say, which clearly retains a feeling of yellow and red)" (Sobel 1987: 66). Bluish-green and yellow, although both are results of mixtures of light, do not have the same status in our minds. The four primary hues thus include red, green, and blue, but also yellow.

All of these groups of colors are labeled in some dictionaries, but as we will demonstrate below, no two dictionaries treat this labeling in the same way.

3. Methodology

We consulted the definitions of the seven spectral colors — red/*rouge*, orange/*orange*/*orangé*, yellow/*jaune*, green/*vert*, blue/*bleu*, indigo/*indigo*, and violet/*violet* — in order to determine the treatment of specialized and non-specialized senses in color definitions. Because of their status as subtractive primary colors, the definitions of *cyan* and *magenta* (spelled the same in French and English) were also included. We examined the splitting or lumping of specialized and non-specialized senses, the difference in the inclusion of specialized information (across time and nationalities), and the labeling of colors as members of a group. The dictionaries we consulted to answer these questions are found in Figures 1, 2 and 3 below:

Dictionary	Edition	Year(s)	Abbreviation
Le Dictionnaire de l'Académie française	8th	1932–5	DAF8
Le Dictionnaire de l'Académie française	9th	1992–in progress	DAF9
Le Grand Robert de la langue française	online	Continually updated	GR
Le Trésor de la langue française informatisé	online	2002	TLFi

Figure 1: French dictionaries consulted

Dictionary	Edition	Year(s)	Abbreviation
Webster's Third New International Dictionary		1961	W3
American Heritage Dictionary	2nd[7]	1982	AHD2
American Heritage Dictionary	5th	2011	AHD5
Random House Dictionary of the English Language	2nd	1987	RHD

Figure 2: American dictionaries consulted

Dictionary	Edition	Year(s)	Abbreviation
Concise Oxford English Dictionary	1st	1911	COD1
Concise Oxford English Dictionary	12th	2011	COD12
Collins English Dictionary	online[8]	2017	CED
Oxford English Dictionary	2nd[9]	1989	OED2

Figure 3: British dictionaries consulted

4. Results

4.1 Splitting or lumping?

Rey and Delesalle's (1979) suggestion discussed above, i.e., that scientific terms should have two separate definitions, could be applied to color terms, which have both an everyday usage and a precise scientific usage. When dividing the specialized and non-specialized senses of colors, one might expect a treatment similar to that of the noun *tree* in the following entry from the *Collins English Dictionary* (CED):

1. any large woody perennial plant with a distinct trunk giving rise to branches or leaves at some distance from the ground *related adjective* arboreal
2. any plant that resembles this but has a trunk not made of wood, such as a palm tree
3. a wooden post, bar, etc.

4. See family tree, shoetree, saddletree
5. (chemistry) a treelike crystal growth; dendrite
6. a. a branching diagrammatic representation of something, such as the grammatical structure of a sentence
   b. (*as modifier*) ⇒ a tree diagram
7. an archaic word for gallows
8. (archaic) the cross on which Christ was crucified
9. See at the top of the tree
10. See up a tree

This split in CED (senses 1 and 2) represents a division between what a specialist would consider a tree and what a layperson would consider a tree, or what Moon (1987: 175-176) calls a "specialist" versus a "general" meaning. For a layperson, a tree does not have to be made of wood. For a specialist, it does.

Likewise, consider the definitions of some of the senses of the word *star* from the *Oxford English Dictionary, 2nd Edition* (OED2):

> **1. a.** Any one of the many celestial bodies appearing as luminous points in the night sky. Now usually restricted (in scientific and to some extent in popular language), to the *fixed stars* as distinguished from planets
>
> **2.** In extended sense, any one of the heavenly bodies, including the sun and moon; sometimes in pl. as a vague designation for the abode of departed spirits; so occas. this star, the earth regarded along with other 'stars' as a place of habitation.

This entry shows a distinct separation between the specialized usage (sense 1) and common usage (sense 2) of the word *star*.

While a similar separation of senses to those found in CED or OED2 is possible, even plausible for colors, it is not what is found in practice. For instance, consider the following definitions from OED2, *Le Trésor de la langue française informatisé* (TLFi) and the *American Heritage Dictionary, 5th edition* (AHD5):[10]

> red a. Designating **the colour of blood, a ruby, a ripe tomato**, etc., and appearing in various shades at the **longer-wavelength end of the visible spectrum**, next to orange and opposite to violet; of or having this colour. In early use also designating shades of purple, pink, and orange, which are now distinguished by these distinct colour terms. (OED2)
>
> rouge **I.** ▬*Adj.* D'une couleur qui parmi les couleurs fondamentales se situe **à l'extrémité du spectre**, et rappelle notamment **la couleur du coquelicot, du rubis, du sang**. (TLFi)
> [Of the primary color **at the end of the spectrum**, resembling in particular the color of the **poppy**, **ruby**, and **blood**.]

