'Italian blues': A challenge to the universal inventory of basic colour terms

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'Blue' is one of the 11 basic colour terms (BCTs) in languages with a developed colour term inventory [1]. In a challenge to the Berlin-Kay model, Italian appears to require more than one BCT to name the blue area: *blu* 'dark blue', *azzurro* 'light (-and-medium) blue' and *celeste* 'light blue'. We addressed the proposition of multiple Italian 'blue' BCTs in a psycholinguistic study. Eight Munsell charts embracing the BLUE area of colour space (7.5BG-5PB, Value 2-9, Chroma 2-12) were employed to explore colour name mapping in Italian speakers compared to English speakers. Participants were Italian monolinguals (N=13, Alghero; N=15, Verona) and English monolinguals (N=19; Liverpool). An unconstrained colour naming method was used; this was followed by indicating the best example (focal colour) of *blu, azzurro* and *celeste* (Italian) or *blue* and *light blue* (English). Choices of focal colours, in Munsell notation, are reported for each of the terms. In addition, distances between centroids of the focal colours, in CIELAB notation, are reported for each of the three participant groups. The dominant focal English *blue* and Italian *blu* appeared to concur in Hue (2.5PB, 5PB), but not in lightness (*blue*: Value 5; *blu*: Value 2-3). Italian speakers required, in addition, the *azzurro* term for naming light/medium blue colours. Notably, for the Algherese, *azzurro* indicates the 'medium blue' and is complemented by *celeste* for denoting light blue shades, similar to English *light blue*. In contrast, the Veronese use *azzurro* for 'light-and-medium blue'; *celeste* was named conspicuously less frequently, overlapping with *azzurro*. The present study adds to psycholinguistic evidence that Italian possesses two BCTs, *blu* and *azzurro*, differentiating 'blues' along the lightness dimension. *Celeste* is a contender for a third BCT for the Alghero speakers. Cognitive representation (i.e. prototype) of *azzurro* as well as the status of *celeste* appear to vary markedly across Italian dialects.

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Introduction

'Blue' is one of 11 basic colour terms (BCTs) in languages with a developed colour term inventory [1]. Several languages, however, appear to have two BCTs for 'blue', in particular Russian (for a review see Paramei (2005) [2]) and several other Slavic languages (e.g. Polish [3], Ukrainian [4]), as well as some languages in the Mediterranean area (Greek [5], Turkish [6], Maltese [7]).

Italian appears, too, to present a 'Blue challenge' to the Berlin-Kay model: numerous linguistic studies provide evidence that more than one name for 'blue' is required by Italians [8-14]. Several recent psycholinguistic studies argue that, to name the BLUE area of colour space, Italian speakers require two BCTs, *blu* 'dark blue' and *azzurro* 'azure/light blue' [15-16], or three BCTs, *blu* 'dark blue', *azzurro* 'medium blue' and *celeste* 'light blue/sky blue' [17-18]. The three Italian 'blues' are conjectured to have emerged in response to the cognitive need of differentiating between the colours of the sky and the water of the Mediterranean Sea [8, 18].

In the present report we address the proposition of multiple Italian 'blue' BCTs using a psycholinguistic approach while exploring choices of focal *blu*, *azzurro*, *celeste* by two samples of Italian monolingual speakers and relating these to focal *blue* and *light blue* choices of English speakers.

Method

Participants: Two samples of Italian monolinguals: Alghero, Sardinia (N=13; 7 females; 19-48 y.o.); Verona (N=15; 5 females; 15-19 y.o.); and a sample of British English monolinguals (N=19; 12 females; 19-48 y.o.; Liverpool). All had normal trichromatic colour vision as diagnosed with the Ishihara Pseudoisochromatic Plates [19]. None had reported any ocular disease, eye surgery, diabetes or use of a medication that could have affected colour vision.

