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Italian Basic Terms *Blu* and *Azzurro*: Semantic Power Assessed in the Stroop Task

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We explored the semantic power of two Italian basic “blue” terms, *blu* “dark blue” and *azzurro* “light/medium blue,” using the Stroop task. Across three experiments with Italian speakers, color word sets and ink colors varied; in a control condition, “X” strings were presented. Experiment 1 employed words ROSSO “red,” GIALLO “yellow,” BLU, and VIOLA “purple” presented in six ink colors, including both dark blue and light blue inks. In Experiment 2, six color words, including BLU and AZZURRO, as well as ROSA “pink” were displayed in six corresponding ink colors. Response speed (absolute RTs) was found to be significantly longer for BLU—light blue ink and AZZURRO—dark blue ink combinations compared to congruent combinations. However, BLU revealed no significant Stroop effects (related to control RTs). In contrast, AZZURRO showed strong Stroop interference (195 ms) and facilitation (46 ms). In Experiment 3, to probe the lightness effect of the ink, BLU was replaced by VERDE “green” rendered in dark green and light green ink: no Stroop effects were found. Projected to the “blue”-pairings, this implies no perceptual factor in the AZZURRO Stroop effects. In addition, across Experiments 1–3, response speed was examined in (in)congruent “red”-pairings, for ROSSO and ROSA: similarly to the “blue”-pairings, these differ in lightness of their denotata and, also, in the terms’ basic status (primary vs. secondary). Stroop interference was demonstrated for ROSSO—pink ink combination only, when ROSA was part of the word set (Experiment 2), indicating that informational conflict is amplified due to the response set membership effect. For the two “Italian blues,” the Stroop effects revealed an asymmetry of their semantic power: although *blu* is a primary term and has higher frequency in modern Standard Italian, *azzurro* (Italian “blue” *arcilessema*), revealed greater interference manifesting its stronger ideation and greater processing automaticity, which conceivably reflect its deep entrenchment in Italian.

1 | Introduction

In the present study, we explored semantic relatedness of two Italian basic “blue” terms, *blu* “dark blue” and *azzurro* “light/medium blue,” operationalized as the terms’ inhibiting potential in the Stroop task. Results of the study—mutual semantic power of the “blue” terms—are considered in relation to (psycho)linguistic factors specific for Italian, such as the terms’ basicness, entrenchment, psychological salience, and denotative clearcutness of the corresponding categories.

1.1 | Basic Color Categories: The Universal Inventory and Language-Specific Modifications

“Blue” is one of the 11 basic color categories (BCCs)/basic color terms (BCTs) in languages with a developed color term inventory [1, 2]. The Berlin–Kay hypothesis implies biocultural bases of the universal color naming system [3]. Three (complementary) explanations were offered (for reviews see Refs [4–7]): (i) panhuman psychophysiological mechanisms of color vision processing (e.g., Ref [8]); (ii) an emergent property of the visual-processing

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system that maximizes inter-category separation [9], with an optimal partitioning of color space in BCCs [10, 11]; and (iii) optimality of BCC assortment reflecting statistical distribution of predominant colors in the natural visual environment, “color diet” [12, 13]. These explanatory schemes constitute non-language-specific cognitive biases mirrored in universal linguistic categories [14, 15]. A recent complementary hypothesis introduced the role of communication efficiency as the driving force for linguistic consensus in naming color of culturally salient objects [16–18], which results in emergence of population-specific BCTs enabling additional lexical distinctions [19].

The most intriguing case is the “blue challenge”: in several languages there are two BCTs for “blue,” with a distinction of the blue area along the lightness dimension. The possibility of Russian *sinij* “dark blue” and *goluboj* “light blue” being both basic terms was surmised by Berlin and Kay [1] and since then confirmed by linguistic and psycholinguistic markers [20–22]. The light–dark distinction in the blue area is also present in Italian, as well as in several other circum-Mediterranean (Greek, Maltese, Turkish) and some Far East languages (Japanese, Thai) (for a review see Ref [7]). The refined signification of the blue area is likely to have developed as a result of the presence of large water bodies and visibility of a blue sky, that is, salient features of the environment [23], hence, the communication pressure to convey refined concepts for color variation of snow or marine environment.

The challenges of the 11 BCC/BCT upper limit tenet triggered fresh inquiries into understanding of color category “basicness.” Berlin and Kay (Ref [1, p. 6]) introduced main and auxiliary criteria of the term “basicness.” Paraphrasing their main criteria, to qualify as a BCT, a color name should be:

- i. hyperonym, understood and widely used by all speakers of a language;
- ii. context independent, that is, generalizable across semantic domains;
- iii. psychologically salient, that is, manifest high intra-individual consistency and inter-individual consensus.

We surmise that the semantic power of Italian “blue” terms, the focus of the present study, is related to their basicness. To provide the context for previous findings on the “Italian blues” reported in the next section, we briefly overview recent developments in the operationalization of the (i)–(iii) criteria, which enables a more rigorous assessment of the basicness of color terms and corresponding categories.

Linguistic criteria (i) and (ii) were scrutinized by Kerttula (in the British English Corpus) [24, 25]: based on a combined estimate of BCTs’ hyperonymy, frequency, number of referents, and derivational productivity, she arrived at the conclusion that BCTs vary on a continuum of “basicness.” The ranking of BCTs’ “relative basicness” matches the order in which they have developed historically; a BCT’s long-term rooting is most reflected by its derivational productivity (Berlin–Kay auxiliary criterion).

Psychological (cognitive) salience, criterion (iii) is tested in (psycho)linguistic studies. Broadly accepted is Sutrop’s [26] cognitive

salience index derived from color lexicon measures—CT’s frequency (“prevalence”) and the order of occurrence (“priority”) across elicited lists. Alternative estimates of CT’s cognitive salience, instead of relying on color lexicon, capture denotative specification of a color category in terms of its concentricity and density [27]. Douven and Gärdenfors [28] operationalized the salience of a BCC as the degree of “well-formedness” through measures of naming consistency and consensus. In comparison, Fider and colleagues [29, 30] developed the measure of BCC “category strength”—the degree of population members’ shared agreement (frequency and consensus) on the labeling of color stimuli.

1.2 | Italian Basic “Blue” Terms

Contemporary Standard Italian possesses 10 counterparts of the universal BCTs [31] and, also, presents the “blue challenge” to the Berlin–Kay hypothesis. Converging evidence has accumulated in recent (psycho)linguistic studies that to name the blue area, speakers of Standard Italian require two terms—*azzurro* “light/medium blue” and *blu* “dark/navy blue” [31–38]. Both Italian “blue” terms are considered to preserve the distinction between the color of the sky and the sea, respectively [39–41]. It is noteworthy that in Italian regiolects the basic “Italian blues” may vary: Tuscan speakers possess a third basic “blue” term, *celeste* “light blue,” distinct from “medium blue” *azzurro* [42–44]; in comparison, for speakers of Alghero (Sardinia), along with *blu*, the other basic term is *celeste* “light/medium blue,” whereas low in use *azzurro* is constrained to a small range of medium blue [45].

Diachronically older is *azzurro* (13th century) idealized by native speakers as being “more Italian” compared to *blu* that entered the language in the 17th century and semantically curtailed the denotative range of *azzurro* (for linguistic historical background of the two “Italian blues,” see the Section 9. Addendum), Grossmann [46] views *azzurro* as Italian “blue” *arcillessema*. It is deeply entrenched in the language (criteria (i)–(ii)), as attested by linguistic corpus analysis [33, 47] and idiomatic expressions [48, 49]; it prevails in collocations and has higher metaphoric and metonymic use than that of *blu*. *Azzurro* is also marked in compounding and richer than *blu* in derivational productivity in part due to its better integration in the morphological and phonological system of Italian [50–52].

In comparison, *blu*, a much later borrowing, is less integrated in the morphological system of Italian [52]; its derivational potential is more limited than that of *azzurro*. In frequency (in the *CORpus di Italiano Scritto*) two decades ago *blu* was comparable to *azzurro* [40]; also, in free-association tasks they were elicited comparably frequently [41, 48, 49]. Notably, the use of *blu* and the number of contexts with *blu* increased considerably during the 20th century, to the detriment of *azzurro*, due to a great number of calques and loans from English, French, and German that entered Italian in the globalization process [33, 53]. As a result, *blu*, a homophone of English *blue*, has taken on an English *blue*-cognate role in the corresponding Italian metonymies (e.g., *casco blu* “Blue Helmet”, *colletti blu* “blue collars”) and compounds (e.g., *blu oltremare*, *blu marina*, *blu di Prussia*, *blu di Persia*, etc.). Currently, *blu* is the most widespread Italian “blue” term frequently used as an umbrella signifier for the whole blue area [47, 49].

In cognitive salience (criterion (iii)), *blu* is argued to have over-ridden *azzurro*, which is losing its footing in contemporary Italian [41, 44, 49]. The listing task provided evidence that *blu* has a higher salience ranking, that is, is evoked more frequently and eagerly than *azzurro*. Specifically, *blu* ranked 7 and *azzurro* 10 about a decade ago [54]; more recently, however, *blu* ranked 3 or 4 among primary Italian BCTs, while *azzurro* ranked 10 or 12 among secondary BCTs [44, 55]. A semantic map of Italian CTs, reconstructed from the listing task, shows a strong association of *blu* and *azzurro* (reflected by the terms' proximity), but *blu* excels *azzurro* on the relative basicness dimension [56].

Denotatively, salience of *azzurro* category is slightly higher than that of *blu* category—rank 2 and 4, respectively. The ranking is based on a cumulative parameter of consistency, consensus and RTs of monolexic naming of (saturated) Munsell Mercator projection colors (for speakers of Standard Italian in Verona) [31]. The two “blue” categories, though, are comparable in their “category strength”, that is, participants' consensus on labeling blue chips, when Verona speakers named unconstrained a densely represented blue “inner” area (varying saturation) of the Munsell Color Solid [32]: *azzurro* 0.156 and *blu* 0.153 (Fider and Komarova, unpublished data).

The discrepancies in the two “blue” terms' ranking, which depends on the basicness criterion and its operationalization, suggest that *blu* and *azzurro* may differ in relative basicness on (linguistic and/or behavioral) grounds that are not captured by the criteria (i)-(iii). In this relation, we speculated that (unequal) relative basicness of *blu* and *azzurro* would manifest in the Stroop test. In our endeavor we leaned upon Klein's [57] notion of the evocative strength of the printed color word that impedes the naming response of the ink color: the greater the semantic power of the printed word, “the more interference the word exerts—the stronger the competition it offers for dominance of the single motor-outlet” (Ref [57, p. 584]). We were also bearing in mind Fox et al.'s [58] semantic gradient hypothesis, according to which interference increases as a function of the relation between the word and color.

