# Color Naming in Italian language

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## Abstract

The present study investigated Italian basic color terms (BCTs). It is an extension of our previous work that explored Italian basic color categories (BCCs) using a constrained color-naming method, with 11 Italian BCTs allowed, including *blu* for naming the BLUE area. Since a latter outcome indicated a categorization bias, here monolexemic color-naming method was employed, enabling also use of *azzurro*, deeply entrenched Italian term that designates light blue. In Experiment 1, colors (N=367), sampling the Munsell Mercator projection, were presented on a CRT; color names and reaction times of vocalization onset were recorded. Naming consistency and consensus were estimated. Consistency was obtained for 12 CTs, including the two blue terms; consensus was found for 11 CTs, excluding *rosso* 'red'. For each consensus category, color with the shortest RT was considered focal. In Experiment 2, consensus stimuli (N=72) were presented; on each trial, observers indicated the focal color ("best example") in an array of colors comprising a consensus category. For each of the 12 Italian CCs, centroid was calculated and focal color (two measures) estimated. Compared to English color terms, two outcomes are specific to Italian color naming: (i) naming of the RED-PURPLE area is highly refined, with consistent use of emergent non-BCTs; (ii) *azzurro* and *blu* both perform as BCTs dividing the BLUE area along the lightness dimension. The findings are considered in the framework of the weak relativity hypothesis. Historico-linguistic, environmental and pragmatic communication factors are discussed that conceivably have driven the extension of the BCT inventory in Italian.

*Keywords: Italian; basic color terms; Munsell; CIELAB; OSA-UCS; monolexemic color naming; consistency; consensus; centroids; focal colors; weak relativity hypothesis*

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## Introduction

Color categorization is a significant cognitive function which assigns a visual stimulus to a certain color category, in adult humans identified by a linguistic label. The seminal work of Berlin and Kay[1] introduced the concept of universal basic color terms (BCTs). According to this universalist view, languages with developed color vocabulary can possess up to 11 basic color categories (BCCs), which emerge in a (almost) fixed order.

A BCT, as defined by Berlin and Kay (Ref. 1:6), should meet the following main criteria, to be distinguished from other words denoting color:

- *It is monolexemic; that is, its meaning is not predictable from the meaning of its component parts;*
- *Its signification is not included in that of any other BCT;*
- *Its application must not be restricted to a narrow class of objects;*
- *It must be psychologically salient for all informants. Indices of psychological salience include, among others, (i) a tendency to occur at the beginning of elicited lists of color terms; (ii) stability of reference across informants and across occasions of use; (iii) occurrence in the idiolects of all informants.*

Underlying the BCTs hypothesis is the concept of panhuman uniformity in the perceptual processing of color as the basis for color naming coherence within and across cultures[2-4]. The Berlin and Kay study has inspired and received support from numerous cross-cultural studies on the BCT inventory and parameters of color categories[5-7].

The endeavor also revived the opposing hypothesis, of linguistic relativity, implying that basic color term inventory is specific to each individual language, whereby color categorization and naming are governed by learned perception–language associations embedded in a given culture[8-11].

The last two decades witnessed reconciliation of the two extreme theoretical views, within the framework of the weak relativity hypothesis that acknowledges that perceptual, linguistic, social, and pragmatic factors all play a role in the cognitive processing of color[12-14] (for a review see Ref. 15).

Based on analysis of the World Color Survey data, Kay and Regier[16-17] concluded that: (i) across languages, color categories tend to cluster around certain privileged points in perceptual color space; (ii) these privileged points – category best examples, or focals – tend to locate near, although not always at, those colors named in English *red, yellow, green, blue, purple, brown, orange, pink, black, white*, and *gray*; and (iii) color category boundaries may vary between individual languages. A now broadly accepted theoretical view on the relation between color space and BCCs was put forward by Jameson and D'Andrade[18]: BCCs reflect an optimal partition of color space, as a way of meaningful information coding of the visible color gamut.

Accordingly, in the development of the BCT inventory color categories are added so that they maximize color differences between adjacent categories and minimize color differences within the new contiguous categories. Using a simulation based on this principle, Regier and colleagues[19] arrived at a solution resembling Berlin and Kay's trajectory for BCT evolution (tracing it to up to six terms).

One more aspect of the Berlin-Kay hypothesis can be embraced by the weak relativity hypothesis – the emergence of new BCCs, beyond the established 11, that are specific to a certain language. A well-known example is Russian, whose color inventory contains two BCTs for 'blue', *sinij* 'dark blue' and *goluboj* 'light blue'. In addition to *sinij*, named as a BCT for 'blue' by Berlin and Kay[1], the basic status of *goluboj* was established by several psycholinguistic measures (e.g., Refs. 6,20), with converging evidence in numerous linguistic studies (for reviews see Refs. 21,22). In recent years evidence has accumulated of further languages that appear to differentiate linguistically between light and dark blue, including Turkish[23], Greek[24], and Maltese[25], all in the Mediterranean area.

Italian, too, appears, to present the 'blue challenge' to the 11 BCT model: Berlin and Kay[1] considered that the Italian basic term for 'blue' is *azzurro*. However, numerous linguistic studies provide evidence that more than one name for 'blue' is required by Italians[26-34]. Also several recent psycholinguistic studies argue that to name the BLUE area of color space, Italian speakers require two BCTs, *blu* 'dark blue' and *azzurro* 'azure, light blue'[35,36] or even three BCTs, *blu* 'dark blue', *azzurro* 'medium blue', and *celeste* 'light blue/sky blue'[37,38]. Notably, performance in a Stroop test with incongruent word/ink pairings of *blu* and *azzurro* also indicate the basic status of both[39].

Current naming pattern of 'Italian blues' apparently reflects historical conditions. The term *azzurro* is traced back to as early as 14th century in Dante's texts[26]. It entered Italian with expansion of the Savoy House to North Italy, with the "d'azur à trois couronnes d'or" shield, whose blue color gradually moved beyond heraldic use to symbolize royalty and nobles (Ref. 40:62-63). *Blu*, a loan word from French too[26], emerged in Italian later, probably in the 17th century, and deployed to lexicalize deep (dark) blue, dying product of indigo that in massive quantities was imported to North Italy from East and West Indies, as an alternative of instable and fading blue that resulted from dying by woad (cf. Ref. 40:127).

As is well known, outcomes of psycholinguistic studies exploring the (basic) status of a color term are often contingent upon the color stimulus set and method employed. A Mercator projection (outer skin) of the Munsell Color Solid is predominantly used in color-naming research (e.g., Refs. 1,5,41). Employing stimuli of highest saturation is likely to result in less variable coordinates of focal colors, compared with stimulus sets varying not only in hue and lightness, but also in saturation (e.g., the OSA-UCS color order system; the Color Aid Corporation set; or sampling the Munsell Color Solid along all three dimensions).

Color naming is also impacted by presentation media, surface vs. self-luminous (e.g., on a CRT). Colorimetrically identical paper and displayed stimuli do not lead to identical performances: the naming agreement between the two presentation media varies between 65%-82% (depending on the illuminant of surface colors)[42]. The reason for the discrepancy is supposed to be due to differences in stimulus spectral composition, so that paper and displayed stimuli are not perceived as perfect metamers.

The empirical method of color naming plays a significant role too, greatly influencing the structure of resulting data[43]. A *constrained* color naming (CCN) method, that allows use of only the 11 BCTs[1,43], is prerequisite of outcomes with higher intra- and inter-individual agreement on naming responses.

A more relaxed version allows use of any *monolexemic* color name (MCN); it implies that also frequent non-BCTs may be elicited (e.g., Refs. 41,43). Compared to the CCN, the MCN results in lower naming consensus, 0.85 vs. 074, respectively[41]. The MCN method was applied with English speakers in two highly cited studies, both using surface colors varying in three color dimensions and uniformly sampling color space. Boynton and Olson[44,45] defined their sample (N=424) in the OSA-UCS system; in comparison, the sample (N=446) of Sturges and Whitfield[46,47] was defined in the Munsell Color System. In both studies centroids and focal colors of 11 BCCs were reported, with the latter defined as consensus stimuli exhibiting the shortest RT in their category. The outcomes manifested unequivocal salience of the 11 BCTs compared to non-BCTs.

Finally, *unconstrained* color-naming (UCN) method allows participants to name a stimulus using any color term, including compound terms, modifiers, or suffixes (e.g., Refs. 37,48-52). The method enables to reveal differences between language groups in the pattern of use of modifying terms, compounds, object glosses, and polylexemic names[51,53].

For Italian speakers, the CCN was employed in our previous studies[35,36], with *blu* as the sole option for naming blue colors. An extended color set (N=1,024) densely sampled the OSA-UCS; design and analysis followed that in the Boynton and Olson studies[44,45]. We found that parameters for 11 Italian BCCs were in good agreement with those for English speakers. However, results indicated lower consistency and consensus for the *blu* category, compared to the other 10 BCCs, as well as a noticeable difference in brightness between its centroid (high) and focal color (low), pointing to a covert category in the upper segment of the BLUE area.

In the present study we followed the design of our previous work; however, Italian speakers were tested using (i) the monolexemic CN method and (ii) color stimuli densely sampling the Munsell Mercator projection. The objective was threefold. First, we further investigated the topology of color categories in the Italian language by relaxing the constraint on the naming method to eliminate possible naming biases. This would allow properties of the Italian BCCs to be investigated, in particular exploring the psychological salience of the two 'Italian blues'. Second, the stimulus set used was intended to overcome certain flaws in our previous work, such as lack of saturated and achromatic colors (in the OSA-UCS system). A third aim was to compare results obtained using the MCN and CCN.

Two experiments were performed: In Experiment 1, using monolexemic color naming, color terms with high consistency and inter-individual consensus were estimated; for each naming consensus category, centroids were calculated and focal colors were estimated, defined by shortest RT within the category. A second, direct, measure of a focal color was obtained in Experiment 2, where participants indicated the "best example" in an array of stimuli constituting consensus colors in a given category.

## Experiment 1: Monolexemic Color Naming

### Subjects

Sixteen Italian subjects (12 males) aged 26.4 ± 4.8 years old (range 20–37) participated in Experiment 1. All were undergraduate or PhD students studying Computer Science or Biotechnology. They all resided in Verona (Veneto dialect region) and were from the Veneto region, apart from 2 originally from Toscana. The participants had normal color vision, as tested by the Ishihara Plates[54].

### Stimuli

A total of 367 color stimuli were used; these were sampled from the outer surface (Mercator projection) of the Munsell Color Solid, i.e., they varied in Hue and Value (lightness), and were of maximum Chroma (saturation), that varies, though, for different hues and at different Value levels. This choice of the set followed the majority of anthropological studies. In addition, the highly saturated colors were intended to complement the less saturated colors employed in our previous work[35,36].

Munsell color coordinates were extracted from http://www.cis.rit.edu/research/mcsl2/online/munsell.php. The latter also renotated Munsell coordinates as CIE *xyY*-coordinates under the assumption of a 2° standard observer and Illuminant C. The *xyY*-coordinates were then converted to RGB-coordinates[55](Figure 1a). The RGB-coordinates were further converted to coordinates in a perceptually uniform CIELAB space (Figure 1b) using the transformation formulae (Ref. 55:513). CIELAB coordinates of the color stimuli and the gray background are provided in Table S1 reported on the website in the section for this article's supplementary materials.

Insert Figure 1a,b about here

The experiment was run on a Dell Precision T3400 computer, implemented in Matlab using the CRS toolbox (Cambridge Research Systems Ltd.). The monitor was calibrated using the ColorCAL colorimeter, part of the of the ViSaGe package (http://www.crsltd.com/tools-for-vision-science/light-measurement-display-calibation/colorcal-mkii-colorimeter/). Each color stimulus was presented on a Mitsubishi Diamond Pro 320 monitor on a mid-gray background (33 cd/m$^2$), as a centered square (2x2 cm$^2$), and viewed at a distance of 57 cm, subtending 2° of visual angle.

**Procedure**

The experiments were performed in a completely dark room and the participants were dark adapted for 10 minutes before the start of the experiment. They were tested individually and instructed to fixate the center of the monitor for the whole duration of the experiment. Participants were instructed to name a color using solely monolexemic color terms, i.e., both BCTs and non-BCTs were potential responses. Compound terms, such as *giallo-verde* 'yellow-green', modifiers, e.g., *scuro* 'dark', or suffixed terms, e.g., *giallastro* 'yellowish', were not allowed.

Color stimuli (N=367) were presented in pseudorandom order, twice each; 734 trials in total spread over six sessions for each observer (four with 122 trials and two with 123). A trial started by presentation of the gray background with a black fixation cross in the center; after 2 sec, this was followed by a color stimulus that remained on the monitor until a verbal response was provided by a participant (Figure 2).

Insert Figure 2 about here

Participant's response was recorded by a microphone. At the beginning of the experiment, a beep was used for synchronizing the two data flows, i.e., color stimulus presentation (Matlab-file) and audio recording (WAVEform audio format). Response times (RTs) refer to the time lapse from the onset of the color stimulus to onset of participant's vocalization of a color name, with 8-msec precision in the recording allowed by the program. RTs were calculated using an audio file from http://www.fon.hum.uva.nl/praat.

## Experiment 2: Indicating Focal Colors

**Subjects**

The same subjects as in Experiment 1.

**Stimuli**

The equipment and presentation conditions were the same as in Experiment 1; however, a different set of stimuli was used which included only 72 color stimuli for which color naming consensus was achieved in Experiment 1 (see Analysis below). The stimuli constituted the following 11 color categories, including nine established BCCs and two 'Italian blue' categories: *verde* 'green', *azzurro* 'light blue', *blu* 'dark blue', *viola* 'purple', *rosa* 'pink', *giallo* 'yellow', *marrone* 'brown', *arancione* 'orange', *bianco* 'white', *grigio* 'gray', and *nero* 'black'.

**Procedure**

Each array of color stimuli was presented twice to an observer on two different sessions. No trials were conducted for the color categories *bianco* and *nero*, in which the single consensus color each was considered focal by default. On each trial, a participant was presented with an array of all consensus colors belonging to the same color category (e.g., all stimuli named *blu*, or all named *giallo*), as illustrated in Figure 3.

Insert Figure 3 about here

As in Experiment 1, a trial started with a 2-sec presentation of the mid-gray background, followed by displaying the stimulus array, which remained until participant's response. Participants were requested to indicate the number of the color patch that, in their view, was the 'best example' of the presented color category. The number corresponding to the chosen color stimulus was recorded by the researcher by pressing the corresponding key on a keyboard.

## Analysis

Based on participants' responses, the following four measures were calculated.

- **Consistency**: Agreement in color naming of a stimulus on its two presentations by an individual subject. It should be noted that, since consistency is an intra-individual measure, it is possible for a color stimulus to be named consistently by two or more subjects although they use different color terms.
- **Consensus**: Agreement in naming a color stimulus consistently by all subjects using the same color term.
- **Focal colors** of a color category, in Experiment 1, were defined as those with the shortest RT across all consensus color stimuli contained by the category in question[44-47]. Note that the present analysis used median RTs (rather than means as in the prior studies), since all RT data were significantly skewed. In Experiment 2, it was the "best example" color chosen by a participant from the array of the consensus stimuli constituting the category.
- **Centroids**, or centers of mass of color categories, were identified by taking the weighted average of the coordinates of all stimuli named by the corresponding color name:

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

where $w_j^i$ is the number of times the stimulus *j* (*j*=1, ..., 367) was given a color name *i* by all the subjects and across all trials; $N_{trials}$ is the number of trials; $v_k(j,i)$ equals 1 if stimulus *j* was assigned to category *i* on trial *k*, and 0 if not. Centroid coordinates for the $i^{th}$ category were defined as:

$$L^i = \sum_{j=1}^{367} w_j^i L_j$$

$$j^i = \sum_{j=1}^{367} w_j^i \, j_j$$

$$g^i = \sum_{j=1}^{367} w_j^i \, g_j \qquad (2)$$

For comparison with the present outcomes, those in our previous studies[35,36] (reported in OSA-UCS coordinates) were converted to CIELAB coordinates, based on the transformation formula (Ref. 55:513). Conversely, present outcomes were converted to OSA-UCS coordinates following the equations in Ref. 56.

## Results and Discussion

Since this study is a replication of those by Boynton and Olson[44,45] and Sturges and Whitfield[46,47], although using a different set of color stimuli, the results are mostly reported using the same measures: frequency of term occurrence, consistency, consensus, parameters of centroids and focal colors. Further, frequency outcomes of a recent study for American English, using MCN, are invoked[41]. In addition, where possible, monolexemic outcomes are adduced from two English-language studies that employed UCN method and CRT-displayed colors, one by Guest and Van Laar[48] and the other an online naming experiment of Mylonas and MacDonald[57]. Finally, the present results obtained using the MCN method are compared with outcomes of our previous study on color naming in Italian using the CCN method[35,36].