Stimuli: From *The Munsell Book of Color* (glossy edition), we employed eight charts embracing the BLUE area, with Hue 7.5BG, 10BG, 2.5B, 5B, 7.5B, 10B, 2.5PB, 5PB, as illustrated in Figure 1. (No further charts were included since a pilot study had shown that at one end, beyond 7.5BG, 'green' responses and at the other end, beyond 5PB, 'purple' responses were elicited.) Value of the Munsell chips varied between 2 and 9 and Chroma varied (even number notation) from 2-10, or 12 in 10B, 2.5PB, 5PB. For purposes of further analysis, Munsell coordinates of the stimuli (N=237) were also renotated in the CIELAB space (http://www.cis.rit.edu/research/mcsl2/online/munsell.php), as presented in Figure 2.

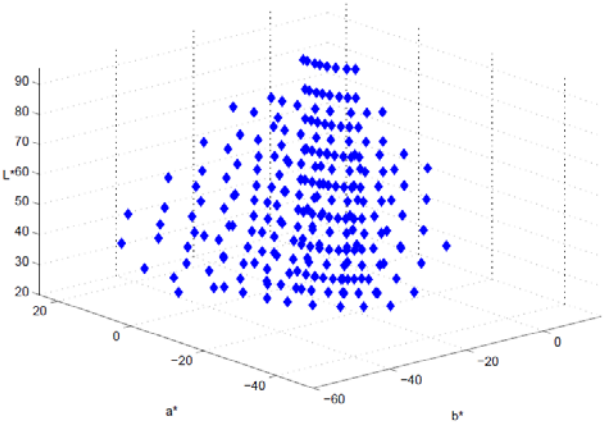

Figure 1 (left): Examples of three BLUE area Munsell charts. Photo Credit: http://colorcard.net.cn/CMYK_Munsell_content.htm

Figure 2 (right): Munsell BLUE area stimuli (N=237) presented in the CIELAB space.

Procedure: After participant's adaptation to mesopic lighting, charts were presented in a viewing booth under D65-metameric illumination (Just Normlicht Mini 5000; Fa. Colour Confidence) suspended 40 cm above the chart (Figure 3). At the chart surface, luminance was 220 cd/m^2 (measured by the PR-650 SpectaScan Colorimeter; Photo Research, Inc.), corresponding to illuminance of 1387 lux.

Figure 3: Viewing booth with standardised lighting of the Munsell charts.

Each chart was presented one-by-one in a fixed order (as indicated above under the Stimuli). For labelling Munsell chips, *unconstrained colour naming* method was used (cf. e.g. [20]): participants were requested to name each chip freely, using any term from a broad colour vocabulary. Elicited colour names included hue terms (e.g. Italian: *blu, azzurro, indaco*; English: *blue, turquoise, indigo*), compound terms (e.g. Italian: *celeste-lilla, grigio-azzuro*; English: *blue-green*), terms with modifiers (e.g. Italian: *blu notte, indaco scuro, turchese chiaro*; English: *sky blue, sea blue, deep turquoise*) or suffixation terms (e.g. Italian: *bluastro*; English: *greyish light blue*).

Participants worked row by row across the chart from top to bottom; colour names were recorded by hand immediately and exactly as the participant said them. Following this, across all eight charts, the participants indicated the 'best example', focal colour, of the terms *blu, azzurro* and *celeste* (Italian) or *blue* and *light blue* (English). The focal colours were noted on the response sheet and coded by their Munsell Hue, Value and Chroma.

Results

Alghero sample

Figure 4 illustrates Munsell maps of focal colours for *blu* and *azzurro*, superimposed on focals for the English *blue*. The size of the symbol indicates the relative number of participants who have chosen the corresponding chip as the focal colour. It is worth noting that the range of English *blue* focals – 10B 5/12; 2.5PB 5/8-12; 5PB 4/10-12 and 5PB 5/12 – found in the present study includes the focal *blue* 2.5PB 5/12 (with a purplish tint) reported earlier for British English [21] and American English [22].