1.3 | The Stroop Task: Probing Semantic Relatedness of the Two “Italian Blues”

In the present study we assessed semantic relatedness of *blu* and *azzurro* using the widely employed Stroop color–word task that probes processing speed in a cognitively conflicting condition [59]. The Stroop task involves naming the color of the ink of a printed color word, whose meaning is either congruent or incongruent with the ink color (e.g., the correct response to the word YELLOW or GREEN printed in green is “green”). The original Stroop test included three charts: (A) color words in black ink to read; (B) color patches to name; and (C) color words written in an incongruent ink color, to name the ink color. Stroop recorded the response time (RT) in (A)–(C) to estimate the increase of the response duration in the conflicting condition (C) compared to the two baseline conditions (A) and (B) (for reviews see Refs [60–62]).

In computerized versions of the Stroop task, individual color words are presented in congruent or incongruent ink colors. For each color word, the speed of naming ink color (Stroop

condition) is related to the speed in the control condition of naming ink color of a nonverbal control stimulus, usually a series of Xs (e.g., Refs [63, 64]; for reviews see Refs [60, 61]).

The *Stroop effect* is observed when an automatic response, that is, lexicalizing the meaning of the color word, is inhibited in the presence of a conflicting stimulus, that is, incongruent ink color. Compared to the control condition, in the incongruent condition naming of the ink color is longer, in the order of 100 ms or more, and more prone to errors, that is, *Stroop interference*. In comparison, *Stroop facilitation* implies that RTs are shorter in the congruent than in the control condition, but the effect is much smaller (in the order of 20 ms or less) (for reviews see Refs [60–62, 65, 66]). Note though that in some studies that reported a strong interference effect no facilitation effect was observed (e.g., Refs [67, 68]).

The Stroop effect implies that the Stroop stimuli activate two responses, a fast and automatic one that is semantically driven (color word meaning) and another perceptually driven (ink color), which are unfolding in parallel and interacting. On incongruent trials, Stroop interference reflects the processing effect of *diverging* information on the color word meaning and the ink color, with a greater relative strength of activation of the word meaning response compared to the ink color response [60, 62]. On congruent trials, *converging* information on the color word and ink color combines to produce response facilitation [69].

For Italian populations, the Stroop task was conducted in several studies using the Italian version of the Stroop Color and Word Test [70] (SCWT). The SCWT follows the design of the original Stroop test, with the multi-item format, and consists of three cards: (1) Italian color words BLU “dark blue,” VERDE “green,” ROSSO “red,” MARRONE “brown,” and VIOLA “purple” printed in black ink, (2) corresponding colored squares or circles, and (3) the five Italian color words printed in an incongruent ink; the five ink colors include navy blue ink as corresponding to *blu*. Assessed are correct answers achieved in the first 30s for each card and the total time of reading each card. The SCWT is broadly used in Italian (clinical) studies, either as a printed version (e.g., Refs [71–73]) or a computer-assisted version (e.g., Ref [74]). In all these studies, reported are RT data aggregated across all color words and ink colors (for a review see Ref [75]).

Recently, a computer-based Stroop task was conducted with highly proficient French-Italian bilinguals, whose performance in Italian language was compared to that of Italian monolinguals [76]. In Italian, four color words were used: ROSSO, GIALLO, VERDE, and BLU, the latter presented in blue ink of two lightness levels. Stroop interference was found in both bi- and monolingual speakers: the word BLU rendered in light blue ink was named *azzurro* slower and less accurately compared to when it was presented in dark blue ink named *blu*.

1.4 | Aims of the Present Study

The focus of the present study was processing speed of *blu* and *azzurro* in the Stroop task executed by native Italian speakers. We reasoned that incongruent conditions—the word BLU

rendered in light blue ink and the word AZZURRO in dark blue ink—will enable gauging semantic power of each word by the amount of interference, that is, slowing down the ink naming response. In other words, the longer it will take to name the conflicting ink color, the greater is the semantic power of the printed “blue” word and, hence, the required inhibition of its meaning.

Below we report results of three experiments. In these, we varied stimulus sets with regard to the composition and number of color words (BCTs) and the selection of ink colors. In addition to lightness variation of blue ink, we employed green and red ink in dark and light versions. This was undertaken to explore whether the light versus dark ink variation would affect RTs to “green” and “red” words in a way similar to that in the “blue series,” to disentangle possible perceptual and categorical effects.

The original data were collected in 2010 to examine whether *azzurro*, along with *blu*, is basic in Italian. The rationale was that its basic status would be manifested by longer RTs in (incongruent) combinations of BLU—light blue ink and AZZURRO—dark blue ink than in the congruent combinations. In a short report, Paggetti and Menegaz [77] presented absolute RTs for the combinations in question, which indeed demonstrated the terms’ incongruence, confirming the hypothesis that *azzurro*, too, is basic in Italian. Since then, basicness of both “Italian blues” was corroborated by employing various methods—linguistic analysis, elicitation task, and color-naming—in ample studies reviewed in the Section 1.2 [31–44].

In the meantime, the richness of the collected data allowed us to explore a different research question—the *semantic power* of the “Italian blues,” as manifested by their inhibitory potential in the Stroop task. We undertook reanalysis of the original data to estimate the Stroop interference and facilitation effects (relative RTs) for each of the two “blue” terms.

Furthermore, to probe candidate (perceptual, linguistic) mechanisms behind the observed interference, we analyzed the Stroop effects for pairings of other Italian BCTs in the word set—VERDE “green” rendered in ink color of two lightness levels. An auxiliary objective was to explore whether the Stroop effects for the “red”-pairings (ROSSO—pink ink and ROSA—red ink combinations), varying in lightness, as well as in basic status, would be comparable to those for the “blue”-pairings.

Our hypotheses were as follows:

H1. *BLU—light blue ink and AZZURRO—dark blue ink combinations will be incongruent and reveal the Stroop interference effect.*

H2. *BLU—dark blue ink and AZZURRO—light blue ink combinations will be congruent and manifest the facilitation effect.*

H3. *There will be no RT difference for VERDE word presented in dark and light green ink.*

H4. *For ROSSO, there will be a facilitation effect in red ink and an interference effect in pink (light red) ink, while the opposite will be observed for ROSA.*

2 | Method: General

2.1 | Participants

Participants were Italian native speakers (functional monolinguals with passive exposure to English through school and university education), students at the University of Verona, who participated as volunteers. All had normal or corrected-to-normal vision and normal color vision assessed by the Ishihara pseudoisochromatic plates. Across Experiments 1–3, the number of participants (constrained by available resources) varied between 6 and 10 (sample sizes were comparable with those in, e.g., Ref [78]). The study was conducted according to the guidelines of the Declaration of Helsinki; it was approved by the local ethics committee. All participants gave their written informed consent prior to participation in the study; data were collected in 2010.

2.2 | Stimuli

Stimuli were color words rendered either in the matching ink color (congruent trials) or a mismatching ink color (incongruent trials) in the Stroop condition; “X” strings were used in the control condition (cf., e.g., Refs [79–81]) (Figure 1). Across Experiments 1–3, in total eight ink colors were employed: red, yellow, dark blue and light blue, purple, pink, dark green and light green (Table 1). In each experiment, six ink colors (out of eight) were employed, with a varying composition (see Stimuli and Design in Experiments 1–3). Specification of the stimuli, chromatic characteristics of the ink colors and vocal recording can be found in “Details of the design” of [Supporting Information](#).

2.3 | Procedure

Participants were dark adapted and tested in an otherwise dark room. They were requested to fixate the center of the screen, where a cross appeared between the trials. Six practice trials

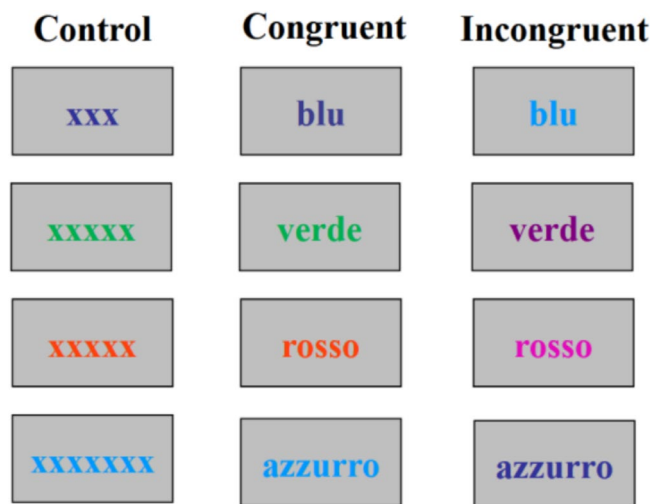


FIGURE 1 | Exemplary stimuli: “X” strings (control condition) match the length of the corresponding Italian color names; color words (Stroop condition) in the congruent and incongruent combinations.

were administered prior to the experimental session. In all three experiments, the blocked control condition was run first, followed by the Stroop condition. The order of the presentation of the color word—ink color combinations was pseudorandom. Figure 2 illustrates the trial timeline. In the control condition, participants were instructed to name the ink color of the “X” string; in the Stroop condition, they were tasked to ignore the meaning of the color word and name the ink color by a monolexic term, responding as quickly and as accurately as possible.

Participants’ vocal responses were recorded using a microphone. RTs (ms) refer to the time lapse from the onset of the “X” string or color word to the onset of the participant’s vocalization when s/he named the ink color. The stimulus remained on the screen

until a response was given. After the participant had provided a response, the researcher pressed a key on the keyboard to present the next stimulus. If an error was made, participants were allowed to correct the response, and the response latency was estimated to the onset of the correct naming of the ink color.

The response-to-stimulus interval (RSI) was 2 s (cf. Refs [82, 83]). This RSI duration ensured that, following the preceding trial, an afterimage had faded and the Stroop suppression effect, slowing the naming of ink color, had dissipated [84]. Also, the 2-s RSI was demonstrated to produce a greater Stroop interference effect than at a shorter RSI [85].

2.4 | Overview of Experiments 1–3

The three experiments partly differed in the set of color words and/or ink colors, but in each experiment six ink colors were used. Specifically, in Experiments 1 and 2 (“blue series”), ink colors were red, yellow, dark blue, light blue, purple, and pink; in Experiment 3 (“green series”), dark and light blue inks were replaced by dark and light green inks. In the report below we capitalize a color WORD and italicize the *named ink color*, while to signify an ideated “Italian color concept,” we use double quotation marks.