In the present Experiment 1, 11,744 responses were obtained (16 participants x 367 stimuli x 2). In total, 33 monolexemic color terms were produced; accompanied by English glosses, these are listed in Table 1, ranked by frequency of occurrence. As Table 1 shows, the first 12 color names that were used by all participants include 10 BCTs and the two ‘blue’ terms, *azzurro* and *blu*, in the following termed 12 Italian BCTs. These were used on 90.9% of the trials (10,679), a value comparable to 84.1% [41], 89.9% [44] or 93.7% [46,47], but higher than 67.4% [45]. On the remaining 1,065 trials, 21 non-BCTs were used, which is significantly less than 71 [45], 38 [46] or 111 [41].

Insert Table 1 about here

## Consistency

Out of the 33 elicited terms, the first 12 color names were consistently used by all participants: *verde, azzurro, viola, blu, rosa, giallo, marrone, arancione, rosso, bianco, grigio,* and *nero*. Notably, the same color names were in the top 12 positions in our study of elicitation frequencies of Italian color names[31], but the ranking was different in the latter: *bianco, rosso, giallo, nero, verde, marrone, blu, rosa, arancione, azzurro, grigio,* and *viola*. This discrepancy probably reflects ease of color term retrieval in Ref. 30 compared to the relative number of stimuli representing each color category in the Mercator projection in the present study.

A further 11 non-BCTs were used consistently by at least one subject: *fucsia, celeste, ocra, lilla, bordeaux, magenta, vinaccia, violetto, amaranto, salmone,* and *panna*. This number of consistently used non-BCTs is comparable to English sources: 13 [45], 10 [46] or 14 [58]. Notably, the consistently used English non-BCTs include *turquoise, peach, beige, olive,* and *lime*, but this is not the case for their Italian counterparts used inconsistently: *turchese* 'turquoise', *pesca* 'peach', *beige, oliva* 'olive', and *lime*. Discrepancy between the two languages with regards to the consistently used non-BCTs is telling: Italian-specific are *celeste* 'light blue/sky blue', *vinaccia* 'grape marc/pomace', and *panna* 'whitish-cream', whereas English-specific are *tan, maroon, rose, lavender, navy, mauve, rust, mustard, teal, cyan,* and *khaki.*

Insert Figure 4 about here

Figure 4 shows the number of color stimuli consistently named by each color term (N=23) for individual participants. It indicates that *azzurro* 'light blue' reaches the highest consistency (in particular, for LR: 81 stimuli; GF: 79 stimuli), followed by *verde* 'green' (LR: 77 stimuli), *viola* 'purple' (AB: 59 stimuli), and *blu* 'dark blue' (FB: 53 stimuli). Notably, the term *azzurro* features for a significantly larger number of colors named consistently than for those named *blu*. A similar trend can also be observed in Figure 5, showing total number of color stimuli named consistently by each color term across all subjects: the maximum for *verde* (1,006) is followed by *azzurro* (786), *viola* (480), and *blu* (474). This finding is in accord with outcomes in all English-language studies indicating that volumes of *green*, *blue* and *purple* categories are largest in color space and notably exceed those of other BCCs[41,45-48,57].

A total of 80% Italian color names (range 68-86%) were used consistently, the number comparable to 78.3% [44] and 81.5% [46], but higher than 65% [45]. Across the 12 Italian BCTs, this number increased to 82%, similar to 75% [45] and 84% [46] for the 11 English BCTs. In comparison, when Italian non-BCTs were used, consistency dropped to 58%, which, however, is higher than in the other two studies, 45% [45] or 37% [46].

The relatively low number of elicited non-BCTs in the present study – and, as a corollary, higher consistency of their use – may be attributed to two factors: (i) overrepresentation of males (12 out of 16 subjects), manifesting a gender effect in color naming, i.e., significantly lower usage of non-BCTs by men compared to women[41,58] [cf. almost equal gender split in Refs. 41,46; no information on subjects' gender is provided in Refs. 44,45; (ii) the choice of high-saturation stimuli of the Mercator projection which are more likely to elicit BCT, whereas less saturated stimuli are more likely to trigger non-basic names (cf. Refs. 41,46). Indeed, monolexemic color names obtained in an extensive online experiment using UCN method, when sorted by chroma (in the CIELAB space), reveal that all chromatic BCTs, with an exception of *brown*, were used for naming high saturation stimuli[50].

Insert Figure 5 about here

To compare ranking of the consistently used Italian color terms (Figure 5) with those in previous studies of English terms[44-48,52], numbers for *azzurro* (N=786) and *blu* (N=474) were counted together, which moved the combined 'Italian blue' category (1,260) to rank 1 followed by *verde* 'green' (N=1,006) with rank 2. Table 2 reveals a fair agreement between rankings of the BCTs in the two languages, with several aspects worth noting.

In almost all studies *rosso*/*red* acquires rank 8, not the highest among the BCTs. This relatively low rank of naming consistency probably reflects a small volume of 'red' category in color space[52] and, hence, the least elicited usage rate among the chromatic BCTs[41]. Contiguous to the 'red' category is a hard-to-name region – between red, pink, and purple ('cerise' region[48]) – whose colors, in both Italian and English, are consistently named by 'red' hyponyms, such as *fucsia*/*fuchsia*, *bordeaux*/*claret*, *magenta,* and *amaranto*/*burgundy*.

Further, the Italian *nero* ranks 12, comparable to rank 11 of *black* in Boynton and Olson's study[45], but unlike rank 6 [46,52], and apparently reflects "the lack of a good black" in the stimulus set (Ref. 45:101).

Noteworthy, *celeste* 'light/sky blue' has the highest consistency rank (13) among the Italian non-BCTs, similar to its English counterpart 'light blue', ranked 14, in a procedure allowing modifiers[47].

Finally, the present study and the online experiment outcome[52] indicate relatively high rankings of *ocra*/*ochre*, *bordeaux*/*claret*, *magenta*, and *salmone*/*salmon*. These terms conceivably convey luminous nature of CRT colors used in both studies. In addition, in the case of *magenta* and *salmone*/ *salmon* it may not necessarily be a perceptual factor alone: as highly frequent non-BCTs, these are registered solely in recent studies[41,52], manifesting term stabilization in the modern color lexicon due to their usage ubiquity[59].

Insert Table 2 about here

## Consensus

Naming consensus was attained by a total of 72 color stimuli comprised by 11 color categories: *verde* 'green' (N=30); *azzurro* 'light blue' (N=2); *blu* 'dark blue' (N=7); *viola* 'purple' (N=10); *rosa* 'pink' (N=7); *giallo* 'yellow' (N=7); *marrone* 'brown' (N=2); *arancione* 'orange' (N=2); *bianco* 'white' (N=1), *grigio* 'gray' (N=3), and *nero* 'black' (N=1). No perfect consensus colors were found for *rosso* 'red' or any non-BCT. CIELAB coordinates of the consensus colors are presented in Table S2, on the website in the section for this article's supplementary materials (OSA-UCS coordinates of the same colors are provided in Table S3, on the website in the section for this article's supplementary materials).

The samples with perfect consensus in Italian constitute 20%, comparable to 23% [46] or <30% [44], but significantly higher than 6.3% [41] or 2% [45], for English. The distribution of consensus samples among the BCTs is markedly uneven in the present study, compared to the previous outcomes for English[41,44,46], but all studies converge in that around 70% of consensus samples are covered by just a few BCTs – *verde/green*, *azzurro+blu/blue*, and *viola/purple*.

The highest number of consensus colors (N=30), or 42%, was found for the *verde* ‘green’ category; the stimuli named *verde* also feature a broad range of lightness ($L^*$-values 20.52–89.72), both findings in accord with previous data for the English *green*[41,44-50,52].

Lightness ranges for remaining color categories are much narrower. In line with our previous studies[35,36] and studies with English color-name counterparts[41,47-50,52,60], high $L^*$-values were found for colors in the *bianco* ‘white’, *giallo* ‘yellow’, *rosa* ‘pink’, and *arancione* ‘orange’ categories, compared to low $L^*$-values for the stimuli named *viola* ‘purple’, *marrone* ‘brown’, and *nero* ‘black’.

As expected, the two ‘Italian blues’ differ in lightness, confirming their English glosses: the colors named *azzurro* ‘light blue’ are of high lightness, $L^*$=83.31 and $L^*$=86.20; in comparison, lightness of colors named *blu* ‘dark blue' is definitely lower, with $L^*$ ranging from 13.64 to 25.88. Thus, the ‘Italian blues’ they refer to two lightness poles, compared to the entire lightness range covered by the English *blue* category.

Remarkably, no naming consensus was found for any color stimulus named *rosso* ‘red’. This finding is contrary to our previous outcome for Italian[35,36] and outcomes in English-language studies[41,44-48], although in all the region of *rosso/red* consensus was found to be very limited. One reason of the lack of *rosso* consensus in the present study may be related to the finding that “best examples” of red are outside the CRT color gamut[61]. However, rather than the colorimetric aspect, more notable is the naming pattern (Table 2): to name colors of the RED area, Italian speakers consistently use multiple non-BCTs, such as *bordeaux, fucsia, salmone, vinaccia, amaranto, magenta, porpora,* and *corallo*, which curtail the *rosso* category. This phenomenon supports Levinson’s[62] conjecture that if non-basic terms are used, they restrict the application of BCTs, dividing up together the corresponding area of color space.

High articulation of the RED area in Italian is in accord with a greater lexical differentiation of the ‘warm’ color space area in general, found for different languages[41,51,63]. Noteworthy, frequent and consistent use of Italian ‘red’ hyponyms in the hard-to-name ‘cerise’ region concurs with the color lexicon development registered in recent English-language studies – deployment of non-BCTs, such as *fuchsia*, *magenta*, *burgundy* and *maroon*, used with high consistency and consensus[41,48,50,52]. (Cf. studies carried out about 20-25 years ago registered only *fuchsia* and *maroon* for American speakers[45] and *burgundy* for British speakers[46].)

Interestingly, in addition to counterparts of the five frequently used English terms, *fuchsia*, *salmon*, *claret*, *burgundy* and *magenta*, the ‘cerise’ region in Italian is further refined by hyponyms that seem to be Italian-specific, like *vinaccia* ‘grape marc/pomace’, *porpora* ‘cardinal red’ and *corallo* ‘coral’. These terms are embedded in Italian language, used in everyday life for communicating different red/purple shades and appear to reflect environmental elements as well as culture-specific practices[33,64]: the term *vinaccia* refers to the color of marc, residue of pressed grapes; *porpora* to the color of cardinals' attire; *corallo* is motivated by the gem color and coral artisanry.

## Focal colors

Focal colors were estimated for all consensus categories using two measures, the shortest RT (Experiment 1) and the highest category vote (Experiment 2).

Table S2, reported on the website in the section for this article's supplementary materials, lists median RTs for each consensus color obtained in Experiment 1 (across 16 participants x 2 presentations). The stimulus in each category with the shortest RT was defined as its focal color (in bold font). Notably, for all colors (except one *viola* stimulus) median RTs were under 1 sec, i.e., shorter than the mean RTs (across all BCT categories) of 1.31 sec reported [46]; 1.46 sec (Ref. 44:95, Table I), or the range of 2.6-3.6 sec (Ref. 45:1315, Fig.3). Longer RTs in the latter studies conceivably resulted from the way participants' responses were recorded, e.g., color names "entered by the experimenter using a three-letter code" (Ref. 44:95). Greater response latencies for written recording of color names are indirectly confirmed by results of the online color-naming experiments which recorded onset RTs for typing a term, with median RTs for BCTs varying between 3 to 5 sec[48,52,58].

The second measure of focal color was the highest category vote in Experiment 2. The number of times (out of 32) the color was chosen as the "best example" of its respective category is indicated by *R* in the rightmost column in Table S2, reported on the website in the section for this article's supplementary materials, with the highest-vote color marked gray. This excepts two categories, *bianco* 'white' and *nero* 'black', whose only consensus category member was the default focal color.

The two focal-color measures coincide for 5 (out of the 9 multiple-member categories): *azzurro, blu, viola, rosa*, and *giallo*. Notably, in the *blu* category, along with the RT- and vote-based focal color, with $L^*$=25.88 (N=15), a darker blue color, with $L^*$=14.21, gathered almost as many choices (N=14). A similar tendency is observed for the *azzurro* (18 vs. 14 choices) and *viola* (13 vs. 10 choices) categories. This split might manifest Italian diatopic variability of the 'typical *blu*' or 'typical *viola*' concepts, respectively, which in the future can be explored by collecting additional information on participants' geographic birth origin and later residence.

This conjecture is grounded in two recent observations on diatopic variability of the 'Italian blues. (i) The focal *blu* ($L^*$=32.85, $a^*$=3.50, $b^*$=-29.10), estimated for Florence participants (Tuscany)[38], is slightly lighter and different in hue than the focal *blu* ($L^*$=25.88, $a^*$=27.67, $b^*$=-58.04) for the Verona participants (Veneto region) in the present study. Focal *azzurro* differs even more between the two participant samples: for Florence speakers, the term apparently designates 'medium blue': $L^*$=58.12, $a^*$=-8.95, $b^*$=-33.00 [38], compared with the very light and greener focal *azzurro* for Verona speakers': $L^*$=86.20, $a^*$=-40.61, $b^*$=-21.54. (Note though that the Florence data were collected using the Color Aid Corporation set whose color space sampling is coarser.) (ii) There is conspicuous difference in the lightness of *azzurro* focals for two participant samples that were tested using the same protocol: *azzurro* is apparently 'light blue' for the Veronese, compared to 'medium blue' for Alghero speakers (Algherese Catalan dialect of Sardinia), Value 5 vs. 7-8 in Munsell coordinates, respectively[65].

Various causes are conceivable for the discrepancies between RT- and vote-based focal colors (see Table S2 on the website in the section for this article's supplementary materials) for the other 4 categories: *verde, marrone, arancione*, and *grigio*. In particular, in Experiment 2 all consensus colors were presented simultaneously; also, the choice of the array "best example", as a rule, took longer than naming a color singleton (Experiment 1), thus, extending stimulus exposure. One may speculate that the simultaneous mode of presentation and a longer array display in Experiment 2 slightly shifted color appearance of the stimuli in these categories, with the contrast against the gray background requiring slightly darker "best example" choices for *verde* and *marrone* and lighter choices for *arancione* and *grigio*.

The *verde* category deserves additional considerations. In particular, with 13 colors selected as focal (across 32 presentations), low agreement between participants may be explained by the high number of stimuli (N=30) spanning all lightness values – which increased the participants' degree of freedom in the choice of the "best example". Two other (complementary) factors may underlie distributed focals for *verde* (suggested by the reviewer): (i) a large range of variation in the settings of unique green[66] and (ii) large MacAdam ellipses in the green area compared to other color space areas, i.e., nonuniform mapping of color space[55], that might attenuate agreement in the *verde* category.

In addition (as suggested by the reviewer), the two psychophysical measures of focal colors likely are related to two modes of thought underlying behavior, i.e., heuristic, fast, effortless, and implicit judgment vs. slow deliberate, and consciously monitored one[67]. As such, the two psychophysical measures probably capture different features of focal colors and, hence, should not necessarily produce identical outcomes: while the RT-based focals may reflect ease-of-retrieval of a color name (correlated with naming confidence), the vote-based focals might draw on an individual's judgment of what is "normative" for communication.

## Centroids vs. focal colors

For the 12 Italian BCCs, Table 3 presents CIELAB coordinates of centroids, i.e., a weighted measure of central tendency for all stimuli given a particular name. Note that the *rosso* category is included too, with its centroid calculated for all color stimuli named *rosso*; the same applies to the *bianco* and *nero* categories. The centroids are reported along with RT-based focal colors (Experiment 1). Figure 6 presents centroids and two focal color measures for all 12 Italian BCCs.

As in outcomes in the English-language studies (Ref. 43, Exp. 1; Ref. 44:99, Fig. 2; Ref. 46:372, Tables V,VI), centroids and focals of Italian BCCs do not fully coincide: while a focal color points to the region where the probability of the name is greatest, a centroid is the middle of a color space area in which the term is used[68]. Since centroid coordinates depend on the extent of a category, a greater difference between the centroid and the focal color indirectly indicates the extent of a category along *L**, *a**, and/or *b** dimensions.

Insert Figure 6 about here

Table 3 and Table 4 show centroids and focal colors, respectively, for the Italian BCCs obtained in the present study, alongside these measures for their English counterparts[44,46]. To facilitate a comparison, these were converted to the CIELAB coordinates using the formulae in Ref. 55:513. The OSA-UCS coordinates {*l,j,g*} were first converted to the XYZ coordinates and from the latter to the CIELAB coordinates. Conversion of the Munsell coordinates to CIE *xyY*-coordinates was carried out as under the assumption of a 2° Standard Observer and Illuminant C.