> red *n.***1. a.** The hue of the **long-wave end of the visible spectrum**, **evoked in the human observer by radiant energy with wavelengths of approximately 630 to 750 nanometers**; any of a group of colors that may vary in lightness and saturation and whose hue resembles that of **blood**; one of the additive or light primaries; one of the psychological primary hues. (AHD5)

In these three definitions, both spectral information and references to everyday objects are included within the same definition, separated only by commas or semi-colons. Specialized and non-specialized senses are lumped, not split by separate numbers. Even in the AHD5 definition, which is almost exclusively scientific, only a semi-colon divides specialized and common usages of red. A clear distinction is not made between color words and color terms. This mixing is indicative of both the nature of color words/terms and of modern society. Society expects a scientific definition. In the minds of lexicographers, at least, there is not a large separation between a color's specialized and non-specialized senses.

4.2 Inclusion of scientific information in color definitions

Today's society considers specialized information to be very important, even to the non-specialist. Dictionaries of all three nationalities show increased scientific information over time.

Consider, for example, the definitions of *bleu* in *Le Dictionnaire de l'Académie française, 8th edition* (DAF8) and *Le Dictionnaire de l'Académie française, 9th edition* (DAF9) and the definitions of *blue* in the *American Heritage Dictionary, 2nd edition* (AHD2) and AHD5:

> BLEU, UE. adj. Qui est de la couleur du ciel quand il est pur. *Satin bleu. Robe bleue. Avoir les yeux bleus.* (DAF8 — **1932–1935**)
> [That which is of the color of the clear sky. Blue satin. Blue dress. To have blue eyes.]

> bleu ★ **I.** Adj.
> ☆ **1. Qui, dans le spectre des couleurs, se situe entre le vert et l'indigo** ; qui est de la couleur du ciel quand il est pur, de l'azur, du saphir. (DAF9 — **1992–in progress**)
> [**Situated in the color spectrum between green and indigo**; that which is of the color of the clear sky, of azure, of sapphires.]

> blue *n.*
> 1. Any of a group of colors that may vary in lightness and saturation, whose hue is that of a clear sky; **the hue of that portion of the spectrum lying between green and violet**; **one of the additive or light primaries**;

one of the psychological primary hues, **evoked in the normal observer by radiant energy of wavelength approximately 475 nanometers**.
(AHD2 — **1982**)

blue *n.*
1. **The hue of that portion of the visible spectrum lying between green and indigo, evoked in the human observer by radiant energy with wavelengths of approximately 420 to 490 nanometers**; any of a group of colors that may vary in lightness and saturation, whose hue is that of a clear daytime sky; **one of the additive or light primaries; one of the psychological primary hues.**
(AHD5 — **2011**)

These successive editions of American and French dictionaries show that specialized information has increased in importance in these dictionaries. AHD5 differs from AHD4 in that it adds wavelengths as well as the fact that the color is evoked by radiant energy. DAF9 mentions spectral position, whereas DAF8 does not. Not only that, but DAF9 puts this spectral information *first*. However, of the four spectral colors currently included in DAF9, only three give their spectral positions: *bleu*, *jaune* and *orange*, but not *indigo*.[11]

Similarly, the British dictionaries we examined give spectral positions for some, but not all spectral colors. In OED2, the definitions of blue, cyan-blue,[12] green, indigo, red, orange and yellow, but not violet, include their spectral position. CED gives the spectral position of all spectral colors except indigo. There is also a diachronic difference in the versions of the *Concise Oxford English Dictionary* (COD) we examined. In COD1, green, red, violet and yellow are defined in relation to their spectral position. In COD12, the definitions of blue[13] and indigo also include spectral information. Dictionaries of all three nationalities, thus, have included more specialized information through time.