In Experiment 1, there were four color words: ROSSO, GIALLO, VIOLA, and BLU. Stroop effects were probed for BLU rendered in dark blue and, critically, in light blue ink.

In Experiment 2, the word set was expanded to include, in addition, AZZURRO and ROSA. The focus was on the Stroop interference effect in the two incongruent combinations, BLU—light blue ink and AZZURRO—dark blue ink.

TABLE 1 | Munsell coordinates of ink colors employed in Experiments 1–3, accompanied by Italian color names elicited in the experiment.

Ink color	Munsell coordinates	Italian name
Red	7.5R 5/20	<i>rosso</i>
Yellow	5Y 9/12	<i>giallo</i>
Dark blue	5PB 1/10	<i>blu</i>
Light blue	5PB 6/14	<i>azzurro</i>
Purple	2.5P 3/18	<i>viola</i>
Pink	7.5RP 7/10	<i>rosa</i>
Dark green	10GY 1/10	<i>verde</i>
Light green	10GY 6/14	<i>verde</i>

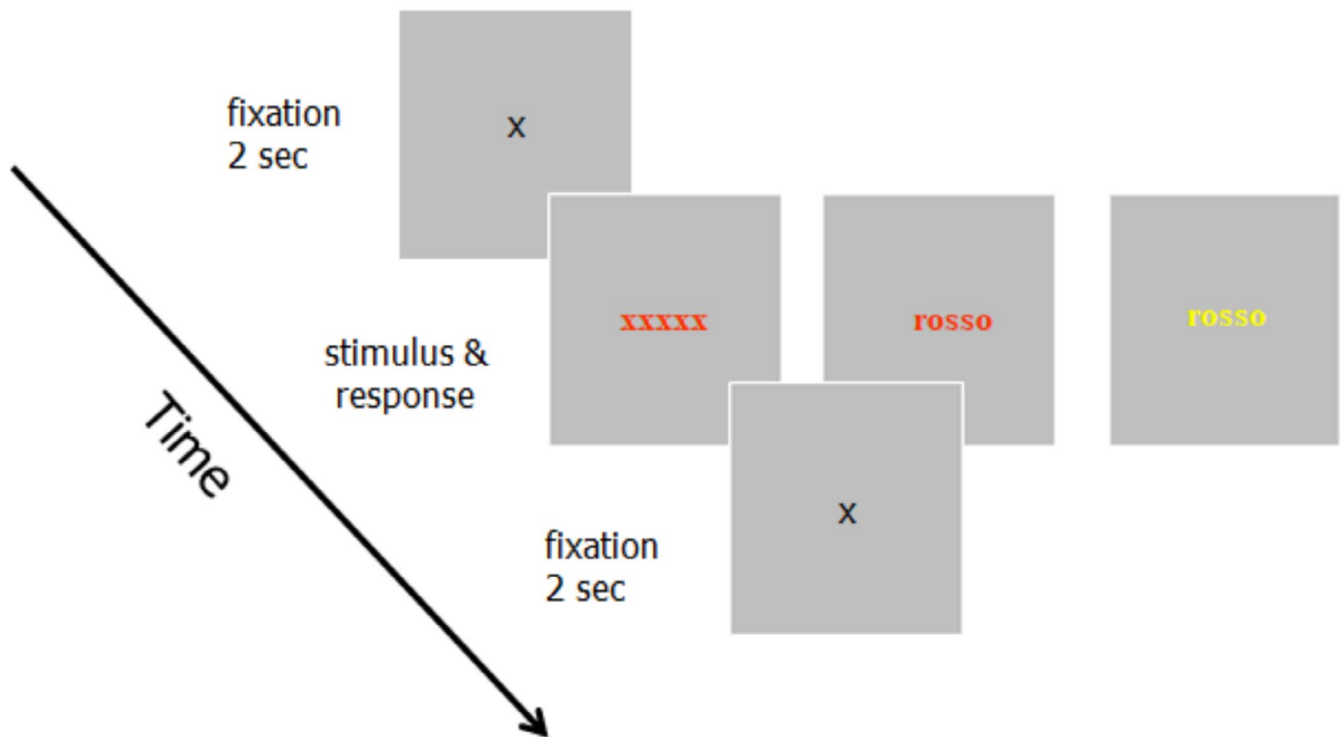


FIGURE 2 | An illustration of the trial timeline. “X” strings (control condition) and color words (Stroop condition) were presented in blocks.

In Experiment 3 (“green series”), VERDE replaced BLU of Experiment 1 in the word set; response speed in VERDE combinations with dark and light green inks was in focus.

Finally, we explored response speed in the “red”-pairings—ROSSO in red and pink ink (Experiments 1–3), and ROSA in pink and red ink (Experiment 2), the combinations similar to the “blue”-pairings with regard to difference in categories’ denotative lightness and terms’ basic status; an overview is presented in Section 6 of the Results.

2.5 | Analysis

For individual experiments, RT means were estimated for (i) each ink color (control condition), (ii) each color word—ink color combination, and (iii) congruent versus (aggregated) incongruent color word—ink color combinations.

All 6 RT datasets (2 conditions, control and Stroop; 3 experiments) contained outliers, partly due to the experimental protocol that allowed participants to correct their responses (in such cases the recorded response latency to the onset of the correct ink color name was greater than average). To deal with RT outliers, we undertook winsorizing of the data by replacing RTs above and below two standard deviations (SDs) with the values at +2 SD and –2 SD, respectively, and recalculated the corresponding mean values [86, 87]. Winsorizing resulted in only 1% of data entries that required replacement. RT means (M) and standard errors (SE) are reported; parametric statistical methods were applied.

Initially, the analysis was carried out for absolute RTs. *T*-tests were conducted between (i) “blue” word(s) rendered in dark blue and light blue ink (critical condition; Experiments 1 and 2); (ii) “green” word rendered in dark green and light green ink (Experiment 3); and (iii) “red” word(s) rendered in red and pink ink (Experiments 1–3); as well as (iv) each color word in congruent combination and aggregated incongruent combinations.

Further, for each experiment a one-way repeated-measures ANOVA was conducted to estimate the effect of ink color on the response speed. For multiple pairwise comparisons, all reported *p*-values were Bonferroni corrected. No error analysis was conducted since the number of errors was negligible.

Next, relative RTs were estimated. First, these were calculated for each participant by subtracting, for each ink color, their mean RT in the control condition from RT in the congruent and the incongruent combinations. Here a value of zero indicates no difference between the control and Stroop condition; thus, a one sample *t*-test was used to test if these values were significantly different from zero. A significant positive difference would indicate Stroop interference, whereas a significant negative difference would demonstrate Stroop facilitation. We were mindful of Ziaka et al.’s [81] warning that subtractions between the Stroop and control conditions should be treated with caution, and conclusions about Stroop interference can be drawn by examining estimates in both conditions separately.

In view of small sample sizes, one of the reviewers enquired about statistical power of the reported results. Since post hoc

power analysis is argued not to be informative for interpreting findings, following Heckman et al.’s [88] guidance, we calculated 95% confidence intervals (CIs) of effect sizes (η^2_p , *d*), which inform of the possibility of low power or inappropriate sample sizes. Effect size CIs were calculated using the Wald test; they are reported for significant and non-significant outcomes.

2.6 | Transparency and Openness

We report all manipulations and measures in the study, to follow the Journal Article Reporting Standards (JARS) [89]. All raw data are available at https://osf.io/rp7z5/?view_only=94f2c825c1c14b8fb0712acd1fde5d09. Data were analyzed using R, version 4.4.1 [90] and the package ggplot2, version 3.4.2 [91]. The study design and analysis plan were not pre-registered. Materials and code for this study are not available.

3 | Experiment 1

3.1 | Method

3.1.1 | Participants

Originally seven participants were tested; one participant was excluded since they were not a native Italian speaker. Analyzed were data of six participants (2 females), aged between 25 and 27 years.

3.1.2 | Stimuli and Design

In the control condition, “X” strings were presented in one of six ink colors: red, yellow, dark blue, light blue, purple, and pink (Figure 3). Each ink color was presented six times, with 36 trials in total spread over two sessions, each with 18 trials.

In the Stroop condition, four color words—ROSSO, GIALLO, BLU, and VIOLA—were rendered in the same six ink colors as in the control condition (Figure 3). The color word set did not include the words that would correspond to the names of two ink colors, light blue (*azzurro*) and pink (*rosa*), the manipulation that allowed comparison of the effect of ink lightness for the critical BLU—light blue ink pairing and the ROSSO—pink ink pairing.

There were 24 color word—ink color combinations, each presented six times, with a total of 144 trials spread across six sessions. Four color word—ink color combinations (24 trials) were congruent (17%); 20 combinations were treated as incongruent (120 trials). The critical Stroop combinations, BLU rendered either in dark blue ink (congruent) or light blue ink (incongruent), are highlighted in Figure 3.

3.2 | Results and Discussion

3.2.1 | Control Condition

RTs (mean and SE) of naming “X” strings in each ink color are reported in Table S1. There was a significant effect of the ink color: $F(5,25)=6.18$, $MSE=1705$, $p<0.001$, $\eta^2_p=0.55$, 95% CI

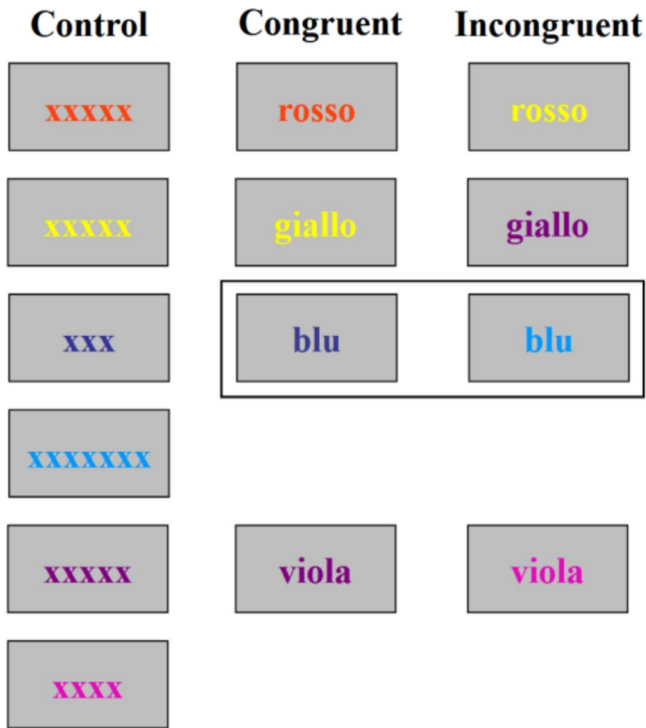


FIGURE 3 | Experiment 1. Control condition: “X” strings in six ink colors. Stroop condition: Four employed color words in congruent and (exemplary) incongruent combinations. Highlighted are the critical Stroop combinations, BLU—dark blue and BLU—light blue ink.