Correspondence of centroids for the 10 BCCs (without 'blue') between the two languages is impressive (Table 3). Centroids of *azzurro* and *blu* (Table 3) distinctly indicate the lightness division of the BLUE area compared to *blue*.

Focal colors (Table 4) are very close for 7 BCCs ('purple', 'pink', 'yellow', 'brown', 'orange', 'white', and 'gray'). In comparison, Italian focal *verde* is lighter, 'greener' and slightly 'yellower' than English focal *green*. Focal *blue* (for the American sample) appears to be much closer to Italian *blu* than to *azzurro*.

Insert Tables 3, 4 about here

## Comparison of outcomes obtained by two versions of the color naming method and two color sets

In addition to the CIELAB coordinates of centroids and RT-based focal colors obtained using the MCN method and sampling the Munsell Mercator projection in the present study, Table 5 reports the same measures of Italian BCCs obtained in our previous study that employed the CCN method and the color set sampling the OSA-UCS system[35,36]. Four differences are worth commenting on.

First, although in our previous, experiment[35,36] three achromatic terms, *bianco, grigio,* and *nero*, were naming options, unlike the present one, no consensus was obtained for these. Rather than being a consequence of the method used (CNN vs. MCN), this apparently reflects the lack of achromatic colors in the OSA-UCS system, the limitation commented upon earlier[45,46].

Second, the two studies reveal considerable difference in the coordinates of focal colors for *verde* 'green', both in lightness and hue (Table 5): $L^*$=28.69, $a^*$=-33.68, $b^*$=31.82[35,36] vs. $L^*$=77.30, $a^*$=-73.23, $b^*$=56.55 (present). In comparison, *verde* centroids in the two studies are much closer in all three coordinates. The large discrepancy for focal *verde* is attributable to the difference in the two color sets, as was also found for the *green* focals (see Ref. 46). It is probably also due to a 'constrained adjustment' when the CCN was employed, accommodating use of this term to name blue-greenish colors otherwise named *azzurro*.

Insert Table 5 about here

Third, no *rosso* 'red' consensus colors were obtained in the present experiment, compared to 13 stimuli named *rosso* with consensus in the CNN study[36]. The latter outcome is also likely to be a 'constrained adjustment' when stimuli otherwise calling for a non-BCT label in the 'cerise' region were recoded as the name of the generic BCT.

Last but not least, a noticeable difference between the two studies using the MCN and CCN methods lies in the volume of the *blu* consensus colors. When participants were constrained to using only one term *blu*, both dark (low lightness) and light (high lightness) blue colors were assigned to the *blu* category[35,36]. In comparison, when any monolexemic color term was allowed, this fractionated out the blue-based terms, *blu* and *azzurro*, to denote dark and light blue colors, respectively. The volume of the *blu* category shrank dramatically in the MCN outcome, constrained to low lightness values, or in the OSA-UCS notation, to negative lightness values[35,36]; in comparison, in the CCN outcome, consensus *blu* colors spanned over both negative and positive lightness values, in the OSA-UCS notation[35,36]. As is illustrated by Figure 7, *blu* consensus colors, identified in the CCN experiment, at higher lightness values were replaced by the *azzurro* consensus colors in the present MCN experiment.

Insert Figure 7 about here

Additional evidence of the splitting of the 'Italian blue' category in two is provided by a shift in the location of centroids identified by the CCN and MCN methods (Table 5 and Table S4, reported on the website in the section for this article's supplementary materials). In the CNN outcome, the *blu* centroid has higher lightness ($L^*$=51.89) than in the MCN outcome ($L^*$=37.65), indicating a considerable extension of the category in the former. In comparison, across both studies *blu* focals are of low lightness and rather stable: $L^*$=18.32 (CNN); $L^*$=25.88 (MCN). Accordingly, the centroid–focal lightness distance reduced significantly from $\Delta L^*$=33.57 (CNN) to $\Delta L^*$=11.77 (MCN). For *azzurro*, lightness distance between the focal ($L^*$=86.20) and the centroid ($L^*$=72.62) is $\Delta L^*$=13.58 in the MCN outcome. Both *blu* and *azzurro* $\Delta L^*$-differences are comparable to those separating focals and centroids of other BCTs in the MCN outcome.

Compared to our previous study[35,36], in the present one all focal colors shifted towards higher lightness values, except for *blu*. Also, for all BCCs (except for *giallo* 'yellow'), difference between lightness of centroids and focals decreased, a good sign of an optimal depiction in modeling the

Italian color terms, including the two 'blues'. Overall, comparison of outcomes of the CNN vs. MCN methods demonstrates that constraining Italian speakers to the 11 BCTs with just one option for naming the BLUE area results in a significant bias in performance.

With regards to the stimulus set employed, in accord with the previous English-language studies[46,69], outcomes for the Italian BCCs demonstrate that locations of centroids and focal colors are affected by the color system employed and the sampling scheme in color space. The OSA-UCS system[35,36,44-47,69] has the advantage of providing a perceptually uniform color space, but its colors have a limited chroma range and lower value, compared with the Munsell system. As a result, focal colors obtained using the latter are of higher chroma than their OSA-UCS equivalents, regardless of whether a stimulus set samples solely the Mercator projection[69] or the whole Munsell Color Solid[46]. More precise conclusions with regards to the Italian BCCs will require a further experiment with dense sampling of the whole Munsell Color Solid, i.e. saturated and less saturated stimuli.

## Conclusions

The present study indicates two outcomes specific to Italian color naming:

- Italian terms *azzurro* and *blu* both perform as BCTs dividing the BLUE area along the lightness dimension, with *azzurro* focals and centroids lighter and *blu* focals and centroids darker than the corresponding parameters for English *blue*, thus confirming previous linguistic[26-34] and recent psycholinguistic[35-39,65] studies. The two main Italian terms for 'blue', *azzurro* and *blu*, both arrived from French[30]: *azzurro*, derived from Romance *l'azur*, is believed to have entered as a heraldic color of the House of Savoy by the beginning of the 14th century, as attested already in Dante's poetry; in comparison, *blu*, derived from *bleu* of Germanic origin, emerged in Italian a few centuries later. Its embedment was conceivably a linguistic response to "the war between woad and indigo", as Pastoureau put it (Ref. 40:124-125): in the 17th-18th centuries indigo became significant trade article in North Italy; deep blue produced by it served as nobility's dress code marker, which required distinguishing it also lexically. Thus, linguistic and denotative fractionation of the BLUE area in Italian appear to be influenced by culture-specific practices leading to distinct functional loads of the two 'Italian blues' (cf. Refs. 33, 62,64). Influences of the physical environment, too, are likely to feed into the socio-cultural influences: both 'Italian blues' are conjectured to have emerged in response to the cognitive need for differentiating and communicating the colors of the sky and the water of the Mediterranean Sea[26,28,34].
- In Italian, naming of the area between 'red' and 'purple' is highly refined, with consistent and frequent use of multiple *rosso* or *viola* hyponyms, such as *porpora* 'cardinal red', *corallo* 'coral', *amaranto* 'burgundy', *bordeaux* 'claret', *magenta*, *fucsia* 'fuchsia', and *vinaccia* 'grape marc/pomace'. Three of these – *corallo*, *porpora*, and *vinaccia,* – are specific for Italian, in addition to the other four that are also emergent in the 'cerise' area in modern American English[41]. The Italian-specific terms are significant for conveying distinctive shades of red

or purplish-red of natural objects (wine, corals) and artifacts (cardinals' attire) in everyday life and environment of Italians and apparently have emerged under the pressure of socially dependent pragmatic communication[70].

- The present findings support the weak relativity hypothesis. In particular, they provide evidence that cultural and environmental factors determine which criteria are most attended to in linguistic refinement of color space (here: lightness discrimination of the two 'Italians blues'), and that linguistic markedness of a color category can influence these criteria[71,72]. Further, the additional 'Italian blue' BCC is considered to be culturally-specific, implying the possibility of emergence of BCCs beyond the postulated universal 11 (cf. Ref. 21). With regards to color space mapping, this implies emergence of additional category boundaries between or within the accepted 11 universal BCCs. A corollary of the additional within-category boundary is "mitosis" of the focal color of the 'parent' BCC (here: 'blue') into two (here: *azzurro* and *blu*) with departing coordinates.
- Similar to Russian[20-22] and several languages around the Mediterranean Sea[23-25] with linguistic differentiation of the BLUE area, the two 'Italian blues', *azzurro* and *blu*, present a case in support of the 'partition' hypothesis put forward by Berlin and Kay[1], i.e., successive differentiation of existing color categories, when distinctions among colors – and communicating these distinctions – become crucial in the everyday lives of speakers. *Celeste* 'light/sky blue', a frequent Italian non-BCT, can be considered another 'partition' term, depicting lightest *azzurro* subrange (centroid: $L^*$=74.03, $a^*$=-17.68, $b^*$=-30.51). In this *celeste* is similar to modern English 'partition' terms *lime* 'light green' or *lavender* 'light purple'[41,47].
- In comparison, the deployment of Italian nascent terms between the RED and PURPLE areas is in accord with the 'emergence' hypothesis of Levinson[62], whereby new color terms are added to designate a hard-to-name color space area that becomes particularly salient. Noteworthy, the same 'emergence' area is attested in modern American English, with frequent use of non-basic terms *burgundy*, *magenta*, *fuchsia*, and *maroon*[41]. Italian *vinaccia* may be considered a loose counterpart of the *maroon*, but in hue is closer to violet. *Coral*, too, appears on the list of relatively frequent non-BCTs in modern American English[41], but its rank (24) is lower than the rank of *corallo* among Italian non-BCTs (16).
- It also worth noting that our findings for Italian color names do not provide any evidence of another category, between BLUE and GREEN, that is emergent in modern English and lexicalized by *teal*, *turquoise*, and *aquamarine* (American English)[41] or predominantly *turquoise* (British English)[52]. The absence of this category in Italian is conceivably due to the existence of the *azzurro* category that includes greenish-blue (turquoise) colors; also, *celeste* appears to be counterpart of English *aqua/aquamarine* (cf. Ref. 65).

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**Table 1.** Italian color terms (N=33) elicited in Experiment 1 and ranked according to cumulative number of responses, English glosses and number of participants using the term.

| Italian color term | English gloss | Cumulative number of responses | No. of participants |
|---|---|---|---|
| *verde* | green | 2215 | 16 |
| *azzurro* | light (medium) blue | 1885 | 16 |
| *viola* | purple | 1184 | 16 |
| *blu* | dark blu | 1160 | 16 |
| *rosa* | pink | 1152 | 16 |
| *giallo* | yellow | 662 | 16 |
| *marrone* | brown | 626 | 16 |
| *arancione* | orange | 487 | 16 |
| *rosso* | red | 455 | 16 |
| *bianco* | white | 354 | 16 |
| *grigio* | gray | 267 | 16 |
| *nero* | black | 232 | 16 |
| *fucsia* | fuchsia | 344 | 12 |
| *celeste* | light/sky blue | 239 | 5 |
| *ocra* | ochre | 149 | 8 |
| *lilla* | lilac | 130 | 10 |
| *bordeaux* | claret | 76 | 7 |
| *magenta* | magenta | 36 | 3 |
| *vinaccia* | grape marc/ pomace | 22 | 1 |
| *violetto* | violet | 15 | 3 |
| *amaranto* | reddish-purple | 12 | 2 |
| *salmone* | salmon | 7 | 2 |
| *panna* | whitish-cream | 7 | 3 |
| *turchese* | turquoise | 7 | 3 |
| *petrolio* | petrol-colored/ dark green-blue | 7 | 1 |
| *porpora* | cardinal red | 3 | 3 |
| *beige* | beige | 2 | 2 |
| *corallo* | coral | 2 | 1 |
| *crema* | yellowish-cream | 2 | 1 |
| *lime* | lime | 2 | 1 |
| *cobalto* | cobalt blue | 1 | 1 |
| *oliva* | olive | 1 | 1 |
| *pesca* | peach | 1 | 1 |

**Table 2.** Consistency ranking of Italian color terms in the present study and corresponding English color terms in the Boynton and Olson (B & O; Ref. 45), Sturges and Whitfield (S & W; Ref. 47), Guest and Van Laar (G & VL; Ref. 48), and Mylonas and MacDonald (M & M; Ref. 57) studies. For comparison with English, Italian *azzurro* and *blu* are counted together.

| **Italian color term** | **English gloss** | **Ranking** | **Ranking B & O** | **Ranking S & W** | **Ranking G & VL** | **Ranking M & M** |
|---|---|---|---|---|---|---|
| *azzurro* & *blu* | light & dark blue | 1 | 2 | 1 | 1.5 | 1 |
| *verde* | green | 2 | 1 | 2 | 1.5 | 2 |
| *viola* | purple | 3 | 3 | 3 | 3.5 | 3 |
| *rosa* | pink | 4 | 4 | 5 | 3.5 | 7 |
| *giallo* | yellow | 5 | 6 | 4 | 13 | 5 |
| *marrone* | brown | 6 | 7 | 10 | 9 | 9 |
| *arancione* | orange | 7 | 5 | 9 | 5 | 16 |
| *rosso* | red | 8 | 8 | 8 | 6 | 8 |
| *bianco* | white | 9 | 10 | 11 | – | 14 |
| *fucsia* | fuchsia | 10 | 20 | – | – | – |
| *grigio* | gray | 11 | 9 | 7 | 7 | 10 |
| *nero* | black | 12 | 11 | 6 | – | 6 |
| *celeste* | light/sky blue | 13 | – | – | 14 | – |
| *ocra* | ochre | 14 | – | – | – | 11 |
| *lilla* | lilac | 15 | – | 14 | – | 4 |
| *bordeaux* | claret | 16 | – | – | – | 21 |
| *vinaccia* | grape marc/ pomace | 17 | – | – | – | – |
| *magenta* | magenta | 18 | – | – | – | 15 |
| *amaranto* | burgundy | 19 | – | 19 | – | – |
| *salmone* | salmon | 20 | – | – | – | 18 |
| *panna* | (whitish-) cream | 21 | – | 12 | | – |
| *violetto* | violet | 22 | 16 | 17 | 18 | 19 |

Table 3. Centroids (in CIELAB coordinates) for the Italian 10 BCCs and two 'blue' categories, azzurro and blu, compared with those for the 11 English BCTs. Estimates of Boynton and Olson (B & O; Ref. 44:100, Table IV) were converted from OSA-UCS coordinates; estimates of Sturges and Whitfield (S & W; Ref. 46:372, Table VI) were converted from Munsell coordinates.

| **Italian color terms** | **Present study** | | | **English color terms** | **B & O** | | | **S & W** | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | ***L**** | ***a**** | ***b**** | | ***L**** | ***a**** | ***b**** | ***L**** | ***a**** | ***b**** |
| ***Verde*** | 57.35 | -42.93 | 36.59 | ***Green*** | 62.18 | -19.04 | 25.46 | 51.60 | -38.88 | 17.73 |
| ***Azzurro*** | 72.62 | -19.15 | -30.78 | ***Blue*** | 57.25 | -14.25 | -15.61 | 51.59 | -12.87 | -33.15 |
| ***Blu*** | 35.67 | 20.16 | -55.29 | | | | | | | |
| ***Viola*** | 44.59 | 60.64 | -55.63 | ***Purple*** | 47.56 | 14.06 | -14.29 | 41.23 | 29.09 | -28.38 |
| ***Rosa*** | 73.03 | 48.16 | -17.11 | ***Pink*** | 62.23 | 27.07 | 4.59 | 61.68 | 36.21 | 8.83 |
| ***Giallo*** | 78.28 | -4.90 | 72.74 | ***Yellow*** | 75.83 | 8.90 | 55.37 | 81.37 | 8.60 | 64.98 |
| ***Marrone*** | 30.84 | 12.87 | 33.51 | ***Brown*** | 45.00 | 16.87 | 20.84 | 41.19 | 16.60 | 32.63 |
| ***Arancione*** | 60.88 | 35.37 | 60.03 | ***Orange*** | 59.49 | 35.86 | 42.03 | 61.69 | 33.21 | 62.40 |
| ***Rosso*** | 41.54 | 60.26 | 21.45 | ***Red*** | 40.25 | 39.09 | 14.41 | 41.19 | 53.95 | 23.84 |
| ***Bianco*** | 89.56 | 7.30 | -7.43 | ***White*** | 82.97 | 0.11 | 11.02 | 91.06 | 4.78 | -5.07 |
| ***Grigio*** | 52.39 | 2.46 | -4.42 | ***Gray*** | 55.96 | -1.19 | 2.45 | 51.57 | 3.01 | -3.20 |
| ***Nero*** | 13.02 | -1.14 | 2.49 | ***Black*** | 27.36 | -2.97 | -3.25 | 20.58 | 1.51 | -1.70 |