As discussed above, American dictionaries include more specialized information than French or British ones. Some American dictionaries include information on the physics of how humans perceive color, information that is lacking in the British and French dictionaries in our study, with the exception of CED. It may be surprising to see a British dictionary that includes wavelengths. However, Béjoint (1994: 74-75) notes that CED is the first example of a British college dictionary, a type imported from the US. He describes a college dictionary as: "an encyclopedic dictionary in one volume … with particular emphasis on the present language and on non-classical culture — particularly scientific and technological". This difference in the amount of scientific information in French and American dictionaries was also confirmed by the findings that no French dictionary in this study included wavelengths for colors other than *vert*. Only *Le Grand Robert de la langue française* (GR) and TLFi included this information, but we have found no reason this color in particular was treated differently. Since both GR and TFLi agree, however, on the wavelength for *vert* (0,52 μ), and, as we will see below, dictionaries generally do not

agree on wavelength figures, it seems likely that they got this figure from the same source (or each other). Annie Mollard-Desfour, the color specialist for the TLFi, explains why she chose not to include wavelengths in her definitions:

> As this is a language dictionary, and not a specialized work, [or] an encyclopedia, I purposefully chose not to define colors by their wavelengths. This holds no interest for a language dictionary. We are interested in words and culture, which is often contrary to definitions used by scientists, physicists, etc. (Personal communication, 29 September 2012)[14]

This confirms Béjoint 1994's claim discussed above that French lexicographers include less encyclopedic content than their American counterparts.

Curiously, the English dictionaries that do include wavelengths do not agree on wavelength measurements. As these dictionaries give no source of their figures, it is difficult to know why this discrepancy occurs. Consider the measurements listed in AHD5, the *Random House Dictionary of the English Language* (RHD) and CED:

Color	Wavelengths in nanometers		
	AHD5	RHD	CED
Red	630–750	610–780	620–740
Orange	590–630	590–610	585–620
Yellow	570–590	570–590	575–585
Green	490–570	500–570	500–575
Blue	420–490	450–500	445–490
Indigo	420–450	(Wavelength not listed)	(Wavelength not listed)
Violet	380–420	400–450	390–445

Figure 4: Wavelengths in AHD5, RHD and CED

Neither the AHD nor the CED editorial staffs were able to determine the source of these figures. Although these numbers are not far from one another, there is a notable discrepancy at the short-wave end of the spectrum. There is no wavelength given for indigo in CED or RHD, and between the wavelengths of violet and blue, there is no gap in the spectrum which indigo could occupy. If indigo were to be part of the spectrum, it would have to occupy part of the same space as blue and violet. However, the definition of indigo in CED specifies that it is a spectral color. AHD5 does list a wavelength for indigo, but it is part of the range given for blue. These discrepancies likely stem from the fact that many modern scientists only divide the spectrum into six parts, leaving out indigo (Waldman 2002: 193). Thus, there is a mismatch between what the specialist and everyday person consider to be spectral colors.

With this conflict between scientific and common usage, as well as the lumping of specialized and non-specialized senses, the definitions of colors do not clearly distinguish between scientific and non-scientific uses. Although

definitions have become more scientific, this scientific information has been incorporated into the non-scientific definitions. Contrary to a case like *star* above, the division between specialized and non-specialized senses of colors is not so clear. The boundary between color *term* and color *word*, then, is less distinct.

4.3 Treatment of groups of colors

As discussed above, the terminology used to define groups of colors varies from dictionary to dictionary. The French dictionaries that included such terminology, i.e., TLFi, DAF8 and GR are not consistent in labeling all colors of a given group. For instance, in TLFi, the five colors *rouge*, *jaune*, *bleu*, *indigo* and *violet* are each defined as one of the "*sept* ('seven') *couleurs fondamentales*". *Orangé* is defined as one of the "*sept couleurs primitives*". One must assume that *vert* is the intended seventh color, but its definition includes neither of these group names, being defined curiously by wavelength, as mentioned above. TLFi includes the following subentry in the entry for *couleur*:

> Couleur fondamentale (ou primaire). Chacune des **trois** couleurs à partir desquelles l'on peut reproduire toutes les autres par des mélanges en proportion convenable.
> [Fundamental (or primary) color. Each of the **three** colors which, when mixed in appropriate amounts, can form all other colors.]

According to this definition, only *rouge*, *bleu* and *vert* should be labeled as being members of the group called *fondamentale*, which is not the case. There is no definition of *couleur primitive* in this dictionary.

DAF8 is less consistent still, defining only two colors as members of a group, and assigning two different names to the group itself. *Indigo* is defined as one of the *sept* ('seven') *couleurs primitives* and *orangé* is defined as one of the *sept couleurs fondamentales*. Neither of these groups is defined in the dictionary itself. It is therefore not clear whether the *sept couleurs primitives* and the *sept couleurs fondamentales* refer to the same group of color terms.