Blu. The most frequent choices of focals for English *blue* and Algherese *blu* are similar in Hue, both varying between 10B, 2.5PB and 5PB (Figure 4). The focals of the two terms differ, however, in lightness, with Value 4-5 for *blue*, compared to definitely darker *blu*, with Value 2-3.

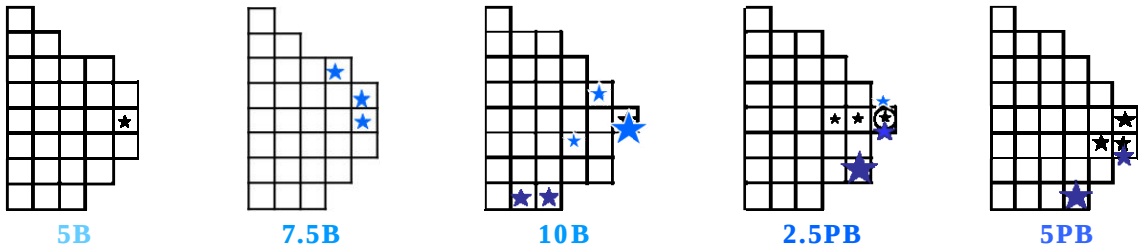

Figure 4: Alghero sample: Munsell charts with mapped focals for blu (★) *and* azzurro (★) *superimposed on focals for English* blue (★). *The size of the symbols indicates relative number of participants' choices. Encircled* ★ *is the focal* blue 2.5PB 5/12 *estimated in [21, 22].*

Azzurro. As is shown in Figure 4, the most frequent choice of *azzurro* focal – 10B 5/12 – maps onto a 'vivid' *blue* focal. The focal ranges of the two terms overlap only partly though, with *azzurro* being more bluish than *blue*, hardly implying any purplish tint and, also, including lighter colours (Value 6-7).

- *azzurro*: Hue: 7.5B-2.5PB; Value: 4-7; Chroma: 8-12
- *blue*: Hue: 10B-5PB; Value: 4-5; Chroma: 8-12

Celeste was used rather frequently by the Algherese participants but not as frequent as *blu* or *azzurro*. Figure 5 illustrates choices of focal colours for *celeste*, in comparison with focals for English non-BCT *light blue*. The most frequent choice of *celeste* focal, 7.5B 7/8, maps onto one of the (frequently chosen) *light blue* focals. The focal ranges of the two 'sky blue' counterparts differ partly though, with the *celeste* focal choices extending to aqua (2.5B) and being more saturated than those for *light blue*.

- *celeste*: Hue: 2.5B-2.5PB; Value: 5-7; Chroma: 8-12
- *light blue*: Hue: 5B-2.5PB; Value: 6-8; Chroma: 6-10

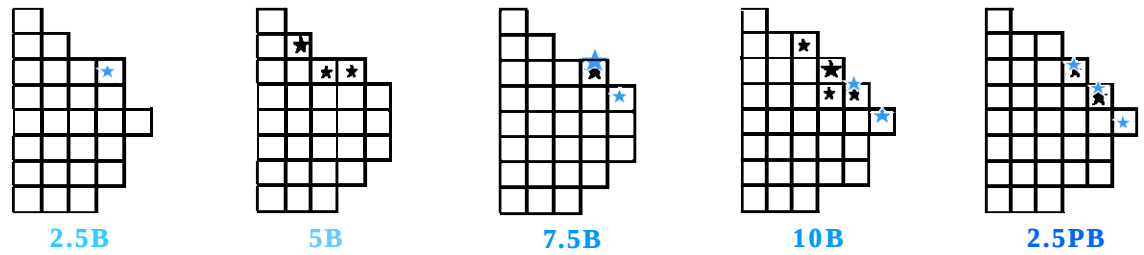

Figure 5: Alghero sample: Munsell charts with mapped focals for celeste (★) *superimposed on focals for* light blue (★). *The size of the symbols indicates relative number of participants' choices.*

Verona sample

Blu. The most frequent focals for *blu* for the Veronese, 2.5PB 3/10 and 5PB 2/8, or 3/10, or 4/12, are similar in Hue, Value and Chroma to those for the Algherese; both designate what English respondents named *dark blue* (Figure 6).