Table 4. Focal colors (in CIELAB coordinates) for the Italian 10 BCCs and two 'blue' categories, *azzurro* and *blu*, compared with those for the 11 English BCTs. Estimates of Boynton and Olson (B & O; Ref. 44:96-97, Fig. 1) were converted from OSA-UCS coordinates; estimates of Sturges and Whitfield (S & W; Ref. 46:372, Table V) were converted from Munsell coordinates.

| **Italian color terms** | **Present study** | | | **English color terms** | **B & O** | | | **S & W** | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | ***L**** | ***a**** | ***b**** | | ***L**** | ***a**** | ***b**** | ***L**** | ***a**** | ***b**** |
| ***Verde*** | 77.30 | -73.23 | 56.55 | ***Green*** | 58.98 | -38.04 | 33.56 | 41.19 | -52.05 | 11.92 |
| ***Azzurro*** | 86.20 | -40.61 | -21.54 | ***Blue*** | 26.36 | -2.82 | -26.04 | 51.59 | -0.41 | -52.67 |
| ***Blu*** | 25.88 | 27.67 | -58.04 | | | | | | | |
| ***Viola*** | 35.97 | 72.35 | -70.45 | ***Purple*** | 38.07 | 18.70 | -23.63 | 41.23 | 42.83 | -39.59 |
| ***Rosa*** | 78.19 | 35.23 | -0.60 | ***Pink*** | 75.28 | 28.25 | -2.96 | 71.58 | 36.76 | -1.36 |
| ***Giallo*** | 90.26 | -8.55 | 89.46 | ***Yellow*** | 84.22 | 0.80 | 87.40 | 81.34 | 0.69 | 98.36 |
| ***Marrone*** | 20.28 | 14.58 | 29.25 | ***Brown*** | 28.69 | 12.29 | 15.69 | 30.78 | 11.76 | 35.90 |
| ***Arancione*** | 61.21 | 36.93 | 68.46 | ***Orange*** | 60.01 | 33.85 | 43.39 | 61.72 | 45.29 | 65.81 |
| ***Rosso*** | – | – | – | ***Red*** | 36.94 | 44.55 | 18.95 | 41.24 | 67.31 | 45.33 |
| ***Bianco*** | 88.86 | 0 | -0.02 | ***White*** | 83.13 | -1.85 | 12.73 | 91.06 | 4.78 | -5.07 |
| ***Grigio*** | 40.57 | 0 | -0.01 | ***Gray*** | 51.93 | -0.25 | 0.56 | 51.57 | 3.01 | -3.20 |
| ***Nero*** | 0.09 | 0 | 0 | ***Black*** | – | – | – | – | – | – |

Table 5. CIELAB coordinates of centroids and focal colors (with shortest RTs) for Italian 10 basic color terms and two 'blue' categories, azzurro and blu, estimated using monolexemic color-naming method and constrained color-naming method.

| **Italian color terms** | **Monolexemic color naming** | | | | | | **Constrained color naming** | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Centroids** | | | **Focals** | | | **Centroids** | | | **Focals** | | |
| | ***L**** | ***a**** | ***b**** | ***L**** | ***a**** | ***b**** | ***L**** | ***a**** | ***b**** | ***L**** | ***a**** | ***b**** |
| ***Verde*** | 57.35 | -42.93 | 36.59 | 77.30 | -73.23 | 56.55 | 64.77 | -30.30 | 28.64 | 28.69 | -33.68 | 31.82 |
| ***Azzurro*** | 72.62 | -19.15 | -30.78 | 86.20 | -40.61 | -21.54 | – | – | – | – | – | – |
| ***Blu*** | 35.67 | 20.16 | -55.29 | 25.88 | 27.67 | -58.04 | 51.89 | 7.45 | -39.93 | 18.32 | 36.00 | -57.06 |
| ***Viola*** | 44.59 | 60.64 | -55.63 | 35.97 | 72.35 | -70.45 | 44.72 | 42.01 | -38.44 | 20.82 | 23.49 | -18.12 |
| ***Rosa*** | 73.03 | 48.16 | -17.11 | 78.19 | 35.23 | -0.60 | 58.53 | 48.25 | -12.54 | 74.78 | 38.35 | -2.01 |
| ***Giallo*** | 78.28 | -4.90 | 72.74 | 90.26 | -8.55 | 89.46 | 76.83 | -4.33 | 49.72 | 78.80 | -5.81 | 78.86 |
| ***Marrone*** | 30.84 | 12.87 | 33.51 | 20.28 | 14.58 | 29.25 | 42.80 | 14.38 | 21.78 | 16.29 | 13.68 | 17.72 |
| ***Arancione*** | 60.88 | 35.37 | 60.03 | 61.21 | 36.93 | 68.46 | 60.33 | 32.16 | 41.67 | 61.41 | 50.47 | 68.82 |
| ***Rosso*** | 41.54 | 60.26 | 21.45 | – | – | – | 41.48 | 52.18 | 22.68 | 39.49 | 59.52 | 44.19 |
| ***Bianco*** | 89.56 | 7.30 | -7.43 | 88.86 | 0 | -0.02 | 84.37 | -1.14 | 2.30 | – | – | – |
| ***Grigio*** | 52.39 | 2.46 | -4.42 | 40.57 | 0 | -0.01 | 55.72 | 2.97 | -4.73 | – | – | – |
| ***Nero*** | 13.02 | -1.14 | 2.49 | 0.09 | 0 | 0 | 10.23 | 2.26 | -2.37 | – | – | – |

## Figure Legends

**Figure 1.** Color stimuli (N=367) represented in the (a) sRGB and (b) CIELAB space.

**Figure 2.** Sequence of stimuli on a trial in Experiment 1. Note that a color singleton was presented on each trial; for illustrative purposes three aligned colors are shown. (To be reproduced in color on the Web and grayscale in print.)

**Figure 3.** Examples of arrays of consensus stimuli with the same color name; each array was presented on an individual trial in Experiment 2. Color of the illustration stimuli is a reproduction approximation. (To be reproduced in color on the Web and igrayscale in print.)

**Figure 4.** Number of color stimuli consistently named by individual participants for each color category (N=23). Inset: Individual participants' initials.

**Figure 5.** Cumulative number (across 16 participants) of color stimuli consistently named in each color category (N=23).

**Figure 6.** Centroids (open circles) and focal colors of the 12 Italian BCCs in the CIELAB space. Two measures of focal colors were derived: shortest median RTs (+) (Experiment 1) and highest "best example" vote (x) (Experiment 2). When the two measures coincide, the focal color is indicated by *. For *rosso* 'red' category, the indicated centroid was calculated for all color stimuli consistently named *rosso*.

**Figure 7.** Color stimuli in the BLUE-GREEN area of the CIELAB space, for which naming consensus was reached: *blu* (circles), *azzurro* (squares) and *verde* (diamonds). Compared are outcomes of monolexemic color naming in the present study (filled symbols) and constrained color naming , with *blu* as the option for naming blue colors[35,36] (open symbols).