In GR, *bleu* and *jaune* are defined as one of the *sept couleurs fondamentales* of the solar spectrum. *Indigo* is called one of the *couleurs fondamentales du spectre* ('spectrum'), with no mention of the number of colors in the set. The following sentence is found in the entry for *rouge*: "*Le rouge (orangé) est une des sept couleurs fondamentales*" [(Orangish) red is one of the seven fundamental colors]. There is no reference to the spectrum here. If all four colors defined as *fondamentale* in some manner (*bleu*, *jaune*, *indigo* and *rouge*) are included, this means that four out of the stated seven are marked as such. *Vert*, *violet* and *orange*/*orangé* are not defined as belonging to any of these groups.

Of the three subtractive primaries (*cyan*, *magenta* and *jaune*), only *cyan* and *magenta* are marked in GR as belonging to a group: "une des trois couleurs monochromatiques fondamentales utilisées dans la reproduction des images

polychromes" [one of the three monochromatic fundamental colors used in the reproduction of polychromatic images].

The following note, marked Sc for *scientifique* ('scientific'), is part of the entry of the word *couleur*:

> ♦ Sc. La sensation de couleur est fonction des propriétés physiques de la lumière (longueur d'onde) et de sa diffusion. La lumière blanche (solaire) est décomposée par le prisme en couleurs dites spectrales (→ Violet, indigo, bleu, vert, jaune, orangé, rouge). Les couleurs du spectre, du prisme, de l'arc-en-ciel (→ Arc-en-ciel, cit. 3 et 5). Couleurs simples, primitives. **Couleurs fondamentales: le jaune, le rouge et le bleu**, couleurs à partir desquelles on peut produire les autres couleurs. Couleurs composées. Couleur complémentaire (d'une couleur primaire), celle qui résulte du mélange des deux autres couleurs primaires. Le vert, couleur complémentaire du rouge (l'orangé, du bleu; le violet, du jaune). Le mélange optique d'une couleur et de sa couleur complémentaire donne le blanc. (GR)

> [♦ Sc. The sensation of color is the result of the physical properties of light (wavelength) and its diffusion. White (solar) light is divided into colors called spectral colors by a prism. (→ Violet, indigo, blue, green, yellow, orange, red). The colors of the spectrum, prism, rainbow (→ Rainbow, cit 3 and 5). Basic, primitive colors. **Fundamental colors: yellow, red, and blue**, colors from which one can produce other colors. Blended colors. Complementary color (of a primary color), that which is the result of the mixture of two other primary colors. Green is complementary to red (orange to blue, violet to yellow). The mixture of light of a color and its complementary color create white.]

From this paragraph, les *couleurs fondamentales* should include *jaune*, *rouge* and *bleu*. However, *vert*, *violet* and *orange/orangé* are in fact labeled as *fondamentale* in their definitions in this dictionary. There is no reference to the solar spectrum in the explanation of *fondamentale* above, which leads one to believe that there are (at least) three sets of *couleurs fondamentale*s considered in this dictionary: *les couleurs fondamentales*, *les couleurs fondamentales du spectre (solaire)* and *les couleurs monochromatiques fondamentales utilisées dans la reproduction des images polychromes*. Of these three sets, none labels all of its members.

The British dictionaries OED2 and COD12 give information about primary colors. COD12 labels *cyan*, *magenta* and *yellow* as primary subtractive colors and lists their complementary colors. There is no mention, however, of these complementary colors forming their own group of primary colors. OED2 labels three colors as primary in some manner:

> yellow
> **1. a.** … constituting one (the most luminous) of the primary colours …

orange
5. (More fully orange-colour)…. one of the so-called seven colours of the spectrum, occupying the region between red and yellow …[15]

indigo
3. The colour yielded by indigo, reckoned by Newton as one of the seven prismatic or primary colours …

These are the only members of these three groups ("primary colours", "so-called seven colours of the spectrum" and "prismatic or primary colours") to be labeled as such. Furthermore, although it is not clear from the definition of yellow if "primary" refers to spectral colors or subtractive primary colors, it appears that "primary" means subtractive primary for *yellow* but spectral for *indigo*.