[0.19, 0.71]. Bonferroni corrected pairwise comparisons revealed one significant difference: “X” strings in red ink were named faster ($M = 496 \pm 44$ ms) than those in pink ink [$M = 604 \pm 61$ ms; $t(5) = -5.28$, $p = 0.050$, $d = -2.15$, 95% CI $[(-3.70), (-0.60)]$]. The speed of *blu*-naming “X” strings in dark blue ink ($M = 510 \pm 48$ ms) did not differ significantly from *azzurro*-naming of “X” strings in light blue ink [$M = 556 \pm 50$ ms; $t(5) = -4.21$, $p = 0.124$, $d = -1.72$, 95% CI $[(-3.05), (-0.39)]$].

Notably (see Table S1) mean RTs of “X”-string inks named *rosso*, *giallo*, and *blu*, by primary BCTs, were each shorter than mean RTs for naming inks *azzurro*, *viola*, and *rosa*, by secondary BCTs. It is likely that a minor information conflict, introduced by automatically triggered reading of pronounceable letter-strings [83], is resolved faster when ink colors are designated by primary BCTs retrieved earlier compared to less salient secondary BCTs.

3.2.2 | Stroop Condition

Mean (SE) RTs for the four color words, each rendered in six ink colors, are shown in Figure 4a (numerical values are presented in Table S2). As expected, for each color word, RTs were shorter for congruent than (aggregated) incongruent combinations (see Figure S1 with accompanying outcomes of the t -test for each color word). In congruent combinations, mean RTs for ROSSO, GIALLO, and BLU, primary BCTs, were slightly shorter (527–565 ms) than for VIOLA, secondary BCT (610 ms). In incongruent combinations, for words ROSSO, GIALLO, and VIOLA ink naming was significantly faster in combinations with dark blue ink (675–690 ms) than with light blue ink [706–728 ms; $t(23) = -3.25$, $p = 0.016$, $d = -0.66$, 95% CI $[(-1.11),$

$(-0.22)]$, hinting that *blu*-naming of the ink was inhibited less by the conflicting words than *azzurro* ink-naming.

Figure 4b,c (and Tables S2 and S5) allow a closer look at naming speed when BLU was rendered in the two blue inks. Absolute mean RT (Figure 4b) for the BLU—dark blue ink ($M = 556 \pm 26$ ms) was 110 ms shorter than for the BLU—light blue ink [$M = 666 \pm 20$ ms; $t(5) = -3.963$, $p = 0.020$, $d = -1.62$, 95% CI $[(-2.90), (-0.34)]$]. Relative mean RTs (Figure 4c) revealed neither significant interference in the BLU—light blue ink combination [$M = 102 \pm 39$ ms; $t(5) = 2.57$, $p = 0.200$, $d = 1.05$, 95% CI $[0.02, 2.08]$], nor facilitation effect in the congruent combination [$M = 45 \pm 33$ ms; $t(5) = 1.37$, $p = 0.920$, $d = 0.56$, 95% CI $[(-0.31), 1.43]$].

The present finding of significantly slower responses (in absolute terms) for the combination BLU—light blue ink, named *azzurro*, compared to the BLU—dark blue ink, named *blu* (666 ms vs. 556 ms), is in accord with the finding for 22 young Italian monolinguals in Simoncelli et al.’s study [76] (719 ms vs. 695 ms, respectively). Noteworthy, in it a design was partly different: responses were input manually using four keys; four color words (ROSSO, GIALLO, VERDE, and BLU) and six inks (including light and dark green inks) were used; control stimuli were neutral words, and these were interspersed with (in)congruent stimuli. The latter design feature, a mixed design, compared to the blocked design in the present study, may have resulted in longer mean RTs in the two critical combinations in Ref. [76], since blocking is considered to strengthen the semantic activation of the concepts corresponding to the stimulus words [83].

4 | Experiment 2

The main purpose of Experiment 2 was to replicate Experiment 1 but matching the “blue” word and the ink-naming response sets. This was to ensure that the Stroop interference demonstrated in Experiment 1 for the BLU—light blue ink combination could not be attributed solely to a response set component, since color words that are members of the color-naming response set were shown to produce greater interference than words not part of the response set [63, 82]. In an analogous way, manipulated was also the “red” word–response set to explore similarity in performance for the “blue”- and “red”-pairings, each containing lightness variation.

4.1 | Method

4.1.1 | Participants

Participants ($N = 10$; 5 females), aged between 21 and 31 years, have not participated in Experiment 1 to avoid the learning effect.

4.1.2 | Stimuli and Design

In the control condition, stimuli and procedure were identical to those in Experiment 1, that is, “X” strings were presented in

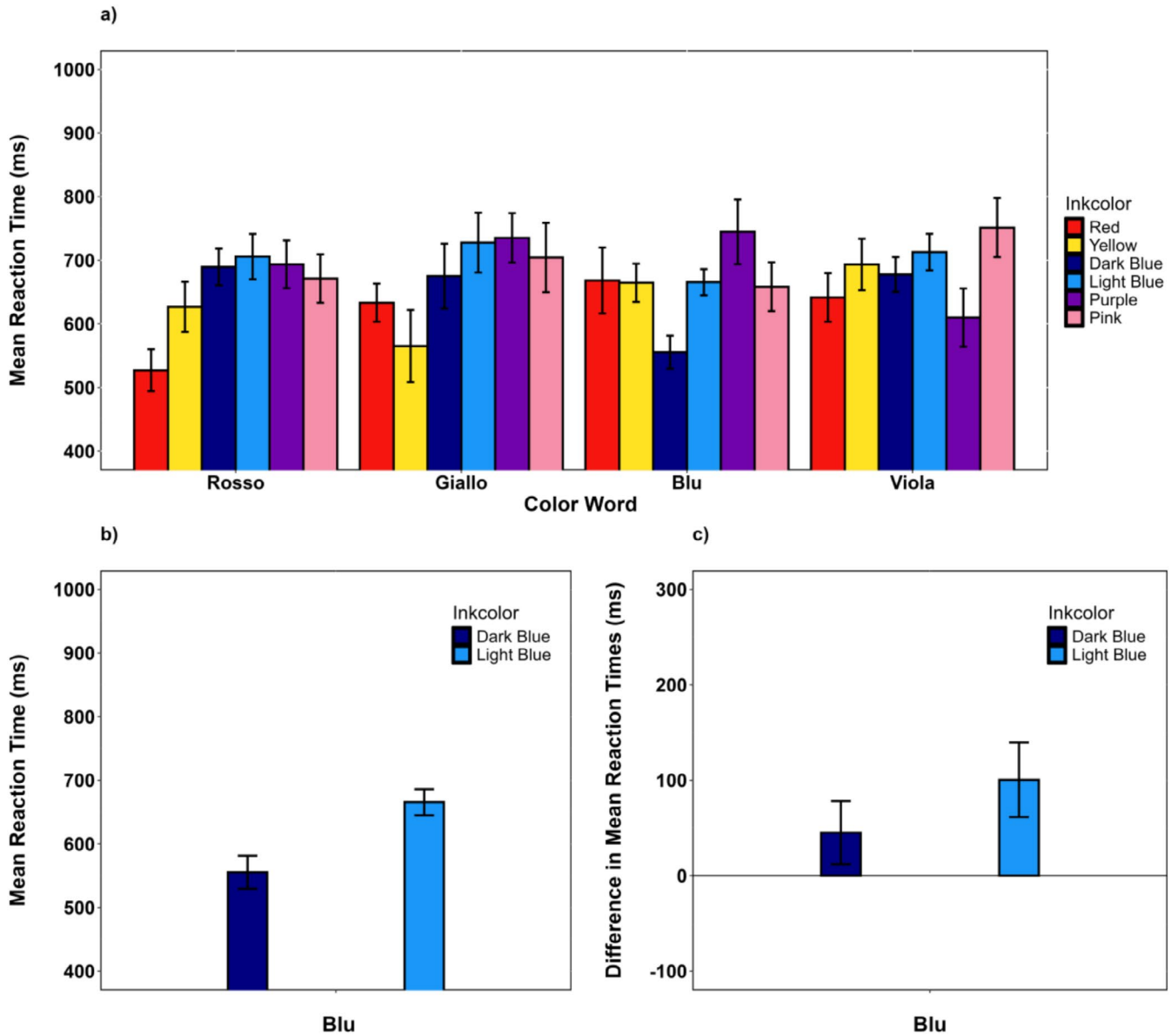


FIGURE 4 | Experiment 1. Stroop condition: Mean RTs (ms). (a) All four color words; (b) absolute and (c) relative speed of naming ink color of the word BLU rendered in dark and light blue ink. Bar color indicates ink color the word was rendered in. Error bars indicate standard error.

one of the six ink colors: red, yellow, dark blue, light blue, purple, and pink (Figure 5). Each ink color was presented six times, with 36 trials in total in the block.

In the Stroop condition, the color word set consisted of six Italian terms: ROSSO, GIALLO, BLU, AZZURRO, VIOLA, and ROSA. AZZURRO was included to compare Stroop effects for each of the two basic “blue” terms. Further, ROSA was added to match the number of color words and the corresponding ink color names and, as well, to explore whether there will be performance similarity between “blu/azzurro” and “rosso/rosa” incongruent combinations. The color words were presented in the same six ink colors, as in the control condition. Thus, there were six congruent color word—ink color combinations and 30 incongruent ones. The critical “blue” combinations are highlighted in Figure 5. Each color word—ink color combination was presented six times, across

six sessions, with a total of 216 trials, including 36 congruent (17%) and 180 incongruent trials.