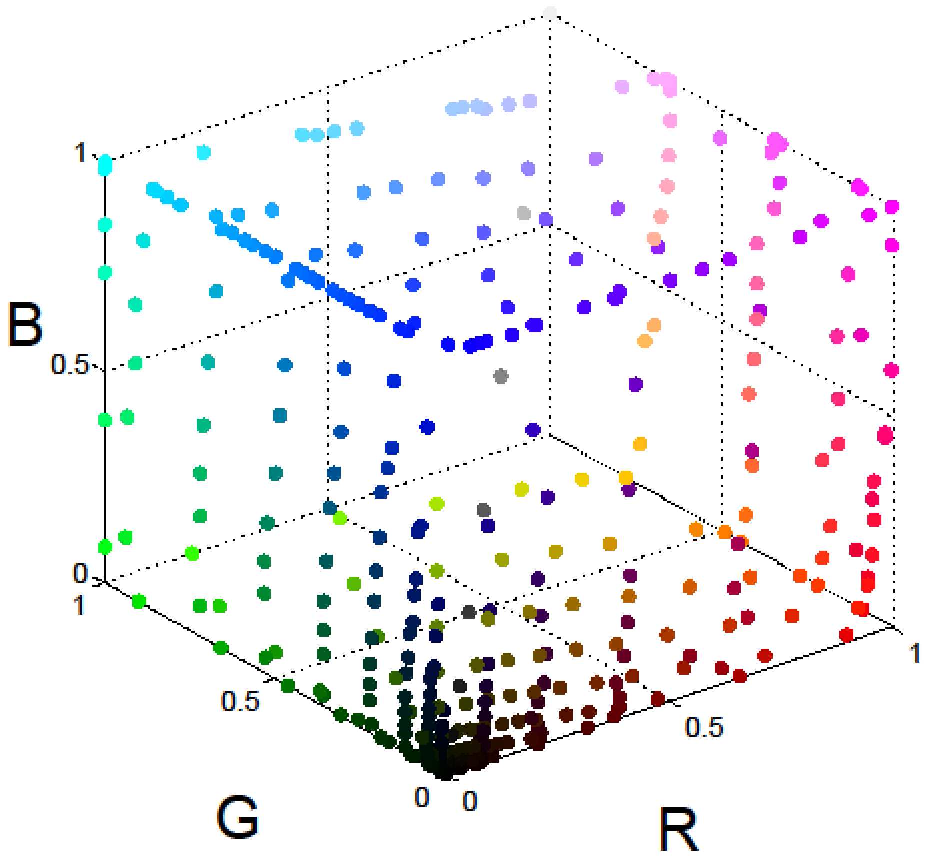



**Figure 1a**

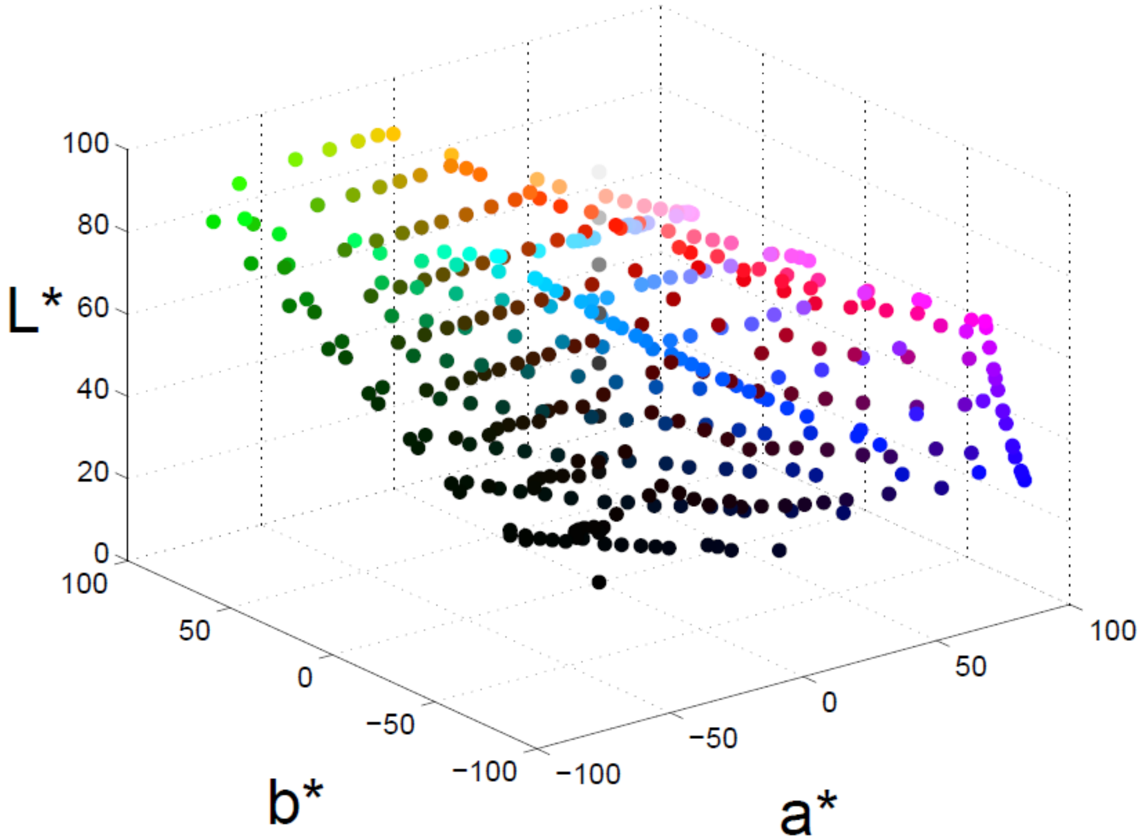



**Figure 1b**

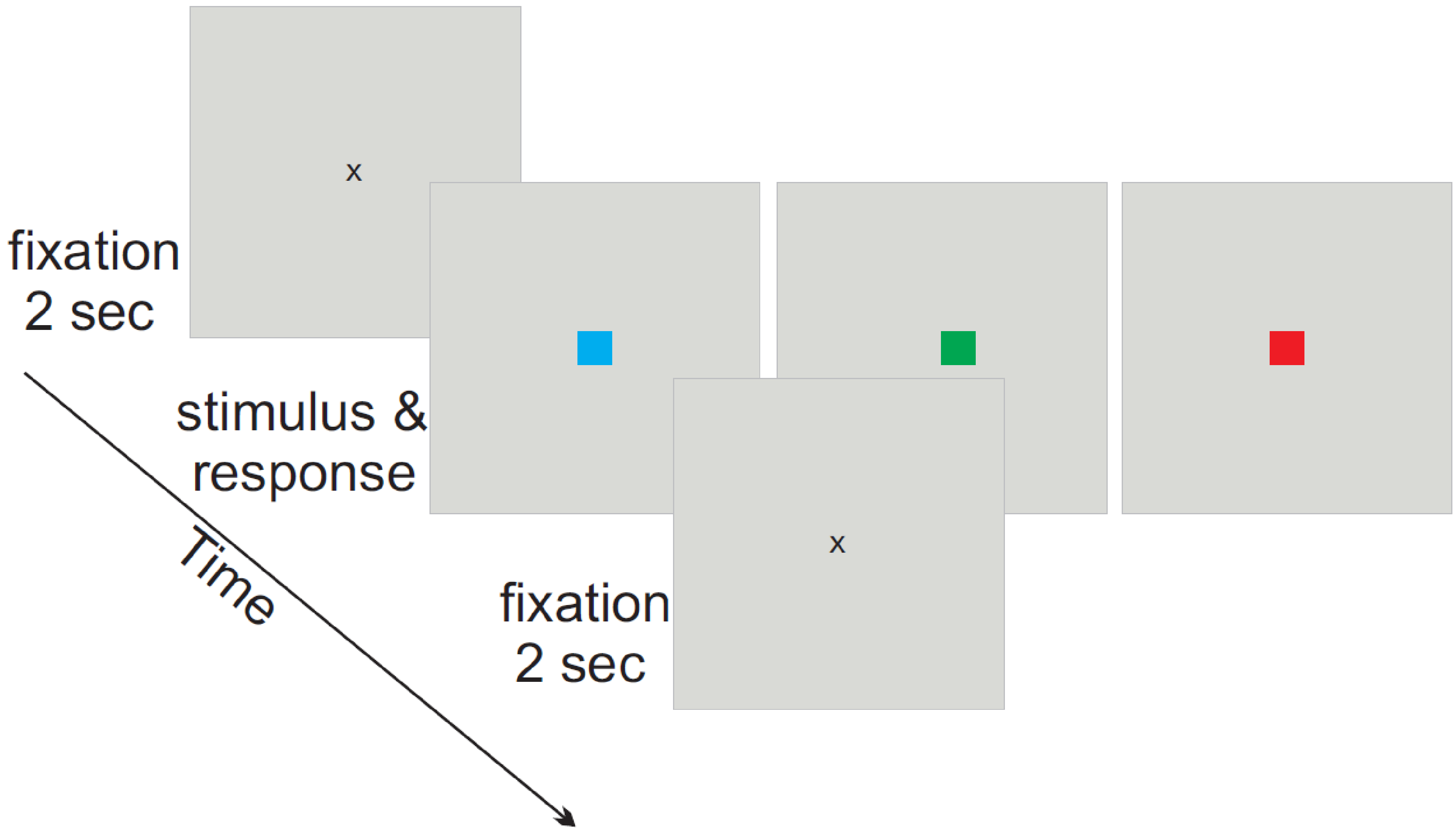



**Figure 2**

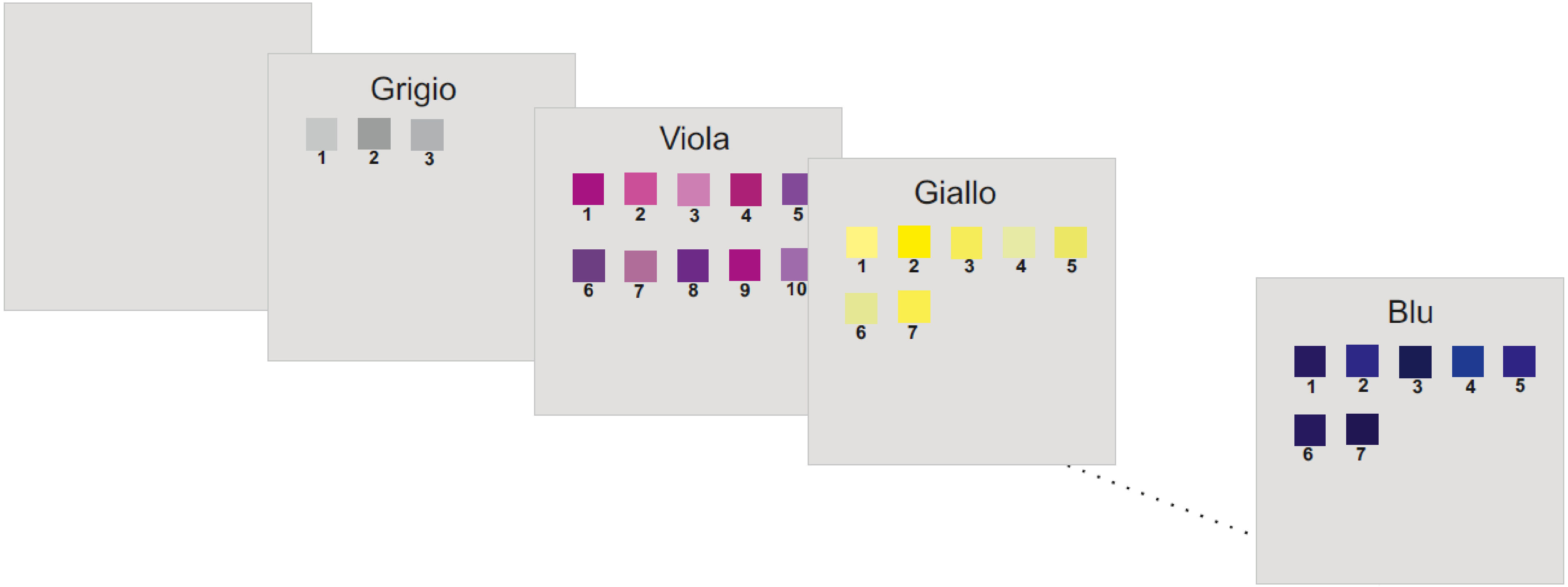
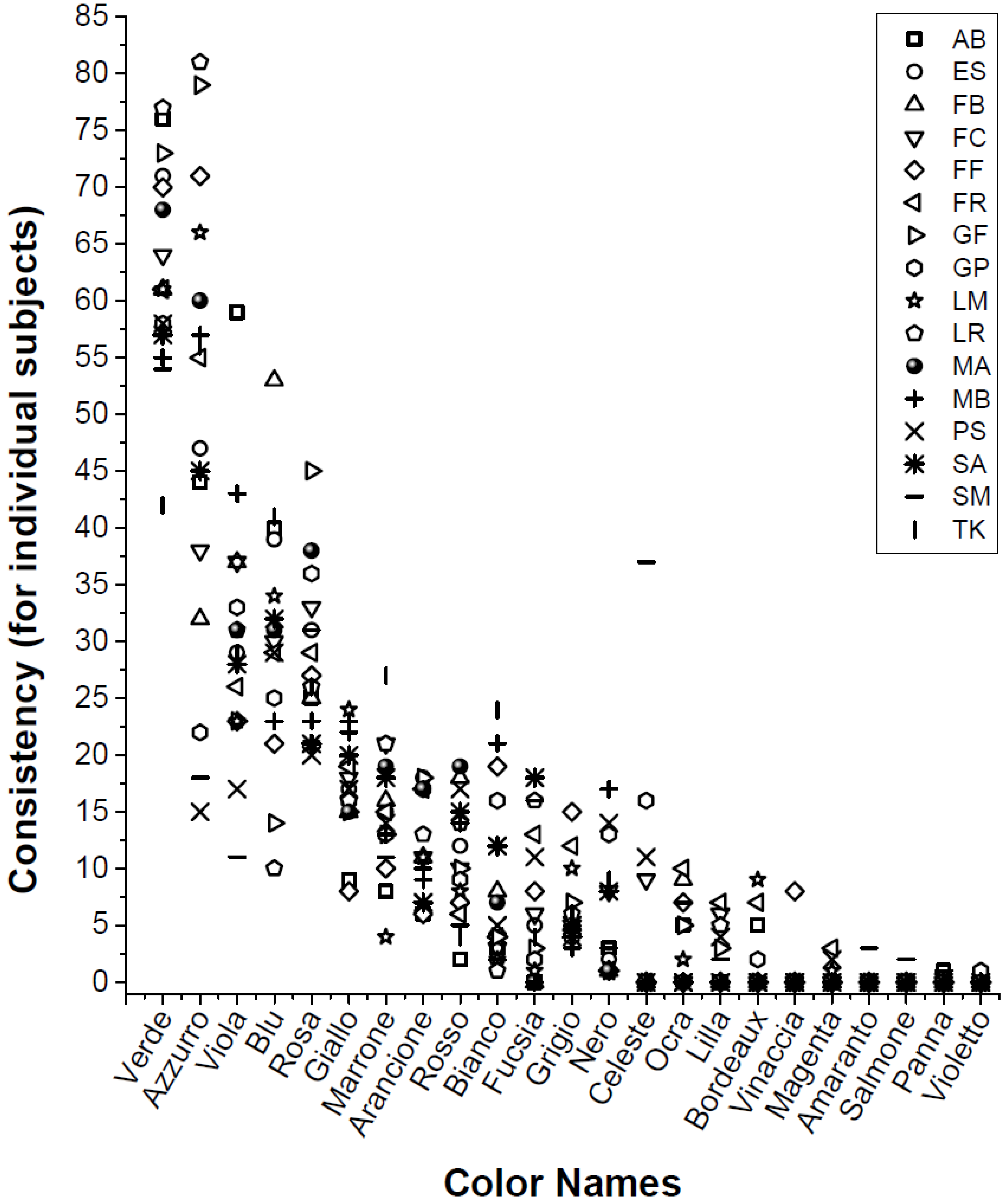
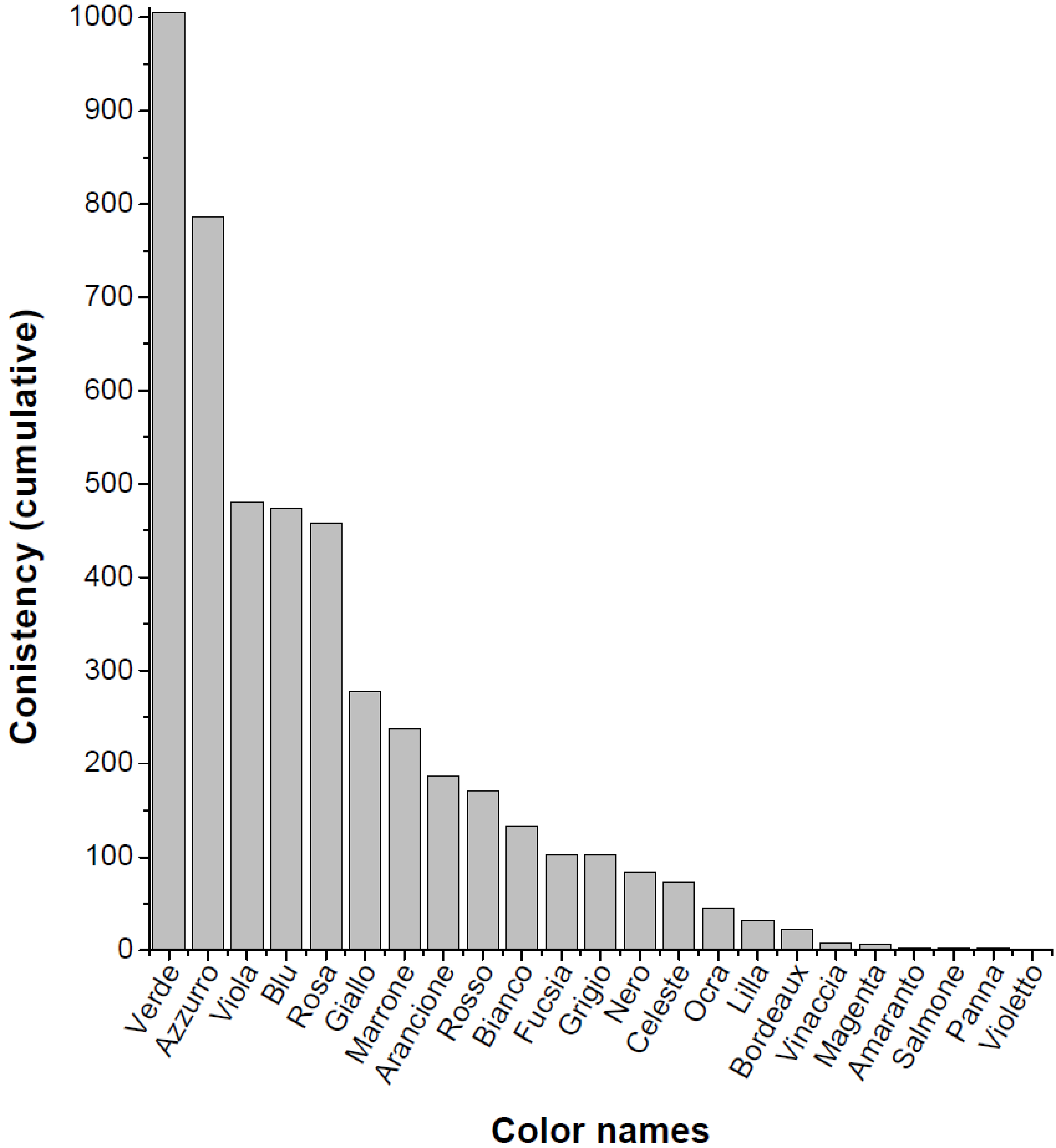



**Figure 3**



Consistency (for individual subjects)
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
AB
ES
FB
FC
FF
FR
GF
GP
LM
LR
MA
MB
PS
SA
SM
TK
Verde
Azzurro
Viola
Blu
Rosa
Giallo
Marrone
Arancione
Rosso
Bianco
Fucsia
Grigio
Nero
Celeste
Ocra
Lilla
Bordeaux
Vinaccia
Magenta
Amaranto
Salmone
Panna
Violetto
Color Names


**Figure 4**



Conistency (cumulative)
1000
900
800
700
600
500
400
300
200
100
0
Verde
Azzurro
Viola
Blu
Rosa
Giallo
Marrone
Arancione
Rosso
Bianco
Fucsia
Grigio
Nero
Celeste
Ocra
Lilla
Bordeaux
Vinaccia
Magenta
Amaranto
Salmone
Panna
Violetto
Color names