CED is another British dictionary that labels primary colors:

Red is the complementary colour of cyan and forms a set of primary colours with blue and green
Yellow is the complementary colour of blue and with cyan and magenta forms a set of primary colours
Green is the complementary colour of magenta and with red and blue forms a set of primary colours
Blue is the complementary colour of yellow and with red and green forms a set of primary colours
Cyan 1. a highly saturated green-blue that is the complementary colour of red and forms, with magenta and yellow, a set of primary colours
Magenta 1. a deep purplish red that is the complementary colour of green and, with yellow and cyan, forms a set of primary colours

Figure 5: Groups of colors in CED

As shown in figure 5 above, this dictionary acknowledges the existence of two sets of primary colors — additive and subtractive, but does not use these terms. It does, however, mention the complementary color, the member of the other set of primaries that either absorbs it or is absorbed by it. For instance, cyan absorbs red, so cyan and red are complementary colors. Pigments of the subtractive primaries (cyan, magenta and yellow) absorb the additive primaries (red, green and blue).

The treatment of color groupings in the dictionaries consulted is another example of the difference in importance of scientific and technical information in French, British and American dictionaries. The American dictionaries consulted and CED were more consistent with their labels than the French diction-

aries or the other British dictionaries. *Webster's Third New International Dictionary* (W3) and AHD5 were the American dictionaries consulted that marked colors as primary. The following charts show the terms used for groups of colors, and the colors that are defined as belonging to this group.

Label	Colors
(four) psychologically primary hues	red, green, yellow, blue
(six) psychologically primary object colors	red, green, yellow, blue, white, black
subtractive primaries	yellow, magenta, cyan

Figure 6: Groups of colors labeled in W3

Label	Colors
additive or light primaries	red, green, blue
psychological primary hues	red, yellow, green, blue
subtractive primary	yellow, magenta, cyan

Figure 7: Groups of colors labeled in AHD5[16]

Both of these dictionaries label all colors in a group. There are, however, differences in the categories chosen and the labels used to identify their members. The subtractive primary colors and the psychological(ly) primary hues are the same in W3 and AHD5. W3, however, does not label additive primaries, but does include a category called "psychologically primary object colors". No group with this name is found in any of the dictionaries or literature consulted in this study. The group of colors, however, matches the Hering psychologically primary colors discussed in 2.4 above. One must suppose that it is this concept of psychological primacy being referred to, but the origin of the label "psychologically primary object colors" is unclear.

Dictionary	Group	Color(s)
GR	(trois) couleurs monochromatiques fondamentales utilisées dans la reproduction des images polychromes	magenta, cyan
GR	(sept) couleurs fondamentales	rouge
GR	(sept) couleurs fondamentales du spectre solaire	bleu, jaune
GR	couleurs fondamentales du spectre	indigo
TLFi	(sept) couleurs primitives	orangé

TLFi	(sept) couleurs fondamentales	rouge, bleu, jaune, violet, indigo
DAF8	(sept) couleurs primitives	indigo
DAF8	(sept) couleurs fondamentales	orangé
W3	(four) psychologically primary hues	red, green, blue, yellow
W3	(six) psychologically primary object colors	red, green, blue, yellow, white, black
AHD5	additive or light primaries	red, blue, green
AHD5	psychological primary hues	red, green, blue, yellow
AHD5	subtractive primary	magenta, yellow, cyan
RHD	primary color	red, blue
RHD	secondary color	orange
CED	a set of primary colors	red, blue, green
CED	a set of primary colors	magenta, yellow, cyan
COD12	one of the primary subtractive colours	magenta, yellow, cyan
OED2	primary colours	yellow
OED2	one of the so-called seven colours of the spectrum	orange
OED2	one of the seven prismatic or primary colours	indigo

Figure 8: The color terms defined as members of a group in our data

The chart above shows that while none of the French dictionaries (GR, TLFi and DAF8) defined all members of *any* group, the American dictionaries W3 and AHD5 were consistent in the terms used and in defining all colors of a group. RHD was the only American dictionary not to do so. While the British dictionary CED was consistent in its group labeling, COD12 included only one group (subtractive primary colors) and OED2 labeled three colors each with their own unique label. While it is clear that American dictionaries label groups of colors more often and more consistently within one dictionary, there does not seem to be a consensus on which groups of colors to label or what terminology to use.

5. Conclusion

Lexicographers face the difficulty of deciding how to treat specialized terms, particularly those that are polysemous with a non-specialized word. We found that specialized and non-specialized senses are not split in color definitions in the French, British and American dictionaries consulted. Specialized and non-specialized senses of colors were shown to be overlapping. This suggests that the distinction between color words and color terms is not as distinct as it is for

words like *star* and *tree*.