4.2 | Results and Discussion

4.2.1 | Control Condition

Across all six ink colors, the grand mean of RTs ($M = 580 \pm 15$ ms) for naming “X” strings was comparable to that in Experiment 1 [$M = 539 \pm 19$ ms; $t(14) = 0.78$, $p = 0.775$, $d = 0.20$, 95% CI $[(-0.71), 0.31]$]. RTs for the ink colors of interest—dark blue, light blue, as well as red and pink—slightly differed between Experiments 1 and 2 (see Table S1), but none of the differences was significant (with the lowest $p = 0.126$). A significant effect of the ink color was found, too: $F(5,45) = 4.48$, $MSE = 0.004$, $p = 0.002$, $\eta^2_p = 0.33$, 95% CI $[0.07, 0.49]$. Pairwise comparisons, using

Control	Congruent	Incongruent
XXXXX	rosso	rosso
XXXXX	giallo	giallo
XXX	blu	blu
XXXXXX	azzurro	azzurro
XXXXX	viola	viola
XXXX	rosa	rosa

FIGURE 5 | Experiment 2. Control condition: “X” strings in six ink colors. Stroop condition: Six employed color words in congruent and (exemplary) incongruent combinations. Highlighted are the critical Stroop combinations, BLU—dark blue and BLU—light blue ink; AZZURRO—light blue and AZZURRO—dark blue ink.

the Bonferroni correction, revealed one significant difference, with faster naming “X” strings *giallo* ($M = 524 \pm 35$ ms) than *viola* [$M = 595 \pm 29$ ms; $t(9) = -5.14$, $p = 0.009$, $d = -1.63$, 95% CI $[(-2.60), (-0.65)]$]. The speed of *blu*-naming of “X” strings in dark blue ink ($M = 571 \pm 24$ ms) did not differ significantly from *azzurro*-naming “X” strings in light blue ink [$M = 650 \pm 46$ ms; $t(9) = -2.14$, $p = 0.917$, $d = -0.68$, 95% CI $[(-1.37), 0.02]$].

4.2.2 | Stroop Condition

Mean RTs for the six words are shown in Figure 6a (for numerical values, see Table S3). As expected, for each color word, RTs were shorter in congruent than in (aggregated) incongruent combinations (Figure S2). In congruent combinations, mean RTs for ROSSO, GIALLO, and BLU, primary BCTs (582–595 ms), were not significantly shorter than for AZZURRO, ROSA, and VIOLA, secondary BCTs [602–626 ms; $t(9) = -1.39$, $p = 0.197$, $d = -0.44$, 95% CI $[(-1.09), 0.21]$]. In incongruent combinations, the interference of ROSSO, GIALLO, VIOLA, and ROSA with *blu*-naming of dark blue ink (672–721 ms) was comparable to when these words were rendered in light blue ink named *azzurro* [737–778 ms; $t(9) = -1.04$, $p = 0.323$, $d = -0.33$, 95% CI $[(-0.97), 0.31]$]. Across incongruent combinations, the magnitude of word interference was comparable for *azzurro*-naming of light blue ink (673–778 ms) and *rosa*-naming of pink ink [721–784 ms; $t(9) = 0.08$, $p = 0.939$, $d = 0.02$, 95% CI $[(-0.64), 0.60]$].

We consider more closely responses to the two “blue” words rendered in blue ink varying in lightness (Figure 6b, Tables S3

and S5). BLU produced 78 ms shorter response in dark blue ink, the congruent combination, than in light blue ink named *azzurro* but the difference was not significant [$M = 596 \pm 30$ ms vs. $M = 674 \pm 27$ ms; $t(9) = -2.90$, $p = 0.119$, $d = -0.92$, 95% CI $[(-1.67), (-0.17)]$]. Conversely, when AZZURRO was rendered in dark blue ink, it took 163 ms longer to name the ink *blu* than when it was rendered in light blue ink [$M = 766 \pm 55$ ms vs. $M = 603 \pm 32$ ms; $t(9) = 4.44$, $p = 0.014$, $d = 1.40$, 95% CI $[0.50, 2.30]$].

Figure 6c shows relative processing speed of the two “Italian blues” and prompts that the response pattern was asymmetrical. Specifically, for BLU rendered in light blue ink, there was no interference effect [$M = 23 \pm 36$ ms; $t(9) = 0.65$, $p = 1.00$, $d = 0.21$, 95% CI $[(-0.42), 0.83]$]; neither there was a facilitation effect in the congruent combination [$M = 24 \pm 38$ ms; $t(9) = 0.64$, $p = 1.00$, $d = 0.20$, 95% CI $[(-0.52), 0.92]$]. In contrast, for AZZURRO in dark blue ink the interference effect was significant [$M = 195 \pm 55$ ms; $t(9) = 13.81$, $p = 0.007$, $d = 4.37$, 95% CI $[2.26, 6.48]$], implying a strong ideation of “azzurro,” hence, its greater inhibition of naming the ink *blu*. AZZURRO also revealed a significant facilitation effect [$M = 46 \pm 3$ ms; $t(9) = -18.95$, $p = 0.007$, $d = -5.99$, 95% CI $[(-8.83), (-3.15)]$].

5 | Experiment 3

5.1 | Method

5.1.1 | Participants

Participants were seven males, aged between 21 and 29 years (other than those in Experiments 1 and 2).

5.1.2 | Stimuli and Design

In the control condition, “X” strings were presented in one of six ink colors, as in Experiment 1, except that the two blue inks were replaced by dark and light green ink colors (Figure 7). In total, there were 36 trials, with each ink color presented six times; data were collected in two sessions, each with 18 trials.

In the Stroop condition, there were four color words: ROSSO, GIALLO, VERDE, and VIOLA, that is, similar to Experiment 1, except that BLU was replaced by VERDE. Presented in the six ink colors, this resulted in 24 color word—ink color combinations. Five combinations were congruent, including VERDE—dark green and VERDE—light green ink (Figure 7), 19 combinations were incongruent. Each color word—ink color combination was presented six times, across six sessions, with a total of 144 trials, with 30 congruent (21%) and 114 incongruent trials.

5.2 | Results and Discussion

5.2.1 | Control Condition

Mean (SE) of RTs are reported in Table S1. A significant effect of the ink color was found: $F(5,30) = 4.72$, $MSE = 0.181$, $p = 0.003$, $\eta^2_p = 0.44$, 95% CI $[0.11, 0.63]$. Bonferroni corrected pairwise

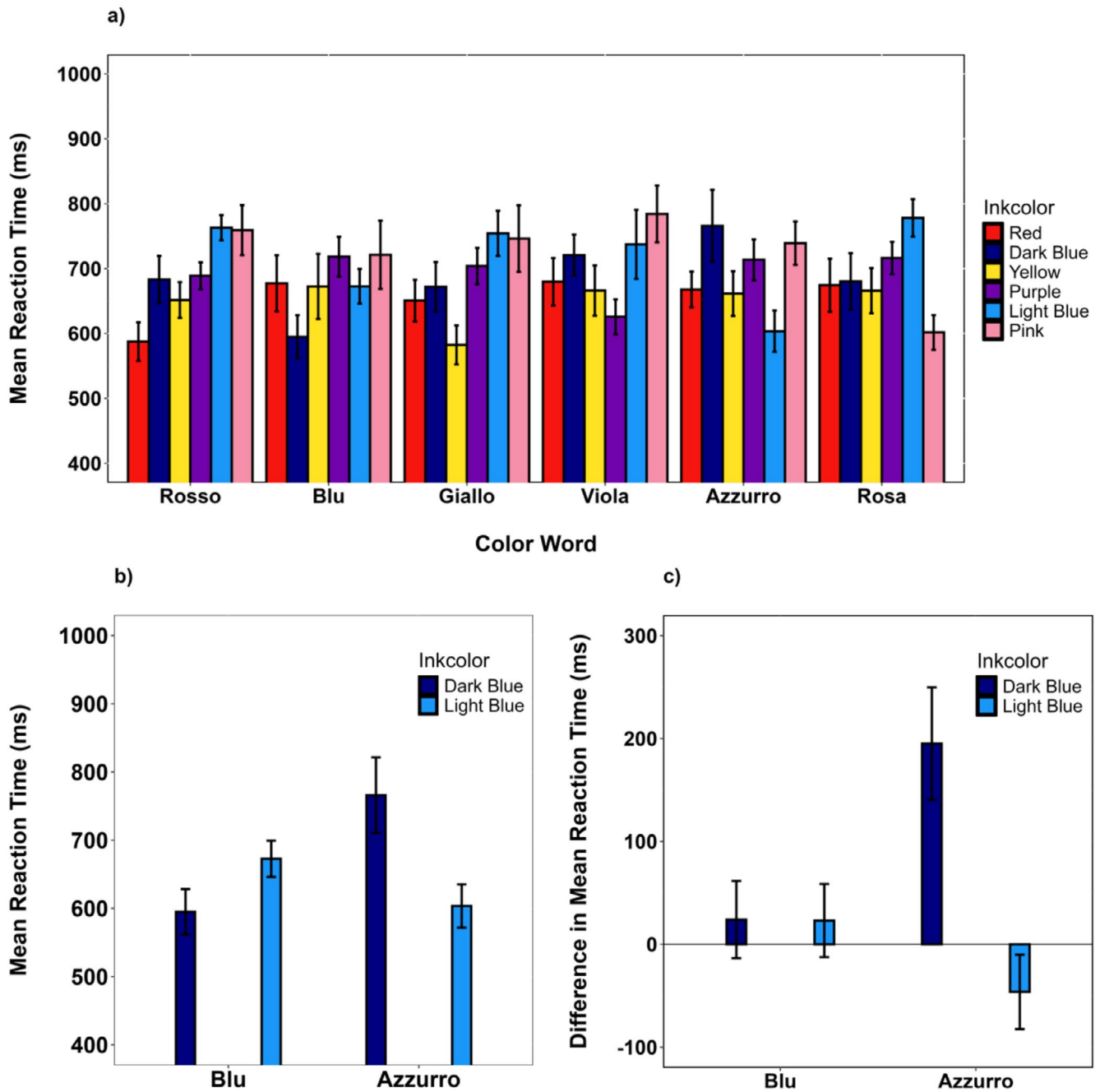


FIGURE 6 | Experiment 2. Stroop condition: Mean RTs (ms). (a) All six color words; (b) absolute and (c) relative speed of naming ink color of the words BLU and AZZURRO, each rendered in dark and light blue ink. The bar color indicates ink color the color word was rendered in. Error bars indicate standard error.

comparisons revealed a single significant difference: naming red ink *rosso* ($M = 532 \pm 32$ ms) was faster than naming purple ink *viola* [$M = 705 \pm 35$ ms; $t(6) = 7.82$, $p = 0.003$, $d = 2.95$, 95% CI [1.12, 4.78]]. Response speed of naming “X” strings *verde* was comparable for dark and light green ink [$M = 675 \pm 42$ ms vs. $M = 699 \pm 53$ ms; $t(6) = -1.04$, $p = 1.00$, $d = -0.39$, 95% CI [(-1.17), 0.38]].