**Figure 5**

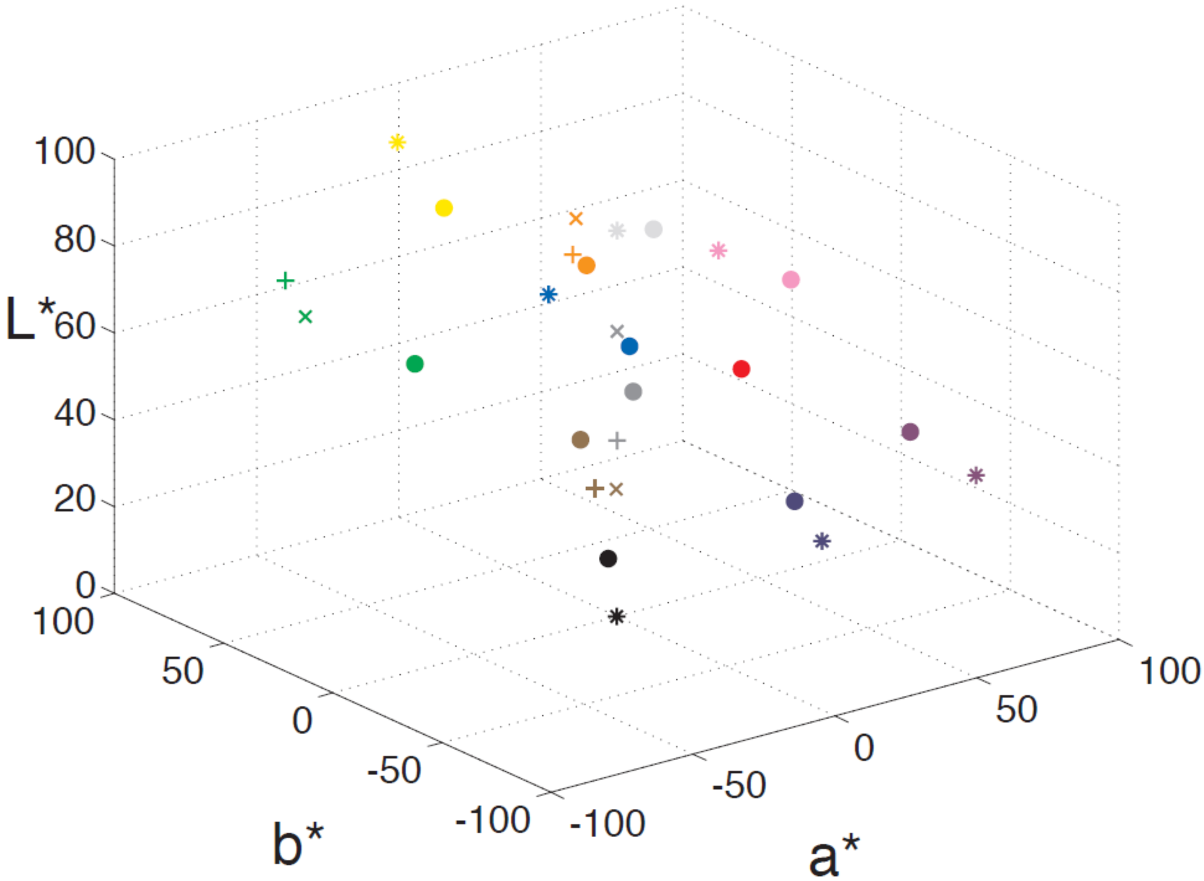



**Figure 6**

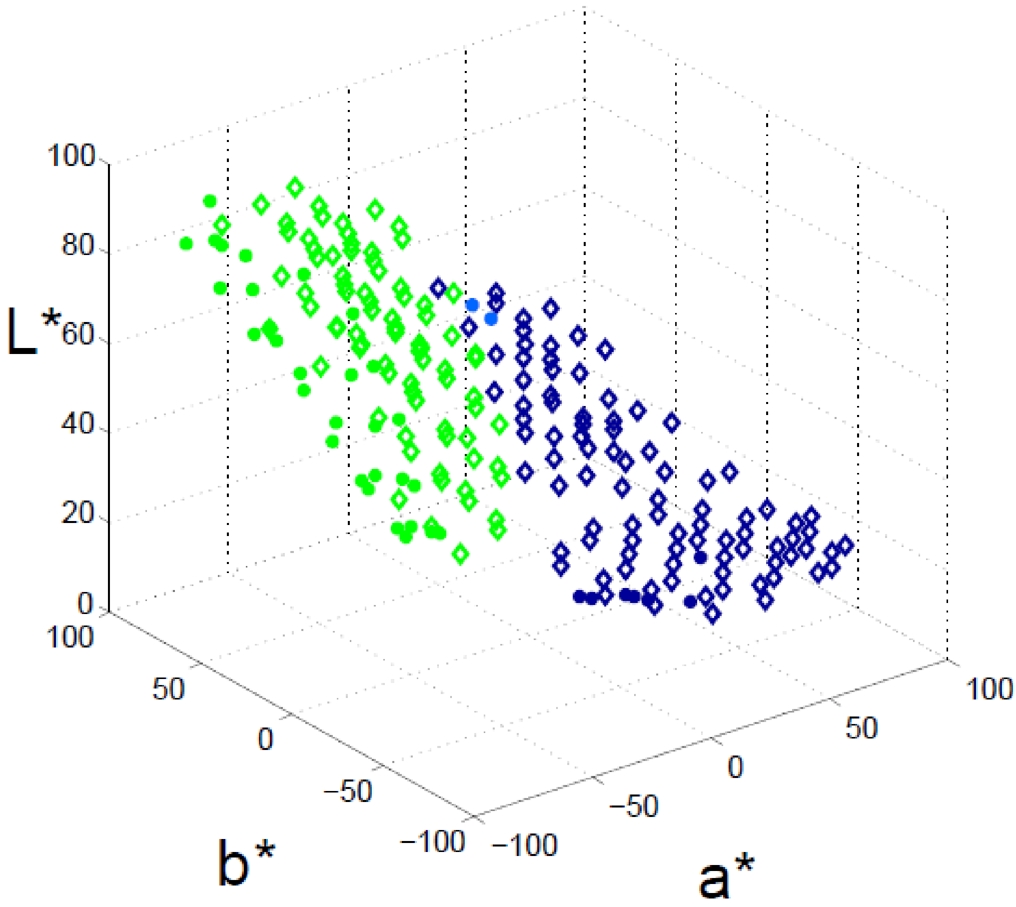



**Figure 7**

**Table S1**. RGB and CIELAB coordinates of the color stimuli (N=367) and gray background.

| RGB | | | CIELAB | | |
|---|---|---|---|---|---|
| ***R*** | ***G*** | ***B*** | ***L**** | ***a**** | ***b**** |
| 1.000 | 1.000 | 1.000 | 100.00 | 0.00 | -0.02 |
| 0.000 | 1.000 | 1.000 | 91.11 | -48.07 | -14.15 |
| 0.492 | 0.953 | 0.000 | 91.07 | -46.44 | 87.85 |
| 0.000 | 1.000 | 0.984 | 91.06 | -48.58 | -13.30 |
| 0.667 | 0.899 | 0.000 | 91.01 | -33.13 | 88.55 |
| 0.821 | 0.851 | 0.000 | 90.93 | -21.96 | 89.16 |
| 0.932 | 0.816 | 0.000 | 90.87 | -14.24 | 89.60 |
| 0.000 | 1.000 | 0.852 | 90.63 | -52.94 | -5.85 |
| 0.623 | 0.794 | 1.000 | 90.42 | -2.68 | -14.56 |
| 0.666 | 0.781 | 1.000 | 90.41 | 0.08 | -14.53 |
| 0.641 | 0.788 | 1.000 | 90.41 | -1.51 | -14.55 |
| 0.163 | 0.927 | 1.000 | 90.30 | -34.34 | -15.20 |
| 0.344 | 0.872 | 1.000 | 90.28 | -21.16 | -15.05 |
| 1.000 | 0.777 | 0.000 | 90.26 | -8.55 | 89.46 |
| 0.000 | 1.000 | 0.734 | 90.24 | -56.96 | 1.40 |
| 0.368 | 0.860 | 1.000 | 90.10 | -19.21 | -15.30 |
| 0.399 | 0.847 | 1.000 | 89.98 | -16.83 | -15.44 |
| 0.982 | 0.673 | 1.000 | 89.96 | 20.43 | -14.89 |
| 0.752 | 0.740 | 1.000 | 89.91 | 6.60 | -15.20 |
| 0.438 | 0.833 | 1.000 | 89.89 | -13.92 | -15.54 |
| 0.715 | 0.749 | 1.000 | 89.87 | 4.35 | -15.29 |
| 1.000 | 0.663 | 1.000 | 89.79 | 21.86 | -15.12 |
| 0.671 | 0.760 | 1.000 | 89.79 | 1.67 | -15.45 |
| 0.920 | 0.684 | 1.000 | 89.73 | 17.26 | -15.30 |
| 0.197 | 1.000 | 0.000 | 89.72 | -69.29 | 85.56 |
| 1.000 | 0.724 | 0.349 | 89.65 | 3.37 | 34.60 |
| 1.000 | 0.655 | 1.000 | 89.54 | 22.43 | -15.51 |
| 1.000 | 0.694 | 0.604 | 89.50 | 11.24 | 11.27 |
| 1.000 | 0.651 | 1.000 | 89.41 | 22.72 | -15.70 |
| 1.000 | 0.649 | 1.000 | 89.33 | 22.90 | -15.82 |
| 1.000 | 0.647 | 0.980 | 89.20 | 22.62 | -14.81 |
| 1.000 | 0.736 | 0.098 | 89.19 | -3.38 | 67.68 |
| 1.000 | 0.674 | 0.668 | 89.07 | 14.05 | 5.72 |
| 0.000 | 1.000 | 0.385 | 89.06 | -69.88 | 28.38 |
| 1.000 | 0.649 | 0.907 | 89.02 | 20.99 | -10.62 |
| 1.000 | 0.653 | 0.822 | 88.87 | 18.91 | -5.38 |

| | | | | | |
|---|---|---|---|---|---|
| 0.739 | 0.739 | 0.739 | 88.86 | 0.00 | -0.02 |
| 1.000 | 0.659 | 0.746 | 88.82 | 16.83 | -0.24 |
| 1.000 | 0.693 | 0.401 | 88.79 | 6.75 | 28.12 |
| 0.000 | 1.000 | 0.084 | 88.03 | -82.39 | 65.78 |
| 0.000 | 0.911 | 0.701 | 87.10 | -54.06 | -0.78 |
| 0.000 | 0.932 | 0.425 | 86.87 | -65.59 | 21.52 |
| 0.000 | 0.887 | 0.864 | 86.83 | -46.99 | -12.25 |
| 0.000 | 0.911 | 0.559 | 86.60 | -59.37 | 9.33 |
| 0.000 | 0.856 | 1.000 | 86.20 | -40.61 | -21.54 |
| 0.000 | 0.938 | 0.138 | 86.05 | -78.00 | 54.68 |
| 0.000 | 0.850 | 1.000 | 86.01 | -40.31 | -21.82 |
| 0.000 | 0.816 | 1.000 | 84.77 | -38.35 | -23.71 |
| 0.000 | 0.898 | 0.000 | 84.10 | -83.15 | 80.23 |
| 0.000 | 0.777 | 1.000 | 83.31 | -36.03 | -25.93 |
| 0.103 | 0.800 | 0.000 | 81.51 | -69.38 | 78.66 |
| 0.349 | 0.725 | 0.000 | 81.43 | -44.32 | 79.83 |
| 0.497 | 0.678 | 0.000 | 81.32 | -30.51 | 80.50 |
| 0.618 | 0.640 | 0.000 | 81.25 | -19.95 | 81.08 |
| 0.711 | 0.611 | 0.000 | 81.19 | -12.16 | 81.53 |
| 0.810 | 0.580 | 0.000 | 81.12 | -4.12 | 82.01 |
| 0.968 | 0.532 | 0.000 | 81.07 | 7.94 | 82.84 |
| 0.290 | 0.620 | 1.000 | 80.58 | -6.93 | -29.82 |
| 0.020 | 0.700 | 1.000 | 80.55 | -29.77 | -30.14 |
| 0.345 | 0.601 | 1.000 | 80.49 | -2.33 | -29.90 |
| 0.425 | 0.577 | 1.000 | 80.47 | 3.86 | -29.85 |
| 0.055 | 0.682 | 1.000 | 80.27 | -26.08 | -30.53 |
| 0.113 | 0.659 | 1.000 | 80.02 | -20.61 | -30.85 |
| 0.579 | 0.519 | 1.000 | 79.98 | 16.38 | -30.44 |
| 0.928 | 0.409 | 1.000 | 79.74 | 40.90 | -30.45 |
| 0.495 | 0.538 | 1.000 | 79.74 | 10.66 | -30.90 |
| 1.000 | 0.488 | 0.000 | 79.72 | 13.21 | 82.09 |
| 0.699 | 0.474 | 1.000 | 79.62 | 25.72 | -30.88 |
| 1.000 | 0.396 | 0.729 | 78.95 | 39.11 | -13.64 |
| 0.000 | 0.698 | 0.662 | 78.85 | -44.11 | -10.09 |
| 0.000 | 0.713 | 0.507 | 78.85 | -51.63 | 2.63 |
| 0.000 | 0.723 | 0.388 | 78.78 | -57.54 | 13.88 |
| 0.000 | 0.677 | 0.838 | 78.72 | -35.72 | -22.77 |
| 0.000 | 0.655 | 0.997 | 78.50 | -28.21 | -33.15 |
| 1.000 | 0.394 | 0.634 | 78.48 | 37.23 | -7.11 |
| 1.000 | 0.419 | 0.362 | 78.39 | 28.59 | 17.86 |
| 0.000 | 0.723 | 0.284 | 78.33 | -62.43 | 24.78 |

| | | | | | |
|---|---|---|---|---|---|
| 1.000 | 0.396 | 0.550 | 78.19 | 35.23 | -0.60 |
| 1.000 | 0.352 | 0.966 | 78.11 | 48.57 | -30.81 |
| 1.000 | 0.403 | 0.452 | 78.07 | 32.31 | 8.19 |
| 1.000 | 0.346 | 1.000 | 78.00 | 49.89 | -33.06 |
| 1.000 | 0.443 | 0.000 | 77.83 | 17.38 | 80.82 |
| 0.523 | 0.523 | 0.523 | 77.43 | 0.00 | -0.02 |
| 1.000 | 0.426 | 0.071 | 77.43 | 20.78 | 60.81 |
| 0.000 | 0.628 | 1.000 | 77.37 | -26.16 | -35.06 |
| 0.000 | 0.720 | 0.072 | 77.30 | -73.23 | 56.55 |
| 1.000 | 0.410 | 0.199 | 77.28 | 25.62 | 37.14 |
| 1.000 | 0.344 | 0.836 | 77.24 | 46.70 | -23.77 |
| 1.000 | 0.324 | 1.000 | 77.07 | 52.22 | -34.48 |
| 0.000 | 0.592 | 1.000 | 75.81 | -23.46 | -37.48 |
| 0.000 | 0.568 | 1.000 | 74.72 | -21.55 | -39.16 |
| 0.000 | 0.659 | 0.000 | 74.28 | -74.99 | 72.35 |
| 0.000 | 0.529 | 1.000 | 72.93 | -18.35 | -41.95 |
| 0.065 | 0.586 | 0.000 | 71.74 | -63.76 | 70.70 |
| 0.000 | 0.504 | 1.000 | 71.71 | -16.12 | -43.86 |
| 0.250 | 0.528 | 0.000 | 71.62 | -40.34 | 71.75 |
| 0.358 | 0.495 | 0.000 | 71.58 | -27.97 | 72.40 |
| 0.452 | 0.466 | 0.000 | 71.52 | -17.77 | 72.97 |
| 0.525 | 0.443 | 0.000 | 71.46 | -10.28 | 73.40 |
| 0.604 | 0.418 | 0.000 | 71.39 | -2.41 | 73.87 |
| 0.706 | 0.386 | 0.000 | 71.29 | 7.30 | 74.50 |
| 0.817 | 0.352 | 0.000 | 71.26 | 17.31 | 75.24 |
| 0.927 | 0.317 | 0.000 | 71.14 | 26.84 | 75.93 |
| 0.061 | 0.465 | 1.000 | 70.71 | -8.03 | -45.36 |
| 0.135 | 0.441 | 1.000 | 70.60 | -0.58 | -45.46 |
| 0.256 | 0.403 | 1.000 | 70.52 | 10.98 | -45.46 |
| 0.476 | 0.333 | 1.000 | 70.26 | 30.67 | -45.63 |
| 0.607 | 0.290 | 1.000 | 70.08 | 41.67 | -45.78 |
| 1.000 | 0.271 | 0.000 | 69.90 | 35.80 | 75.69 |
| 0.358 | 0.359 | 1.000 | 69.80 | 21.64 | -46.48 |
| 0.899 | 0.197 | 1.000 | 69.76 | 64.31 | -45.98 |
| 0.000 | 0.466 | 0.962 | 69.64 | -14.17 | -44.77 |
| 0.000 | 0.534 | 0.266 | 69.57 | -53.22 | 15.10 |
| 0.000 | 0.525 | 0.360 | 69.56 | -47.32 | 3.73 |
| 0.000 | 0.535 | 0.187 | 69.19 | -57.89 | 25.88 |
| 0.000 | 0.490 | 0.632 | 69.17 | -30.83 | -22.33 |
| 0.000 | 0.504 | 0.487 | 69.13 | -39.10 | -9.82 |
| 0.000 | 0.472 | 0.758 | 68.92 | -23.50 | -32.28 |

| | | | | | |
|---|---|---|---|---|---|
| 0.000 | 0.441 | 1.000 | 68.57 | -10.24 | -48.79 |
| 0.000 | 0.531 | 0.037 | 68.20 | -67.21 | 55.28 |
| 1.000 | 0.203 | 0.306 | 67.99 | 52.08 | 9.94 |
| 0.000 | 0.420 | 1.000 | 67.48 | -8.14 | -50.51 |
| 1.000 | 0.160 | 0.619 | 67.40 | 64.92 | -22.57 |
| 1.000 | 0.219 | 0.000 | 67.22 | 42.41 | 74.05 |
| 1.000 | 0.204 | 0.069 | 66.80 | 46.16 | 49.73 |
| 1.000 | 0.127 | 0.780 | 66.52 | 72.92 | -36.36 |
| 1.000 | 0.157 | 0.472 | 66.43 | 62.25 | -10.77 |
| 1.000 | 0.103 | 1.000 | 66.39 | 80.72 | -51.19 |
| 0.000 | 0.397 | 1.000 | 66.19 | -5.63 | -52.55 |
| 1.000 | 0.178 | 0.161 | 65.87 | 52.09 | 28.70 |
| 1.000 | 0.158 | 0.365 | 65.87 | 59.81 | -0.23 |
| 1.000 | 0.093 | 1.000 | 65.86 | 82.20 | -52.02 |
| 0.349 | 0.349 | 0.349 | 65.63 | 0.00 | -0.02 |
| 0.000 | 0.374 | 1.000 | 64.91 | -3.08 | -54.59 |
| 0.000 | 0.465 | 0.000 | 64.38 | -66.75 | 64.40 |
| 0.000 | 0.334 | 1.000 | 62.59 | 1.63 | -58.27 |
| 0.033 | 0.412 | 0.000 | 61.83 | -58.70 | 62.61 |
| 0.167 | 0.371 | 0.000 | 61.72 | -36.80 | 63.57 |
| 0.246 | 0.347 | 0.000 | 61.69 | -25.38 | 64.18 |
| 0.316 | 0.325 | 0.000 | 61.64 | -15.76 | 64.72 |
| 0.371 | 0.308 | 0.000 | 61.58 | -8.53 | 65.13 |
| 0.429 | 0.290 | 0.000 | 61.51 | -1.19 | 65.58 |
| 0.498 | 0.268 | 0.000 | 61.42 | 7.08 | 66.10 |
| 0.568 | 0.245 | 0.000 | 61.32 | 15.21 | 66.65 |
| 0.662 | 0.217 | 0.000 | 61.29 | 25.43 | 67.48 |
| 0.774 | 0.182 | 0.000 | 61.21 | 36.93 | 68.46 |
| 0.887 | 0.146 | 0.000 | 61.06 | 48.14 | 69.46 |
| 0.000 | 0.308 | 1.000 | 61.01 | 4.93 | -60.80 |
| 0.125 | 0.263 | 1.000 | 60.52 | 20.20 | -61.45 |
| 1.000 | 0.101 | 0.000 | 60.35 | 60.20 | 70.23 |
| 1.000 | 0.000 | 1.000 | 60.32 | 98.23 | -60.84 |
| 0.000 | 0.344 | 0.478 | 59.95 | -25.39 | -22.89 |
| 0.417 | 0.167 | 1.000 | 59.92 | 51.24 | -62.11 |
| 0.256 | 0.214 | 1.000 | 59.82 | 35.68 | -62.44 |
| 0.567 | 0.121 | 1.000 | 59.81 | 65.11 | -62.12 |
| 1.000 | 0.000 | 0.909 | 59.73 | 96.80 | -55.98 |
| 0.000 | 0.286 | 1.000 | 59.60 | 7.94 | -63.06 |
| 0.000 | 0.362 | 0.249 | 59.59 | -41.70 | 3.12 |
| 0.862 | 0.030 | 1.000 | 59.56 | 90.00 | -62.21 |