Azzurro for the Veronese, in comparison to the Algherese, appears to convey the 'light-and-medium blue' meaning. As shown in Figure 6, the most frequently chosen *azzurro* focal, 10B 8/6,

although similar in Hue, is definitely lighter and less saturated than that for the Algherese, 10B 5/12. In addition, the Veronese Hue range of *azzurro* focals is wider than that of its Algherese counterpart and extends in both directions, to include 5B, on the on hand, and blues with a greater purplish tint, 5PB, on the other. Also, Veronese *azzurro*, along with 'vivid' blues with Chroma 8-12, is frequently used for naming low-saturated blues, with Chroma 4-6 (the latter is not the case for the Algherese).

- *azzurro* (Verona): Hue: 5B-5PB; Value: 4-8; Chroma: 4-12
- *azzurro* (Alghero): Hue: 7.5B-2.5PB; Value: 4-7; Chroma: 8-12

Celeste was named by the Veronese conspicuously less frequently than by the Algherese. In addition, the focal choices are spread across 7 BLUE charts (out of 8 presented), extending to very light and unsaturated turquoise colours, 7.5BG 9/2 and 10BG 9/2 (Figure 7). Notably, for the Veronese the range of the *celeste* focals greatly overlaps with a sub-range of light *azzurro* focals.

- *celeste* (Verona): Hue: 7.5B-5PB; Value: 5-9; Chroma: 2-12
- *azzurro* (Verona): Hue: 5B-5PB; Value: 4-8; Chroma: 4-12

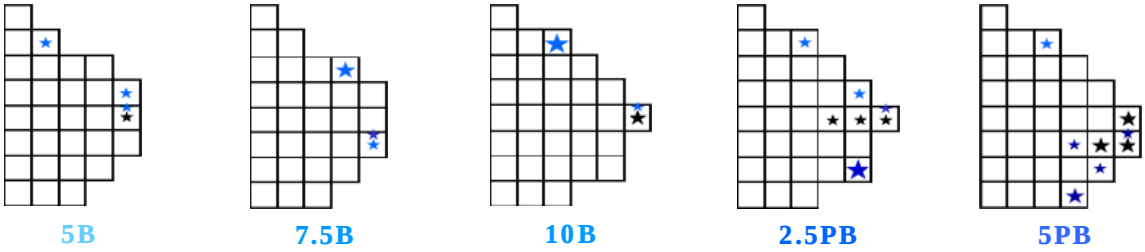

Figure 6: Verona sample: Munsell charts with mapped focals for blu (★) *and* azzurro (★) *superimposed on focals for English* blue (★). *The size of the symbols indicates relative number of participants' choices.*

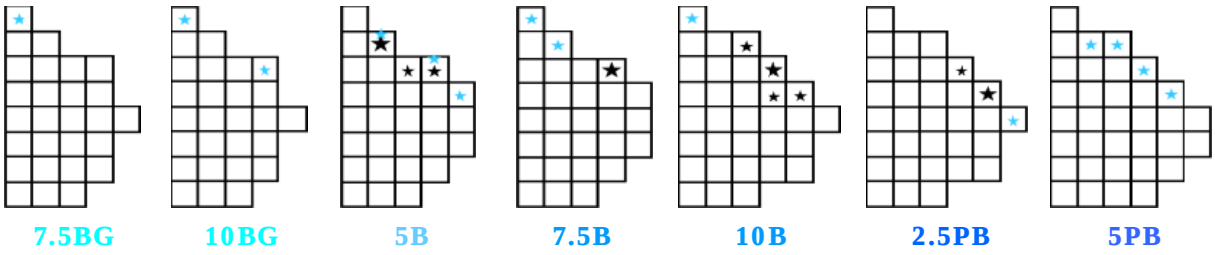

Figure 7: Verona sample: Munsell charts Munsell charts with mapped focals for celeste (★) *superimposed on* light blue *focals* (★). *The size of the symbols indicates relative number of participants' choices.*