5.2.2 | Stroop Condition

Mean RTs for the four color words rendered in six ink colors are shown in Figure 8a. For each color word, RTs were shorter

in congruent than in incongruent combinations (Tables S4 and S5). RTs for individual color words in congruent against (aggregated) incongruent combinations are presented in Figure S3 accompanied by statistics. In incongruent combinations, GIALLO and VIOLA exerted a slightly lesser interference with *verde*-naming of dark green ink (822–858 ms) than light green ink (842–872 ms), but the difference was not significant [$t(6) = -0.25$, $p = 0.083$, $d = -0.09$, 95% CI [(-0.89), 0.72]]. The greater interference (slowed down lexical access) in the combinations with light green ink may be related to Italian speakers’ ideation (conceptual typicality) of “verde” as a relatively light color (Ref [31], tab. V).

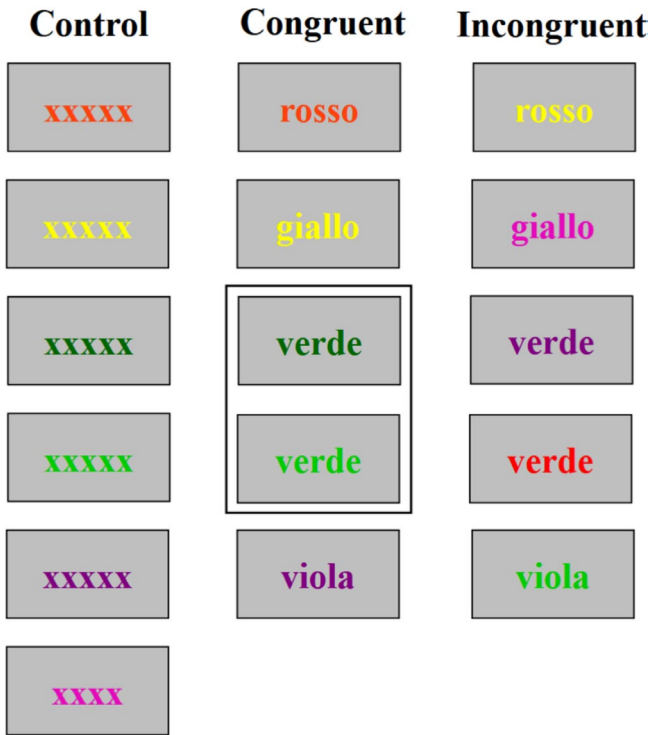


FIGURE 7 | Experiment 3. Control condition: “X” strings in six ink colors. Stroop condition: Four employed color words in congruent and (exemplary) incongruent combinations. Highlighted are the critical Stroop combinations, VERDE in dark and light green ink.

Figure 8b,c singles out the critical combinations of VERDE in green ink varying in lightness. For absolute RTs, the difference between VERDE—dark green ink and VERDE—light green ink combinations (43 ms) was not significant [$M=644 \pm 36$ ms vs. $M=687 \pm 57$ ms; $t(6)=-1.30$, $p=0.726$, $d=-0.49$, 95% CI $[(-1.28), 0.30]$]. In relative RTs, no facilitation effect was observed for verde-naming of either dark green ink [$M=-55 \pm 45$ ms; $t(6)=-1.22$, $p=1.00$, $d=-0.46$, 95% CI $[(-1.25), 0.32]$] or light green ink [$M=12 \pm 20$ ms; $t(6)=0.59$, $p=1.00$, $d=0.22$, 95% CI $[(-0.53), 0.97]$].

6 | ROSSO and ROSA in the Stroop Condition

For comparison with the two “Italian blues,” we consider performance for the “red”-pairings in Experiments 1–3 (Figure 9, Tables 2 and S2–S5). As a reminder, in Experiments 1 and 3, ROSSO was rendered in red and pink ink; in Experiment 2, the word set included ROSSO and ROSA, each presented in red and pink ink.

In Experiments 1–3, absolute RTs for ROSSO in pink ink were longer than when it was rendered in red ink (Figure 9a,c,e), with differences being comparable across the experiments and (marginally) significant (Table 2). The incongruent ROSSO—pink ink combination (Figure 9b,d,f) showed no interference in Experiment 1 or Experiment 3; however, the interference effect (179 ms) was significant in Experiment 2. No facilitation effect was found in either experiment (Table 2).

In Experiment 2, ROSA incurred 73 ms longer absolute RTs in incongruent than congruent combination (Figure 9c);

the difference was marginally significant. In relative terms (Figure 9d), there was neither interference effect for ROSA—red ink nor facilitation effect for ROSA—pink ink (Table 2).

7 | General Discussion

We focused on assessing the mutual semantic power of the two basic Italian “blue” terms, *blu* and *azzurro*, by using the Stroop task. We anticipated that the amount of interference within the “blue”-pairings would accord to the semantic gradient hypothesis: as the semantic relationship between the color word and ink color increases, so also does the magnitude of the Stroop interference [57, 58, 63, 65, 82, 83].

We hypothesized that the combinations BLU—light blue ink and AZZURRO—dark blue ink will be incongruent revealing the interference effect (H1); conversely, BLU—dark blue ink and AZZURRO—light blue ink, congruent combinations, will show the facilitation effect (H2).

In the “blue series” (Experiments 1–2), as expected, dark blue ink evoked *blu*-response, while light blue ink elicited *azzurro*-response. We manipulated the color word set by presenting solely BLU (Experiment 1) or both BLU and AZZURRO words (Experiment 2).

Further, in the “green series” (Experiment 3), we related the Stroop effects for the “blue”-pairings to effects for VERDE rendered either in dark or light green ink, hypothesizing that variation of lightness of the ink color, a low-level stimulus characteristic, as such would not incur Stroop effects (H3).

Finally, to explore the potential role of difference in basicness of *blu* and *azzurro*, across Experiments 1–3 we examined the semantic relatedness for the “red”-pairing, *rosso* and *rosa*, the terms that differ in both lightness of their denotata and basic status (primary vs. secondary BCTs), and hypothesized observing Stroop effects for the “red”-pairing (H4)—like those manifested by the “Italian blues.”

Prior to discussing main results related to H1–H4, we shortly address an incidental finding on the ink naming by BCTs varying in their basic status and a certain aspect of the Stroop task protocol, with both conceivably impacting/related to the main results.

7.1 | Response Speed of Naming Ink Color by Italian Primary and Secondary BCTs

One of the study’s novelties is reporting Stroop effects for individual ink colors/their combinations with color words, unlike usually reported effects for aggregated congruent vs. aggregated incongruent combinations. This scrutiny revealed differences in lexical access to ink names by Italian primary and secondary BCTs. Specifically, in the control condition mean RTs of “X”-string inks named by primary BCTs—*rosso*, *giallo*, and *blu*—were shorter than mean RTs for inks named by secondary BCTs—*azzurro*, *viola*, and *rosa* (Experiments 1–2). Similarly, in congruent combinations of the Stroop condition naming the

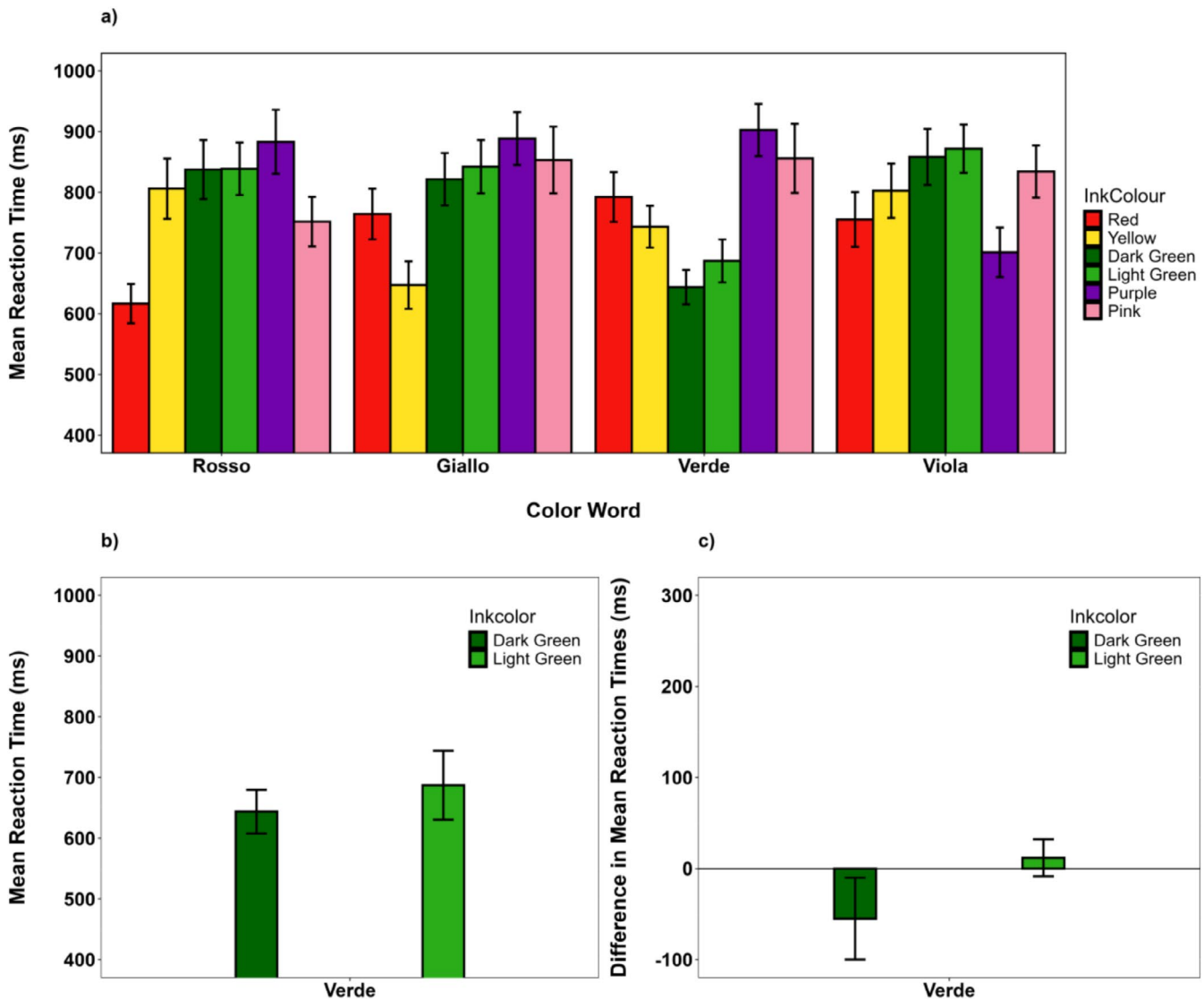


FIGURE 8 | Experiment 3. Stroop condition: Mean RTs (ms). (a) All four color words; (b) absolute and (c) relative speed of naming ink color of the word VERDE rendered in dark and light green ink. Bar color indicates ink color the color word was rendered in. Error bars indicate standard error.

ink by primary BCTs—for words ROSSO, GIALLO, and BLU (Experiments 1–2) or VERDE (Experiment 3)—in most cases was slightly shorter than naming the ink for words AZZURRO, ROSA, and VIOLA, secondary BCTs.