The type of scientific information included in definitions in our data was primarily concerned with the spectrum of light. Specifically, definitions referenced the wavelength with which the color is associated and/or the color's position on the spectrum. The dictionaries to include wavelengths were the American dictionaries AHD1, AHD5 and RHD, as well as the British dictionary CED. The French dictionaries GR and TLFi included the wavelength only for *vert*. Overall, American dictionaries were found to include more scientific detail than French and most British dictionaries, validating claims made in Béjoint 1988 and 1994 that it is particularly important in American dictionaries. Our study confirmed that specialized information has, however, increased in importance in the dictionaries of all three nationalities. This confirms Béjoint 1988 and Landau 1974 that scientific information has risen in importance over time.

Another type of specialized information in our data was the defining of colors as members of a group, such as *primary* or *fondamentale*. With regards to the grouping of color terms, with the exception of CED and COD12, British and French dictionaries were found to be inconsistent both in defining all members of a group as such and in the naming of groups themselves. This is consistent with the observation that American dictionaries place a higher value on specialized information.

Based on our findings, we make the following suggestions for defining colors in a general use dictionary:

a. If one color in a certain group (primary, spectral etc.) is labeled as belonging to that group, all members should be. This would solve the inconsistencies such as those seen in GR, TLFi, DAF8, OED2 and RHD.
b. Both the choice of groups to define and the labels chosen for them should be considered carefully. Selection should be based on the probability of the groups and labels being meaningful to the reader, likely because they are working in a color-related field such as physics or art. W3's choice of defining the Hering primaries as "psychologically primary object colors" is questionable, as we have not found this term in any other source as of April 2017.
c. The terminology used to label the group should be defined in the dictionary. Cases like OED2, GR and TLFi show that this is necessary. Labels are not helpful if it is unclear what they refer to.

Ideally, in order to follow these suggestions, colors should be either assigned to one editor or defined according to a set of guidelines. In addition to correcting the confusion caused by the cases above, this would eliminate instances such as those found in GR and TLFi, where only one color is defined by the wavelength at which it is observed, as well as OED2, COD1 and COD12 where some spectral colors are defined based on their position on the spectrum and others are not.

Endnotes

1. Unless otherwise noted, English translations in this article are ours.
2. For descriptions of the methodology lexicographers use to determine dictionary user needs and expectations, see Schierholz 2015 and Béjoint 1994: 140-168.
3. As an anonymous reviewer noted, it would be interesting to see the results of recent studies on whether these preferences hold true in the age of the internet and online dictionaries. As we will see below, dictionaries still reflect these differences, but this could be due more to tradition than to current user expectations.
4. In reality, there is no clear division among these seven colors, or any scientific reason for the rainbow to be divided into seven segments. This seven-part division is traced back to Isaac Newton, who divided the spectrum into seven colors to reflect the seven notes in a diatonic musical scale, and because he considered the number seven to be lucky. He had earlier divided the spectrum into five colors, but then added orange and indigo to bring the number to seven (Shapiro 1994: 619).
5. The original adjectival form of *orange* was *orangé*. Some dictionaries, the *Grand Robert de la Langue Française*, for example, still include *orangé* in their list of spectral colors instead of *orange*.
6. Other sets of additive primaries are possible, based on the purpose of color mixing. The additive primaries used for television sets, for example, are a somewhat orange red, a slightly unsaturated blue and a yellowish green. These deviations from red, blue and green are made in order to compensate for the loss of brightness caused by the phosphors at the long and short ends of the spectrum not being very intense. Tiny dots of these colors placed close together produce the illusion that we are looking at mixtures of these colors. This process is similar to that used in impressionism (Sobel 1987: 62).
7. AHD2 is a collegiate edition.
8. This is a digitized version of the *Collins Concise English* Dictionary, 12th edition.
9. Because the OED's color definitions have been revised decades apart, if at all, we chose the latest print version, OED2 (1989).
10. Here and elsewhere in the text, we have bolded parts of definitions to which we want to draw special attention.
11. DAF9 is being edited alphabetically: thus *rouge*, *vert* and *violet* are not yet included.
12. Defining cyan this way is very unexpected, as it is not one of the traditional seven spectral colors.
13. Blue is defined in COD12 as "of a colour intermediate between green and violet …", which does not overtly mention the spectrum. The spectrum is, however, implied, as blue does fall between these two colors on the spectrum.
14. It is unclear why she did not follow this philosophy for the term *vert* in TLFi.
15. The definition of orange was updated in 2004 and no longer uses the term "spectral colour". It does still give the color's spectral position.
16. All three of these groupings are defined within this dictionary.

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