Centroids of 'blue' focal colours: Comparison between the three participant samples

To verify our observations on the colour term meaning summarised above, for each studied colour term in question we renotated all focal colour choices in CIELAB and calculated centroids of *blu*, *azzurro* and *celeste* separately for the Alghero and Verona samples and related these to centroids of focals for English *blue* and *light blue* (Table 1).

Colour term	Alghero sample (N=13)			Verona sample (N=15)			Florence sample [17]		
	*L**	*a**	*b**	*L**	*a**	*b**	*L**	*a**	*b**
Celeste	63.93	-11.07	-39.58	76.05	-4.84	-25.35	–	–	–
Azzurro	54.65	-10.65	-45.66	68.80	-9.58	-33.58	58.12	-8.95	-33.00
Blu	28.45	4.07	-41.53	32.90	4.74	-45.33	32.85	3.50	-29.10

Colour term	Liverpool sample (N=19)		
	*L**	*a**	*b**
Light blue	72.08	-8.02	-31.47
Blue	47.21	2.07	-49.30

Table 1: CIELAB coordinates of centroids of focal 'blue' colours for the Alghero, Verona and Liverpool participant samples. For comparison, mean focal azzurro *and* blu *obtained for a Florence sample [17] are provided.*

Centroids, or centers of mass, were identified by taking the weighted average of the coordinates of focal choices with the corresponding colour name, with weights:

$$w_j^i = \frac{1}{N}\sum_{k=1}^{N} v_k(j,i)$$

where w_j^i is the fraction of times the stimulus j was chosen as a focal of category i in a sample; N is the number of participants in a sample; $v_k(j,i)$ equals 1 if stimulus j was assigned to category i by subject k, and 0 if not.

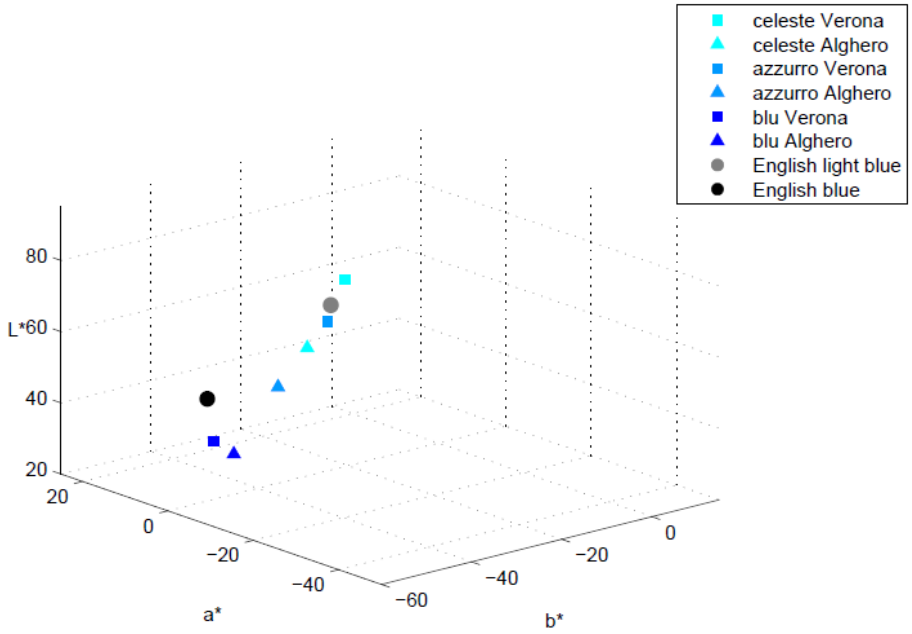

Figure 8: Centroids of focal colours for blu, azzurro *and* celeste, *for the Alghero and Verona samples, in comparison with centroids of focals for English* blue *and* light blue.