The RT differences observed in the Stroop task are at odds with the finding that primary and secondary BCTs (American English) were comparable in response speed for naming color patches [92]. We attribute the discrepancy to the Stroop “whole task set of reading” (Ref [93, p. 137]): unlike naming color of a patch, naming ink of colored characters—here: pronounceable letter-strings and color words in the congruent combinations—automatically triggers an online covert language that aids verbal encoding [94] and, by the same token, introduces a minor information conflict [82, 83]. It appears that the conflict is resolved faster when ink naming involves primary BCTs characterized by higher elicitation prevalence, that is, have greater access to semantic and phonological codes, than secondary BCTs.

7.2 | The Proportion of Congruent and Incongruent Trials

Foreshadowing the discussion of the results for the “Italian blues” in the Stroop condition, we note that the magnitude of the reported Stroop effects may have been affected by a rather low proportion of congruent-to-incongruent trials in our design (17% or 21% across Experiments 1–3). Compared to a design with a prevalence of congruent trials, our design implies high information monitoring demand. Consequently, RTs are expected to be longer for congruent and shorter for incongruent combinations, resulting in smaller, if any, facilitation effects on congruent trials and a decrease of interference effects on incongruent trials [78, 82, 95, 96]. Indeed, in Experiments 1–3 all congruent combinations, apart from one, showed no facilitation effect. We remark that in many cases, the RT difference between congruent and control conditions is comparable to values reported earlier, about 20 ms [60–62, 65, 66].

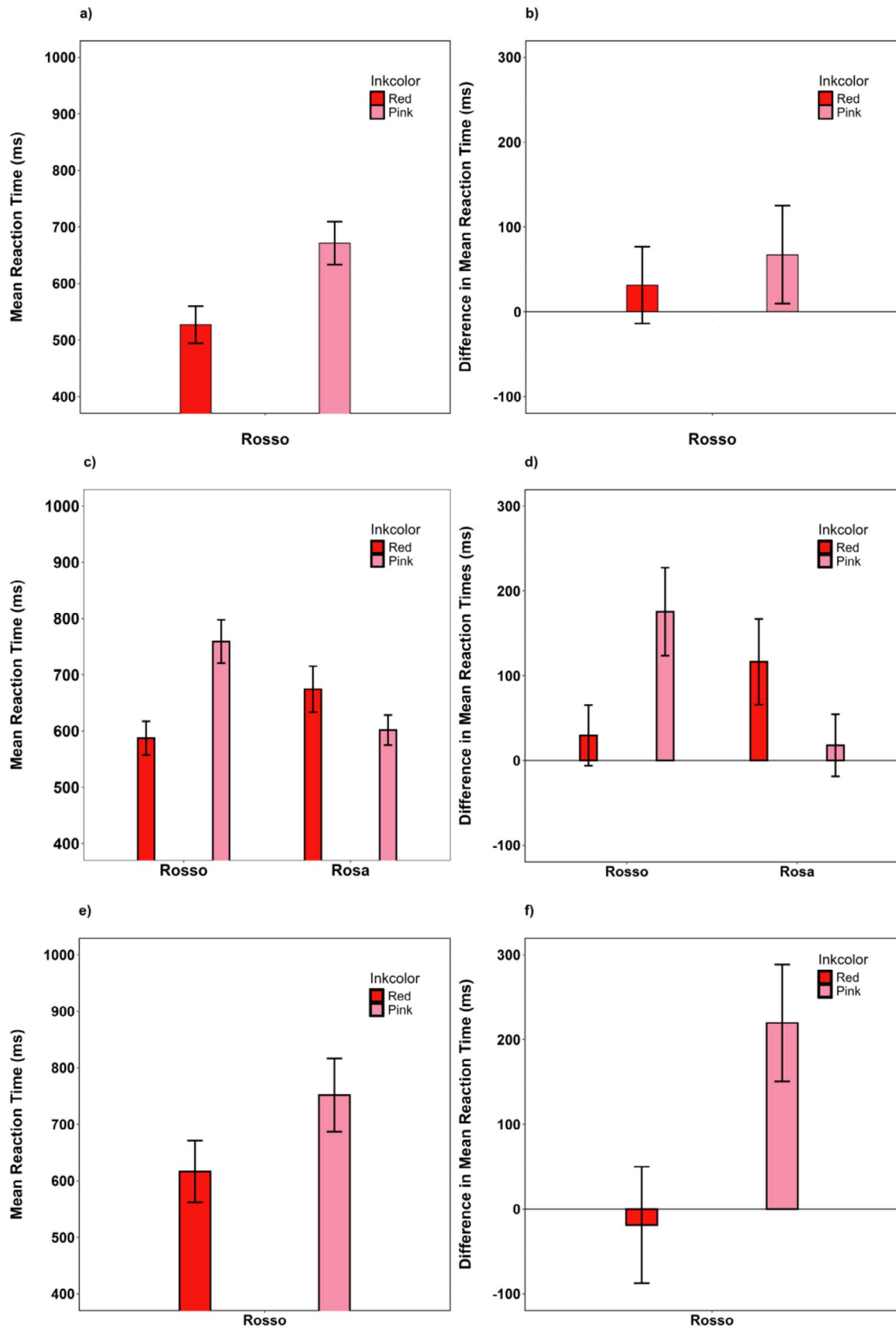


FIGURE 9 | Experiments 1–3. Stroop condition: Mean RTs (ms). (a, b) Experiment 1: ROSSO rendered in red and pink ink; (c,d) Experiment 2: ROSSO and ROSA, each rendered in red and pink ink; (e, f) Experiment 3: ROSSO rendered in red and pink ink. (a, c, e) absolute and (b, d, f) relative speed of naming ink color. Error bars indicate standard error.

TABLE 2 | Color words ROSSO and ROSA: Mean (\pm SE) of absolute and relative RTs (ms) in congruent (C) and incongruent (IC) conditions.

Absolute RTs					
Color word	Experiment	Red ink	Pink ink	IC–C difference	Statistic
ROSSO	Exp. 1	527 \pm 33	671 \pm 38	144	$t(5) = 2.50, p = \mathbf{0.055}, d = 1.02, 95\% \text{ CI } [0.00, 2.04]$
	Exp. 2	587 \pm 30	759 \pm 38	172	$t(9) = 4.39, p = \mathbf{0.014}, d = 1.39, 95\% \text{ CI } [0.50, 2.28]$
	Exp. 3	617 \pm 55	752 \pm 65	135	$t(6) = 5.04, p = \mathbf{0.012}, d = 1.91, 95\% \text{ CI } [0.60, 3.22]$
ROSA	Exp. 2	674 \pm 41	602 \pm 27	73	$t(9) = 2.10, p = \mathbf{0.065}, d = 0.67, 95\% \text{ CI } [(-0.02), 1.36]$
Relative RTs					
Color word	Experiment	IC–control (interference)	Statistic	C–control (facilitation)	Statistic
ROSSO	Exp. 1	67 \pm 58	$t(5) = 1.17, p = 0.296, d = 0.48,$ 95% CI $[(-0.37), 1.33]$	32 \pm 45	$t(5) = 0.70, p = 0.518, d = 0.29,$ 95% CI $[(-0.53), 1.11]$
	Exp. 2	179 \pm 37	$t(9) = 3.39, p = \mathbf{0.032},$ $d = 1.07, 95\% \text{ CI } [0.28, 1.86]$	36 \pm 22	$t(9) = 0.82, p = 1.00, d = 0.29,$ 95% CI $[(-0.53), 1.11]$
	Exp. 3	116 \pm 60	$t(6) = 1.85, p = 0.114, d = 0.70,$ 95% CI $[(-0.14), 1.54]$	–19 \pm 69	$t(6) = -0.27, p = 1.00, d = -0.10,$ 95% CI $[(-0.85), 0.64]$
ROSA	Exp. 2	116 \pm 51	$t(9) = 2.30, p = 0.118, d = 0.73,$ 95% CI $[0.02, 1.44]$	20 \pm 19	$t(9) = 0.49, p = 1.00, d = 0.15,$ 95% CI $[(-0.47), 0.77]$

Note: Significant and marginally significant effects are highlighted by bold.

7.3 | Processing Speed of the “Italian Blues”

First, we were interested whether the naming speed of dark and light blue ink by *blu* and *azzurro*, respectively, would differ in the control condition and incongruent combinations with non-“blue” words in the Stroop condition (Experiments 1 and 2). In the control condition, we found that “X” strings in dark blue ink were named *blu* slightly faster than named *azzurro* in light blue ink, although the difference was not significant: 510 versus 565 ms (Experiment 1); 571 versus 650 ms (Experiment 2). We remark that color patches were found to be named *blu* (752 ms) faster than *azzurro* (912 ms) [31].

Further, in incongruent combinations of the blue inks with non-“blue” words we observe difference in the amount of interference with naming dark blue and light blue inks. Specifically, ROSSO, GIALLO and VIOLA (Experiment 1), and ROSSO, GIALLO, VIOLA and ROSA (Experiment 2) interfered significantly less (Experiment 1) or slightly less (Experiment 2) with naming dark blue ink *blu* than when these words were rendered in light blue ink named *azzurro*.

Faster *blu*-naming in the control condition and conflict Stroop combinations conceivably reflects easier activation of and, hence, faster lexical access to *blu*—a primary BCT, the term used with high frequency, than *azzurro*, a secondary BCT. Alternatively, faster naming of the ink color by phonetically shorter *blu* might reflect its faster phonological encoding, that is, unfolding of a phonetic plan for generating an oral response, compared to *azzurro*. The phonetic length seems though to be unlikely the factor: the naming speed of color patches by two basic “Russian blues,” *sinij* and *goluboj* [97], and two basic “Japanese blues,” *ao* “blue” and *mizu* “water” [98], indicates

that RTs are shorter for the respective primary “blue” terms, *sinij* and *ao*, compared to secondary “blue” terms, *goluboj* and *mizu*, for respective languages.