| | | | | | |
|---|---|---|---|---|---|
| 0.000 | 0.351 | 0.348 | 59.54 | -34.11 | -9.64 |
| 0.000 | 0.302 | 0.827 | 59.50 | -1.99 | -51.95 |
| 1.000 | 0.054 | 0.321 | 59.37 | 75.95 | -4.57 |
| 0.000 | 0.326 | 0.568 | 59.36 | -18.26 | -32.06 |
| 0.948 | 0.000 | 1.000 | 59.32 | 97.32 | -62.51 |
| 0.000 | 0.362 | 0.179 | 59.18 | -46.81 | 13.41 |
| 0.000 | 0.310 | 0.676 | 59.00 | -10.47 | -41.59 |
| 1.000 | 0.073 | 0.065 | 58.95 | 66.72 | 42.23 |
| 0.000 | 0.363 | 0.121 | 58.81 | -51.31 | 23.87 |
| 1.000 | 0.053 | 0.231 | 58.75 | 74.10 | 7.16 |
| 1.000 | 0.060 | 0.146 | 58.58 | 71.08 | 21.96 |
| 0.000 | 0.267 | 1.000 | 58.33 | 10.69 | -65.10 |
| 1.000 | 0.022 | 0.453 | 58.14 | 84.60 | -21.42 |
| 0.000 | 0.360 | 0.025 | 57.94 | -59.07 | 48.76 |
| 1.000 | 0.002 | 0.609 | 57.81 | 91.50 | -36.53 |
| 0.000 | 0.256 | 1.000 | 57.60 | 12.30 | -66.28 |
| 0.930 | 0.000 | 0.719 | 57.04 | 92.32 | -46.77 |
| 0.983 | 0.000 | 0.457 | 56.31 | 88.75 | -24.73 |
| 0.792 | 0.000 | 1.000 | 56.14 | 94.53 | -67.78 |
| 0.000 | 0.226 | 1.000 | 55.44 | 17.14 | -69.76 |
| 0.954 | 0.000 | 0.321 | 54.67 | 85.50 | -11.66 |
| 0.000 | 0.310 | 0.000 | 54.24 | -58.32 | 56.26 |
| 0.214 | 0.214 | 0.214 | 53.39 | 0.00 | -0.01 |
| 0.000 | 0.198 | 1.000 | 53.37 | 21.92 | -73.11 |
| 0.705 | 0.000 | 0.856 | 53.14 | 90.30 | -63.28 |
| 0.920 | 0.000 | 0.212 | 53.05 | 82.47 | 1.85 |
| 0.945 | 0.000 | 0.138 | 53.05 | 81.56 | 15.89 |
| 0.637 | 0.000 | 1.000 | 52.69 | 91.63 | -73.53 |
| 0.933 | 0.000 | 0.067 | 52.20 | 79.72 | 33.14 |
| 0.012 | 0.274 | 0.000 | 51.70 | -53.36 | 54.34 |
| 0.105 | 0.245 | 0.000 | 51.59 | -32.93 | 55.22 |
| 0.158 | 0.229 | 0.000 | 51.57 | -22.67 | 55.76 |
| 0.208 | 0.214 | 0.000 | 51.52 | -13.74 | 56.26 |
| 0.247 | 0.202 | 0.000 | 51.47 | -6.94 | 56.66 |
| 0.288 | 0.189 | 0.000 | 51.41 | -0.11 | 57.07 |
| 0.332 | 0.175 | 0.000 | 51.33 | 6.94 | 57.52 |
| 0.378 | 0.160 | 0.000 | 51.24 | 13.94 | 57.99 |
| 0.576 | 0.000 | 1.000 | 51.22 | 90.44 | -75.99 |
| 0.446 | 0.139 | 0.000 | 51.22 | 23.54 | 58.78 |
| 0.509 | 0.119 | 0.000 | 51.09 | 32.23 | 59.47 |
| 0.600 | 0.091 | 0.000 | 51.01 | 43.86 | 60.59 |

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|---|---|---|---|---|---|
| 0.899 | 0.000 | 0.017 | 50.97 | 77.67 | 52.64 |
| 0.750 | 0.044 | 0.000 | 50.83 | 61.64 | 62.54 |
| 0.686 | 0.000 | 0.531 | 50.00 | 83.42 | -42.37 |
| 0.502 | 0.000 | 1.000 | 49.37 | 88.98 | -79.09 |
| 0.000 | 0.191 | 0.586 | 49.35 | 2.22 | -49.41 |
| 0.203 | 0.086 | 1.000 | 49.13 | 57.85 | -79.81 |
| 0.032 | 0.136 | 1.000 | 49.02 | 36.74 | -80.16 |
| 0.000 | 0.206 | 0.390 | 48.95 | -13.32 | -30.71 |
| 0.000 | 0.196 | 0.476 | 48.87 | -5.74 | -39.93 |
| 0.000 | 0.212 | 0.317 | 48.85 | -19.83 | -22.09 |
| 0.000 | 0.220 | 0.226 | 48.74 | -28.49 | -9.41 |
| 0.000 | 0.155 | 0.864 | 48.68 | 24.19 | -71.91 |
| 0.000 | 0.224 | 0.161 | 48.50 | -34.94 | 1.51 |
| 0.000 | 0.174 | 0.650 | 48.41 | 9.25 | -56.38 |
| 0.402 | 0.018 | 1.000 | 48.34 | 82.02 | -80.88 |
| 0.000 | 0.137 | 1.000 | 48.25 | 34.35 | -81.45 |
| 0.000 | 0.225 | 0.113 | 48.10 | -39.73 | 11.06 |
| 0.000 | 0.162 | 0.706 | 47.84 | 14.78 | -61.78 |
| 0.000 | 0.224 | 0.074 | 47.73 | -43.82 | 20.63 |
| 0.654 | 0.000 | 0.321 | 47.26 | 77.84 | -23.58 |
| 0.000 | 0.223 | 0.017 | 47.05 | -50.09 | 40.54 |
| 0.675 | 0.000 | 0.140 | 46.14 | 73.98 | 4.82 |
| 0.647 | 0.000 | 0.216 | 46.06 | 75.05 | -9.95 |
| 0.380 | 0.000 | 1.000 | 46.05 | 86.52 | -84.66 |
| 0.000 | 0.113 | 1.000 | 46.01 | 40.07 | -85.13 |
| 0.377 | 0.000 | 1.000 | 45.96 | 86.46 | -84.81 |
| 0.423 | 0.000 | 0.781 | 45.13 | 82.65 | -71.25 |
| 0.659 | 0.000 | 0.004 | 44.28 | 69.76 | 54.56 |
| 0.310 | 0.000 | 1.000 | 43.95 | 85.08 | -88.18 |
| 0.000 | 0.191 | 0.000 | 43.79 | -49.63 | 47.86 |
| 0.616 | 0.000 | 0.038 | 43.32 | 69.22 | 31.73 |
| 0.409 | 0.000 | 0.536 | 42.12 | 76.36 | -55.86 |
| 0.546 | 0.000 | 0.093 | 41.67 | 68.32 | 9.54 |
| 0.000 | 0.169 | 0.000 | 41.39 | -47.63 | 45.93 |
| 0.060 | 0.150 | 0.000 | 41.24 | -28.94 | 46.68 |
| 0.096 | 0.138 | 0.000 | 41.07 | -18.92 | 47.07 |
| 0.124 | 0.129 | 0.000 | 41.05 | -11.77 | 47.49 |
| 0.206 | 0.105 | 0.000 | 41.01 | 6.79 | 48.74 |
| 0.147 | 0.122 | 0.000 | 41.00 | -6.22 | 47.81 |
| 0.171 | 0.114 | 0.000 | 40.95 | -0.59 | 48.14 |
| 0.235 | 0.095 | 0.000 | 40.93 | 13.00 | 49.16 |

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|---|---|---|---|---|---|
| 0.266 | 0.085 | 0.000 | 40.82 | 19.21 | 49.59 |
| 0.321 | 0.069 | 0.000 | 40.80 | 29.54 | 50.53 |
| 0.360 | 0.056 | 0.000 | 40.66 | 36.72 | 51.15 |
| 0.116 | 0.116 | 0.116 | 40.57 | 0.00 | -0.01 |
| 0.487 | 0.017 | 0.000 | 40.53 | 57.16 | 53.53 |
| 0.199 | 0.000 | 1.000 | 40.35 | 82.82 | -94.26 |
| 0.193 | 0.000 | 1.000 | 40.12 | 82.69 | -94.65 |
| 0.412 | 0.000 | 0.330 | 39.82 | 70.69 | -36.97 |
| 0.148 | 0.000 | 0.994 | 38.44 | 81.67 | -97.12 |
| 0.407 | 0.000 | 0.220 | 38.28 | 67.12 | -23.24 |
| 0.000 | 0.085 | 0.537 | 37.83 | 23.98 | -63.62 |
| 0.026 | 0.030 | 1.000 | 37.72 | 66.79 | -98.80 |
| 0.000 | 0.109 | 0.289 | 37.63 | -2.31 | -35.84 |
| 0.000 | 0.057 | 0.802 | 37.59 | 48.03 | -85.75 |
| 0.000 | 0.114 | 0.229 | 37.51 | -9.52 | -27.12 |
| 0.000 | 0.118 | 0.189 | 37.46 | -14.78 | -20.30 |
| 0.000 | 0.095 | 0.387 | 37.13 | 10.06 | -49.07 |
| 0.000 | 0.121 | 0.131 | 37.07 | -22.43 | -9.13 |
| 0.195 | 0.000 | 0.751 | 37.05 | 76.38 | -82.55 |
| 0.400 | 0.000 | 0.143 | 37.01 | 64.26 | -10.34 |
| 0.000 | 0.101 | 0.318 | 36.99 | 2.51 | -40.84 |
| 0.000 | 0.123 | 0.094 | 36.93 | -27.91 | -0.07 |
| 0.000 | 0.089 | 0.426 | 36.82 | 15.08 | -54.02 |
| 0.000 | 0.123 | 0.064 | 36.54 | -32.18 | 8.31 |
| 0.000 | 0.073 | 0.559 | 36.51 | 29.39 | -67.82 |
| 0.000 | 0.123 | 0.041 | 36.21 | -35.76 | 16.61 |
| 0.089 | 0.000 | 1.000 | 36.19 | 80.66 | -101.28 |
| 0.225 | 0.000 | 0.583 | 35.97 | 72.35 | -70.45 |
| 0.000 | 0.123 | 0.012 | 35.74 | -40.70 | 31.81 |
| 0.074 | 0.000 | 1.000 | 35.58 | 80.39 | -102.31 |
| 0.379 | 0.000 | 0.084 | 35.36 | 61.25 | 2.22 |
| 0.387 | 0.000 | 0.050 | 35.19 | 60.30 | 14.19 |
| 0.388 | 0.000 | 0.025 | 34.86 | 59.35 | 26.47 |
| 0.052 | 0.000 | 1.000 | 34.66 | 80.00 | -103.87 |
| 0.378 | 0.000 | 0.006 | 34.17 | 58.12 | 40.57 |
| 0.000 | 0.106 | 0.000 | 33.09 | -40.72 | 39.25 |
| 0.206 | 0.000 | 0.393 | 32.29 | 65.45 | -57.23 |
| 0.317 | 0.000 | 0.000 | 31.24 | 54.59 | 44.93 |
| 0.212 | 0.000 | 0.303 | 31.10 | 62.29 | -47.76 |
| 0.000 | 0.093 | 0.000 | 31.04 | -39.01 | 37.60 |
| 0.031 | 0.083 | 0.000 | 30.78 | -24.52 | 38.05 |

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|---|---|---|---|---|---|
| 0.052 | 0.075 | 0.004 | 30.63 | -14.86 | 34.32 |
| 0.068 | 0.070 | 0.001 | 30.59 | -9.52 | 37.38 |
| 0.080 | 0.066 | 0.001 | 30.57 | -4.92 | 37.78 |
| 0.132 | 0.051 | 0.000 | 30.54 | 11.67 | 40.16 |
| 0.093 | 0.062 | 0.002 | 30.53 | -0.23 | 36.91 |
| 0.106 | 0.058 | 0.004 | 30.51 | 4.26 | 34.83 |
| 0.149 | 0.045 | 0.000 | 30.44 | 16.79 | 40.48 |
| 0.167 | 0.039 | 0.003 | 30.37 | 22.49 | 37.19 |
| 0.212 | 0.026 | 0.000 | 30.29 | 33.78 | 41.81 |
| 0.222 | 0.000 | 0.209 | 29.98 | 58.86 | -34.96 |
| 0.091 | 0.000 | 0.559 | 29.37 | 67.61 | -79.42 |
| 0.217 | 0.000 | 0.142 | 28.50 | 55.59 | -23.98 |
| 0.206 | 0.000 | 0.100 | 27.03 | 52.87 | -15.87 |
| 0.051 | 0.051 | 0.051 | 26.98 | 0.00 | -0.01 |
| 0.000 | 0.046 | 0.205 | 26.07 | 10.27 | -41.23 |
| 0.000 | 0.049 | 0.168 | 25.89 | 4.13 | -34.62 |
| 0.000 | 0.034 | 0.312 | 25.88 | 27.67 | -58.04 |
| 0.000 | 0.043 | 0.227 | 25.87 | 14.46 | -45.33 |
| 0.000 | 0.054 | 0.114 | 25.79 | -6.40 | -22.44 |
| 0.210 | 0.000 | 0.026 | 25.74 | 49.09 | 12.30 |
| 0.000 | 0.025 | 0.392 | 25.71 | 39.25 | -68.39 |
| 0.203 | 0.000 | 0.045 | 25.71 | 49.70 | 1.86 |
| 0.097 | 0.000 | 0.357 | 25.71 | 59.77 | -63.92 |
| 0.000 | 0.059 | 0.048 | 25.50 | -21.20 | -1.19 |
| 0.191 | 0.000 | 0.068 | 25.47 | 50.22 | -8.12 |
| 0.000 | 0.050 | 0.137 | 25.45 | -1.09 | -28.49 |
| 0.000 | 0.039 | 0.239 | 25.41 | 17.62 | -48.11 |
| 0.000 | 0.057 | 0.065 | 25.38 | -16.74 | -8.20 |
| 0.209 | 0.000 | 0.011 | 25.37 | 48.14 | 23.99 |
| 0.000 | 0.054 | 0.090 | 25.32 | -10.70 | -16.63 |
| 0.000 | 0.059 | 0.032 | 25.16 | -24.89 | 5.94 |
| 0.206 | 0.000 | 0.001 | 24.91 | 47.27 | 35.87 |
| 0.000 | 0.059 | 0.020 | 24.89 | -27.80 | 12.60 |
| 0.000 | 0.059 | 0.007 | 24.52 | -31.48 | 23.64 |
| 0.000 | 0.052 | 0.000 | 22.84 | -32.16 | 30.30 |
| 0.093 | 0.000 | 0.232 | 22.51 | 53.37 | -51.42 |
| 0.000 | 0.045 | 0.000 | 20.94 | -30.57 | 28.27 |
| 0.090 | 0.000 | 0.179 | 20.88 | 50.11 | -44.54 |
| 0.014 | 0.040 | 0.000 | 20.52 | -19.77 | 28.13 |
| 0.025 | 0.035 | 0.007 | 20.46 | -9.96 | 18.80 |
| 0.032 | 0.033 | 0.004 | 20.41 | -6.66 | 22.93 |

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|---|---|---|---|---|---|
| 0.038 | 0.032 | 0.003 | 20.39 | -3.39 | 24.51 |
| 0.044 | 0.030 | 0.004 | 20.37 | 0.07 | 23.99 |
| 0.049 | 0.028 | 0.005 | 20.35 | 3.36 | 22.15 |
| 0.055 | 0.026 | 0.008 | 20.35 | 7.00 | 19.01 |
| 0.074 | 0.021 | 0.000 | 20.28 | 14.58 | 29.25 |
| 0.082 | 0.018 | 0.003 | 20.23 | 19.06 | 25.18 |
| 0.111 | 0.009 | 0.002 | 20.11 | 30.94 | 27.56 |
| 0.087 | 0.000 | 0.141 | 19.54 | 47.43 | -38.72 |
| 0.084 | 0.000 | 0.109 | 18.29 | 44.87 | -32.53 |
| 0.081 | 0.000 | 0.076 | 16.88 | 41.96 | -24.74 |
| 0.082 | 0.000 | 0.043 | 15.84 | 39.16 | -12.84 |
| 0.077 | 0.000 | 0.053 | 15.60 | 39.49 | -17.95 |
| 0.000 | 0.017 | 0.101 | 15.08 | 13.16 | -36.01 |
| 0.000 | 0.015 | 0.106 | 14.72 | 15.41 | -37.93 |
| 0.000 | 0.022 | 0.027 | 14.35 | -11.52 | -7.05 |
| 0.000 | 0.009 | 0.152 | 14.21 | 29.17 | -50.16 |
| 0.077 | 0.000 | 0.011 | 14.04 | 35.34 | 6.84 |
| 0.080 | 0.000 | 0.005 | 14.03 | 34.92 | 14.82 |
| 0.075 | 0.000 | 0.018 | 14.03 | 35.76 | 0.17 |
| 0.072 | 0.000 | 0.027 | 13.99 | 36.28 | -6.50 |
| 0.000 | 0.013 | 0.109 | 13.87 | 18.68 | -40.38 |
| 0.000 | 0.018 | 0.060 | 13.84 | 2.62 | -24.25 |
| 0.000 | 0.019 | 0.052 | 13.83 | -0.34 | -20.94 |
| 0.000 | 0.019 | 0.042 | 13.69 | -4.11 | -16.40 |
| 0.000 | 0.017 | 0.066 | 13.64 | 5.44 | -27.13 |
| 0.000 | 0.020 | 0.034 | 13.47 | -7.25 | -12.28 |
| 0.000 | 0.022 | 0.003 | 13.35 | -22.22 | 14.55 |
| 0.000 | 0.020 | 0.018 | 12.97 | -14.05 | -1.97 |
| 0.000 | 0.020 | 0.013 | 12.79 | -16.11 | 1.80 |
| 0.000 | 0.020 | 0.010 | 12.61 | -17.91 | 5.54 |
| 0.014 | 0.014 | 0.014 | 12.19 | 0.00 | -0.01 |
| 0.000 | 0.019 | 0.002 | 11.84 | -21.70 | 15.08 |
| 0.063 | 0.000 | 0.001 | 11.70 | 31.92 | 17.02 |
| 0.001 | 0.016 | 0.002 | 10.69 | -18.04 | 12.25 |
| 0.004 | 0.016 | 0.000 | 10.65 | -15.79 | 15.43 |
| 0.010 | 0.013 | 0.008 | 10.61 | -4.50 | 5.11 |
| 0.012 | 0.013 | 0.006 | 10.58 | -3.15 | 7.55 |
| 0.014 | 0.012 | 0.005 | 10.56 | -1.65 | 9.39 |
| 0.016 | 0.012 | 0.004 | 10.54 | 0.26 | 10.19 |
| 0.018 | 0.011 | 0.004 | 10.52 | 2.30 | 10.22 |
| 0.020 | 0.010 | 0.005 | 10.51 | 5.09 | 9.14 |

| | | | | | |
|---|---|---|---|---|---|
| 0.022 | 0.009 | 0.006 | 10.51 | 7.27 | 7.27 |
| 0.036 | 0.006 | 0.001 | 10.39 | 17.38 | 14.10 |
| 0.000 | 0.000 | 0.000 | 0.09 | 0.00 | 0.00 |
| **Gray background coordinates** | | | | | |
| 0.23 | 0.23 | 0.23 | 55.61 | 0.00 | -0.01 |