Figure 8 it illustrates locations of centroids of focals for *blu*, *azzurro*, *celeste* (Algherese and Veronese) and *blue* and *light blue* (English) in the CIELAB colour space. As it is apparent from Figure 8, for both Italian samples the prototypes of *blu* are very close to each other and darker than *blue* (*L**) but similar to it in Hue (*a*b** coordinates). However, both prototypical *azzurro* and *celeste*, as indicated by Table 1 and Figure 8, are perceptibly lighter for the Veronese than for the Algherese and, also, semantically a better match to the English *light blue*. Distances (ΔE) between centroids of focals for the two Italian samples for each of the 'blue' terms, as well as their distances to the English 'blue' terms, are provided in Table 2.

	Celeste (A)	*Celeste* (V)	*Azzurro* (A)	*Azzurro* (V)	*Blu* (A)	*Blu* (V)	*Light blue* (E)
Celeste (V)	19.70						
Azzurro (V)			18.63				
Blu (V)					5.88		
Light blue (E)	11.90	7.96	22.62	4.20			
Blue (E)			15.18	29.13	20.40	15.09	32.22

Table 2: Paired distances (ΔE; CIELAB coordinates) between centroids of focals of the 'blue' terms for the Alghero (A), Verona (V) and English (E) participant samples.

Conclusions

The present study was inspired by a recently emerged controversy on whether the lighter part of the BLUE area requires in Italian one BCT, *azzurro* 'light blue' [16], or two, *azzurro* 'medium blue' and *celeste* 'light blue' [17, 18]. Since the former was conducted in Verona (Veneto region) and the latter in Florence (Tuscany), we questioned whether the dialect, "a shared linguistic layer that groups together perceptions to guarantee communicative success" ([23], p. 7936), could have played the role in the two discrepant outcomes.

Our results provide additional psycholinguistic evidence that for Italian speakers at least two colour terms are necessary to name the BLUE area, *blu* 'dark blue' and *azzurro* 'light-and-medium blue'. Both were shown to behave as basic colour terms, in linguistic and previous psycholinguistics studies [8-18].

For the Algherese, *azzurro* focals hint at its 'medium blue' meaning. For denoting light blue shades, *azzurro* apparently is complemented by *celeste*. *Celeste* may be considered a contender for a third 'blue' BCT for this sample exposed to Algherese Catalan dialect [24, 25], a dialect that might have been influenced by the two Catalan terms for 'blue', *blau marí* 'navy blue' and *blau cel* 'sky blue' [10, 26] but the status of *celeste* ('relative basicness' [cf. 27]) seems to be markedly lower than that of *blu* and *azzurro*.

It is worth noting that also speakers from Florence (Tuscany dialect) appear to attach the 'medium blue' meaning to *azzurro*, as is indicated in Table 1 based on data from Bimler and Uusküla [17]. In comparison, the Verona sample clearly points to the 'light-and-medium blue' meaning of *azzurro*. *Celeste* was named by the Veronese infrequently and interchangeably with *azzurro*, with low agreement about its focal. For this sample, *celeste* appears to be a hyponym of *azzurro*, with its range co-extending with *azzurro* light sub-range (cf. [22]). Infrequent use of *celeste* by the Veronese and

rather "blurred" prototype conceivably reflect its cognitive representation in speakers exposed to Veneto dialect (one of Northern Italy dialects but not a Gallo-Italian, as other in this region) [25].

As indicated by the present data, in spite of using identical colour terms of modern standard Italian, speakers of different Italian dialects may vary in cognitive representation of a term, specifically, in the denotata of the prototypes of *azzurro* and *celeste* and their relationship (pair-wise distances in colorimetric terms).

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