**Table S2**. Color stimuli with naming consensus, across 11 color categories: CIELAB coordinates. In bold are focal colors estimated via shortest median RTs (sec) in the category (Experiment 1). *R* indicates number of times (out of 32) the color was chosen as focal in its category (Experiment 2). The color stimulus with the highest vote is shaded gray.

| ***L**** | ***a**** | ***b**** | **Median RT (sec)** | ***R*** |
|---|---|---|---|---|
| ***Verde*** (N=30) | | | | |
| 89.72 | -69.29 | 85.56 | 0.772 | 0 |
| 88.03 | -82.39 | 65.78 | 0.736 | 0 |
| 86.05 | -78 | 54.68 | 0.812 | 1 |
| 84.10 | -83.15 | 80.23 | 0.716 | 1 |
| 81.51 | -69.38 | 78.66 | 0.780 | 2 |
| **77.30** | **-73.23** | **56.55** | **0.692** | 1 |
| 74.28 | -74.99 | 72.35 | 0.720 | 3 |
| 71.62 | -40.34 | 71.75 | 0.884 | 0 |
| 68.20 | -67.21 | 55.28 | 0.740 | 7 |
| 64.38 | -66.75 | 64.40 | 0.712 | 3 |
| 61.83 | -58.7 | 62.61 | 0.740 | 3 |
| 61.69 | -25.38 | 64.18 | 0.916 | 0 |
| 57.94 | -59.07 | 48.76 | 0.708 | 1 |
| 51.70 | -53.36 | 54.34 | 0.704 | 0 |
| 51.59 | -32.93 | 55.22 | 0.764 | 0 |
| 51.57 | -22.67 | 55.76 | 0.872 | 0 |
| 47.05 | -50.09 | 40.54 | 0.732 | 2 |
| 41.39 | -47.63 | 45.93 | 0.800 | 4 |
| 41.24 | -28.94 | 46.68 | 0.728 | 0 |
| 41.07 | -18.92 | 47.07 | 0.848 | 0 |
| 36.21 | -35.76 | 16.61 | 0.808 | 0 |
| 35.74 | -40.7 | 31.81 | 0.728 | 0 |
| 33.09 | -40.72 | 39.25 | 0.720 | 1 |
| 31.04 | -39.01 | 37.60 | 0.720 | 0 |
| 30.78 | -24.52 | 38.05 | 0.728 | 0 |
| 24.89 | -27.8 | 12.60 | 0.808 | 0 |
| 24.52 | -31.48 | 23.64 | 0.744 | 0 |
| 22.84 | -32.16 | 30.30 | 0.712 | 2 |
| 20.94 | -30.57 | 28.27 | 0.812 | 0 |
| 20.52 | -19.77 | 28.13 | 0.840 | 0 |
| ***Azzurro*** (N=2) | | | | |
| **86.20** | **-40.61** | **-21.54** | **0.912** | **18** |
| 83.31 | -36.03 | -25.93 | 0.920 | 14 |

| ***L**** | ***a**** | ***b**** | **Median RT (sec)** | ***R*** |
|---|---|---|---|---|
| ***Blu*** (N=7) | | | | |
| **25.88** | **27.67** | **-58.04** | **0.752** | **15** |
| 15.08 | 13.16 | -36.01 | 0.808 | 1 |
| 14.72 | 15.41 | -37.93 | 0.820 | 0 |
| 14.21 | 29.17 | -50.16 | 0.792 | 14 |
| 13.87 | 18.68 | -40.38 | 0.808 | 2 |
| 13.84 | 2.62 | -24.25 | 0.900 | 0 |
| 13.64 | 5.44 | -27.13 | 0.928 | 0 |
| ***Viola*** (N=10) | | | | |
| 46.05 | 86.52 | -84.66 | 0.940 | 1 |
| 45.13 | 82.65 | -71.25 | 1.048 | 3 |
| 43.95 | 85.08 | -88.18 | 0.824 | 0 |
| 37.05 | 76.38 | -82.55 | 0.832 | 0 |
| **35.97** | **72.35** | **-70.45** | **0.744** | **13** |
| 32.29 | 65.45 | -57.23 | 0.868 | 0 |
| 25.71 | 59.77 | -63.92 | 0.800 | 4 |
| 22.51 | 53.37 | -51.42 | 0.796 | 10 |
| 19.54 | 47.43 | -38.72 | 0.880 | 1 |
| 18.29 | 44.87 | -32.53 | 0.864 | 0 |
| ***Rosa*** (N=7) | | | | |
| 78.95 | 39.11 | -13.64 | 0.888 | 8 |
| 78.48 | 37.23 | -7.11 | 0.824 | 8 |
| **78.19** | **35.23** | **-0.6** | **0.736** | **8** |
| 78.07 | 32.31 | 8.19 | 0.872 | 7 |
| 67.40 | 64.92 | -22.57 | 0.944 | 1 |
| 66.43 | 62.25 | -10.77 | 0.908 | 0 |
| 65.87 | 59.81 | -0.23 | 0.828 | 0 |
| ***Giallo*** (N=7) | | | | |
| 90.87 | -14.24 | 89.6 | 0.788 | 10 |
| **90.26** | **-8.55** | **89.46** | **0.696** | **21** |
| 89.19 | -3.38 | 67.68 | 0.804 | 0 |
| 81.19 | -12.16 | 81.53 | 0.828 | 0 |
| 81.12 | -4.12 | 82.01 | 0.736 | 0 |
| 81.07 | 7.94 | 82.84 | 0.804 | 1 |
| 71.39 | -2.41 | 73.87 | 0.808 | 0 |
| ***Marrone*** (N=2) | | | | |
| **20.28** | **14.58** | **29.25** | **0.844** | 11 |
| 20.23 | 19.06 | 25.18 | 0.884 | 21 |

| | | | | |
|---|---|---|---|---|
| ***Arancione*** (N=2) | | | | |
| 67.22 | 42.41 | 74.05 | 0.868 | 32 |
| **61.21** | **36.93** | **68.46** | **0.864** | 0 |
| ***L**** | ***a**** | ***b**** | **Median RT (sec)** | ***R*** |
| ***Bianco*** (N=1) | | | | |
| **88.86** | **0** | **-0.02** | **0.768** | **32** |
| ***Grigio*** (N=3) | | | | |
| 65.63 | 0 | -0.02 | 0.976 | 18 |
| **40.57** | **0** | **-0.01** | **0.824** | 12 |
| 26.98 | 0 | -0.01 | 0.856 | 2 |
| ***Nero*** (N=1) | | | | |
| **0.09** | **0** | **0** | **0.756** | **32** |

**Table S3**. Color stimuli with naming consensus, across 11 color categories: OSA-UCS coordinates. In bold are focal colors estimated via shortest median RTs (sec) in the category (Experiment 1). *R* indicates number of times (out of 32) the color was chosen as focal in its category (Experiment 2). The color stimulus with the highest vote is shaded gray.

| ***L*** | ***j*** | ***g*** | **Median RT (sec)** | ***R*** |
|---|---|---|---|---|
| ***Verde*** (N=30) | | | | |
| 5.18 | 12.08 | 9.87 | 0.772 | 0 |
| 5.06 | 9.94 | 11.30 | 0.736 | 0 |
| 4.62 | 8.54 | 10.70 | 0.812 | 1 |
| 4.57 | 11.33 | 11.44 | 0.716 | 1 |
| 3.84 | 11.09 | 9.76 | 0.780 | 2 |
| **3.12** | **8.60** | **10.01** | **0.692** | 1 |
| 2.79 | 10.18 | 10.28 | 0.720 | 3 |
| 1.72 | 10.02 | 5.93 | 0.884 | 0 |
| 1.51 | 8.20 | 9.13 | 0.740 | 7 |
| 0.94 | 8.97 | 9.06 | 0.712 | 3 |
| 0.23 | 8.61 | 7.99 | 0.740 | 3 |
| -0.57 | 8.45 | 3.63 | 0.916 | 0 |
| -0.84 | 6.80 | 7.56 | 0.708 | 1 |
| -1.94 | 7.05 | 6.80 | 0.704 | 0 |
| -2.3 | 7.11 | 4.44 | 0.764 | 0 |
| -2.38 | 7.15 | 3.15 | 0.872 | 0 |
| -2.82 | 5.54 | 6.24 | 0.732 | 2 |
| -3.70 | 5.83 | 5.88 | 0.800 | 4 |
| -4.06 | 5.87 | 3.79 | 0.728 | 0 |
| -4.16 | 5.89 | 2.57 | 0.848 | 0 |
| -4.81 | 2.46 | 4.40 | 0.808 | 0 |
| -4.80 | 4.26 | 4.91 | 0.728 | 0 |
| -5.15 | 4.86 | 4.90 | 0.720 | 1 |
| -5.50 | 4.61 | 4.66 | 0.720 | 0 |
| -5.80 | 4.62 | 3.09 | 0.728 | 0 |
| -6.71 | 1.77 | 3.25 | 0.808 | 0 |
| -6.72 | 3.04 | 3.61 | 0.744 | 0 |
| -6.91 | 3.63 | 3.67 | 0.712 | 2 |
| -7.24 | 3.40 | 3.43 | 0.812 | 0 |
| -7.50 | 3.35 | 2.31 | 0.840 | 0 |
| ***Azzurro*** (N=2) | | | | |
| **5.02** | **-3.56** | **7.46** | **0.912** | **18** |
| 4.57 | -4.36 | 7.05 | 0.920 | 14 |

| ***L**** | ***a**** | ***b**** | **Median RT (sec)** | ***R*** |
|---|---|---|---|---|
| ***Blu*** (N=7) | | | | |
| **-5.66** | **-9.48** | **1.98** | **0.752** | **15** |
| -7.78 | -5.3 | 1.27 | 0.808 | 1 |
| -7.82 | -5.58 | 1.26 | 0.820 | 0 |
| -7.79 | -7.54 | 1.51 | 0.792 | 14 |
| -7.94 | -5.92 | 1.25 | 0.808 | 2 |
| -8.14 | -3.37 | 1.24 | 0.900 | 0 |
| -8.13 | -3.80 | 1.20 | 0.928 | 0 |
| ***Viola*** (N=10) | | | | |
| -3.42 | -14.67 | -5.85 | 0.940 | 1 |
| -1.72 | -15.60 | -9.04 | 1.048 | 3 |
| -1.99 | -13.36 | -10.54 | 0.824 | 0 |
| -2.09 | -16.04 | -7.65 | 0.832 | 0 |
| **-3.7** | **-12.66** | **-7.43** | **0.744** | **13** |
| -4.47 | -10.33 | -7.91 | 0.868 | 0 |
| -5.62 | -10.92 | -4.58 | 0.800 | 4 |
| -6.28 | -8.75 | -5.31 | 0.796 | 10 |
| -6.90 | -6.61 | -5.79 | 0.880 | 1 |
| -7.17 | -5.61 | -5.95 | 0.864 | 0 |
| ***Rosa*** (N=7) | | | | |
| 3.86 | -3.04 | -6.75 | 0.888 | 8 |
| 3.70 | -1.87 | -6.60 | 0.824 | 8 |
| **3.58** | **-0.71** | **-6.39** | **0.736** | **8** |
| 3.46 | 0.82 | -5.99 | 0.872 | 7 |
| 2.16 | -5.21 | -11.89 | 0.944 | 1 |
| 1.90 | -3.08 | -11.79 | 0.908 | 0 |
| 1.74 | -1.20 | -11.53 | 0.828 | 0 |
| ***Giallo*** (N=7) | | | | |
| 5.03 | 12.51 | 2.31 | 0.788 | 10 |
| **4.96** | **12.46** | **1.44** | **0.696** | **21** |
| 4.80 | 10.05 | 0.33 | 0.804 | 0 |
| 3.36 | 11.35 | 1.98 | 0.828 | 0 |
| 3.40 | 11.38 | 0.74 | 0.736 | 0 |
| 3.54 | 11.42 | -1.19 | 0.804 | 1 |
| 1.69 | 10.18 | 0.46 | 0.808 | 0 |
| ***Marrone*** (N=2) | | | | |
| **-7.31** | **3.49** | **-2.02** | **0.844** | 11 |
| -7.24 | 2.92 | -2.82 | 0.884 | 21 |

| | | | | |
|---|---|---|---|---|
| ***Arancione*** (N=2) | | | | |
| 1.81 | 9.84 | -7.34 | 0.868 | 32 |
| **0.56** | **9.02** | **-6.27** | **0.864** | 0 |
| ***L**** | ***a**** | ***b**** | **Median RT (sec)** | ***R*** |
| ***Bianco*** (N=1) | | | | |
| 5.17 | -0.15 | -0.04 | **0.768** | **32** |
| ***Grigio*** (N=3) | | | | |
| 0.97 | -0.12 | -0.03 | 0.976 | 18 |
| **-3.98** | **-0.07** | **-0.02** | **0.824** | 12 |
| -6.30 | -0.05 | -0.01 | 0.856 | 2 |
| ***Nero*** (N=1) | | | | |
| -12.61 | -0.01 | 0 | **0.756** | **32** |

Table S4. OSA-UCS coordinates of centroids and focal colors (with shortest RTs) for Italian 10 basic color terms and two 'blue' categories, blu and azzurro, estimated using monolexemic color-naming method and constrained color-naming method.

| **Italian color terms** | **Monolexemic color naming** | | | | | | **Constrained color naming** | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Centroids** | | | **Focals** | | | **Centroids** | | | **Focals** | | |
| | ***L*** | ***j*** | ***g*** | ***L*** | ***j*** | ***g*** | ***L*** | ***j*** | ***g*** | ***L*** | ***j*** | ***g*** |
| ***Verde*** | -1 | 5 | 6 | -6 | 5 | 3 | 0 | 5 | 4 | 3 | -1 | 4 |
| ***Azzurro*** | 3 | -5 | 5 | 5 | -4 | 7 | – | – | – | – | – | – |
| ***Blu*** | -4 | -9 | 2 | -8 | -8 | 2 | -1 | -7 | 1 | -6 | 4 | 1 |
| ***Viola*** | -2 | -10 | -7 | -7 | -7 | -6 | -3 | -7 | -5 | 3 | 11 | -3 |
| ***Rosa*** | 3 | -4 | -8 | 4 | -1 | -6 | 0 | -3 | -9 | 1 | 9 | -7 |
| ***Giallo*** | 3 | 10 | 1 | 5 | 12 | 1 | 3 | 8 | 0 | -7 | -9 | 1 |
| ***Marrone*** | -6 | 4 | -2 | -7 | 3 | -2 | -4 | 3 | -2 | -8 | 2 | -2 |
| ***Arancione*** | 0 | 8 | -6 | 1 | 9 | -6 | 0 | 6 | -6 | -7 | -3 | -9 |
| ***Rosso*** | -3 | 2 | -11 | – | – | – | -3 | 2 | -10 | -3 | 5 | -11 |
| ***Bianco*** | 5 | -2 | -1 | 5 | 0 | 0 | 4 | 0 | 0 | – | – | – |
| ***Grigio*** | -2 | -1 | 0 | 1 | 0 | 0 | -1 | -1 | 0 | – | – | – |
| ***Nero*** | -9 | 0 | 0 | -13 | 0 | 0 | -9 | 0 | 0 | – | – | – |