7.4 | Asymmetric Stroop Effects in the “Blue”-Pairings

For the “blue”-pairings in Experiments 1–2, we anticipated that “*blu*” and “*azzurro*” would exert mutual interference reflecting their semantic power. We reasoned that if their Stroop effects would not be comparable, this could manifest differences in semantic representation of the “blue” terms in one or more aspects reviewed in the Section 1.2, specifically, (i) variation on the perceptual dimension—in lightness of denotata of the two “blue” categories; (ii) linguistic distinction: while *blu* is more frequent and often is used as an umbrella term for describing the whole blue area, *azzurro* is older, more entrenched, and better morphologically integrated in Italian; (iii) relative basicness (based on elicitation indices): cognitive salience of *blu*, a primary BCT, is higher than that of *azzurro*, a secondary BCT.

We found that in absolute RTs, for both “blue” words naming the ink color in incongruent combinations was significantly longer than in the respective congruent combinations. For BLU—light blue ink, the difference was 110 ms (Experiment 1) and 78 ms (Experiment 2). Slightly greater inhibition in the former probably was due to the BLU-only word set that ensued higher expectancy of “*blu*” (cf. Ref. [93]) and, hence, its greater lexical access when it competed with naming light blue ink *azzurro*. For AZZURRO (Experiment 2) rendered in dark blue ink, it took significantly longer (163 ms) to name the ink *blu* than in the congruent combination.

Within the interactive activation model [83], mutual impeding of BLU and AZZURRO in incongruent combinations reveals the task conflict—between the ink color-naming and automatically triggered color word reading, as well as the informational conflict—the activation of the competing semantically related color concepts. Mutual interference of these semantic neighbors points to the distinctiveness of their semantic representations, in accord with the conclusion that both terms are basic, arrived at in earlier (psycho)linguistic studies and in the previous analysis of absolute RTs of the present dataset [77].

Experiment 2, with the matched color-word set and the response set, enabled direct comparison of Stroop effects (in relative RTs) for the two “blue” terms. Unexpectedly, BLU revealed neither interference nor facilitation effects. For AZZURRO, in contrast, the interference effect was considerable, 195 ms; the facilitation effect (46 ms), too, was significant, both with large effect sizes. The latter finding is indicative of a strong ideation of “azzurro” and suggests, in terms of Levin and Tzelgov [83], informational amplification of the word, that is, its greater activation and lexical access and, hence, greater inhibitory potential in competition with naming dark blue ink *blu*. As pointed out by Klein (Ref [57, p. 586]), “[t]he evocative power of a word will be indicated by its impeding effect upon the naming of color”. Our main finding is the marked asymmetry of the Stroop effects in the “blue”-pairings: strong interference and facilitation is exerted solely by AZZURRO but not by BLU. We conjecture that the revealed Stroop effects of AZZURRO, idealized by native speakers as being “more Italian” [33], reflect the term’s deep linguistic entrenchment, that is, routinized and automated activation of the corresponding semantic unit [99, 100]. An indication that “azzurro” representation is activated with higher automaticity than “blu” comes from a triad discrimination task of the two “Italian blues,” which demonstrated that light(er) blue stimuli labeled *azzurro* by Italian monolinguals were discriminated faster and more accurately than dark(er) blue stimuli labeled *blu* [101].

We remark that, along with the factors relating to the word meaning, the semantic power of a color word was argued to reflect frequency of the word usage [57, 58], which is attributed to faster visual recognition and, hence, more efficient lexical encoding of high frequency words [92]. Our finding that Stroop effects were absent for BLU implies that, although in modern Italian *blu* usage is higher than that of *azzurro* [49, 53, 102], it is not the term’s frequency that stipulates impelling of lexical access to the name of the ink color in the Stroop task. However, it is possible that it is not the frequency of the term’s usage per se that affects the amount of Stroop interference but the frequency with which the word used to interfere is associated with the color of the ink to be named (cf. Scheibe et al. 1967; cit. in Ref [89]). In the present context this would imply that the frequency of AZZURRO-association with *blu* is greater than otherwise, of BLU with *azzurro*.

Our hypotheses H1 and H2 are confirmed only partly: BLU—light blue ink and AZZURRO—dark blue ink demonstrated slowing down of ink naming, that is, indicating that these combinations are incongruent and implicating semantic competition between the two activated “blue” concepts; conversely, RTs were shorter on congruent than incongruent trials. However, at odds with our

hypotheses, the Stroop effects—interference (H1) and facilitation (H2)—were revealed only for AZZURRO, not for BLU.

7.5 | Difference in Lightness of the Ink Color: “Blue Series” Versus “Green Series”

We asked whether the Stroop effects in the “blue”-pairings are stipulated by the difference in lightness of the ink color. To disentangle the “lightness” factor from the “basicness” factor of the two Italian “blue” terms, BLU (of Experiment 1) was replaced by VERDE, Italian BCT for “green” (Experiment 3). We reasoned that if the processing speed in (in)congruent combinations were influenced by the perceptual dimension, the same trend would emerge for both BLU and VERDE in combinations with dark versus light inks.

The results of Experiment 3 (“green series”), with VERDE—dark green and VERDE—light green ink combinations, showed that the variation of ink color lightness incurred neither interference nor facilitation effect, in line with H3. Based on this outcome, we reckon that when a color space area (here: green) is denoted by one basic term and, in the Stroop task, two corresponding ink colors are identical in hue, it is not the lightness level of the ink color (stimulus feature) or difference in lightness between the (prototypical) color ideated by the word and the perceived ink color that instigates Stroop effects. Provided this inference is correct, the non-effect of ink color lightness on Stroop interference can be projected onto the “blue”-pairings.

7.6 | Relative Basicness of the Interfering BCTs: “Blue”-Pairings Versus “Red”-Pairings

Based on elicitation indices, the two “Italian blues” differ in relative basicness, *blu* a primary BCT and *azzurro* a secondary BCT. We asked whether the amount of Stroop interference could be related to the basic status of the interfering terms. For comparison with the “blue”-pairings, we explored processing speed in the Italian “red”-pairings—of primary BCT *rosso* and secondary BCT *rosa*. We reasoned that semantic relatedness within both pairings is comparable—in difference of lightness of the corresponding denotata and of basic status: *rosso* in cognitive salience is ranked 1 or 2, while *rosa* is ranked 8 or 9, that is, the *rosso-rosa* difference in cognitive salience (6–8 ranks) is comparable to that between *blu* and *azzurro* (6–9 ranks) [44, 55]. Thus, we expected that in the within-pairings incongruent combinations, the pattern of Stroop interference would be comparable for “blu” and “rosso”, and as well it would be similar for “azzurro” and “rosa.”

First, we observe that the primary “blue” term manifested slightly lesser inhibiting potential than the primary “red” term, as assessed by the difference (in absolute RTs) between the incongruent and congruent combinations. Specifically, responses in BLU—light blue ink were longer than BLU—dark blue ink by 110 ms (Experiment 1) and 78 ms (Experiment 2). In comparison, responses in the ROSSO—pink ink were longer than ROSSO—red ink by 144 ms (Experiment 1), 172 ms (Experiment 2), and 135 ms (Experiment 3).

Further, we expected that in Experiment 2 (with six words and six ink colors), in incongruent combinations the words BLU and

ROSSO would slow down naming of the respective light inks, *azzurro* and *rosa*, to a greater degree than the words AZZURRO and ROSA would stall naming the darker inks, *blu* and *rosso*, respectively. However, this prediction was supported only for the “red”-pairing: in ROSA—red ink, the response was 73-ms longer than in ROSA—pink ink (i.e., shorter than 172-ms (in)congruent difference for ROSSO). In contrast, the response in AZZURRO—dark blue ink was longer than in AZZURRO—light blue ink by 163 ms (i.e., longer than 78-ms (in)congruent difference for BLU).

Finally, for ROSSO—pink ink the interference effect (179 ms) was significant only in Experiment 2, where ROSA was part of the word set. We reckon that while in all three experiments the ROSSO—pink ink combination involved lexical and semantic relatedness components of the response competition [82], ROSSO-impeding of *rosa*-naming was greater in Experiment 2 due to the additional response set membership component [82]. The latter implies an increased activation in the lexical system of the internal unit corresponding to the printed word [63, 65] (here: ROSA), hence, a greater competition between the activated *rosso*- and *rosa*-responses, and an increase in the time needed at the response selection stage.

Crucially, the comparison of naming speed in incongruent combinations in the “blue”- and “red”-pairings shows that it is not the term’s primary basic status that incurs greater inhibition than a secondary term. In addition, results for both pairings are consistent in that Stroop interference of dark(er) and light BCT counterparts are sensitive to response set membership.

The results for the “red”-pairings only partly confirm H4. In none of the experiments, facilitation effects for ROSSO or ROSA were observed. The interference effect was found only for ROSSO when the word set and response set matched. The asymmetry of the interference pattern for the two “red” terms can be attributed to a greater semantic power of the ideated “rosso” than “rosa.”

7.7 | Stroop Effects for the Two Basic “Russian Blues”

Related to the present study of the two “Italian blues” is a Stroop task testing of the two basic “Russian blues,” where words SINIJ “dark blue” and GOLUBOJ “light blue” were rendered in either dark blue or light blue ink [103]. Also employed were “red” and “yellow” words and the corresponding inks. Notably, in congruent combinations, responses for GOLUBOJ were significantly faster than for the other three words. In incongruent combinations, the “Russian blues” revealed, too, response asymmetry: SINIJ was a stronger interferer than GOLUBOJ, that is, the reverse pattern compared to the Italian “blue” counterparts, BLU and AZZURRO (Experiment 2). However, compared to SINIJ, GOLUBOJ was a stronger facilitator, like Italian AZZURRO.

7.8 | Constraints on Generality

The present study’s analysis of the Stroop effects in the “blue”-pairings demonstrated that the two basic “Italian blues” are asymmetric in their semantic power: AZZURRO, older and more entrenched term, exerts strong interference and facilitation,

unlike BLU, historically later emerged term, that revealed neither interference nor facilitation effects. We expect that our results, obtained for Verona participants, generalize to speakers of Standard Italian. However, the *blu/azzurro* Stroop effects might vary for speakers of other Italian dialects, in which entrenchment of *azzurro* deviates from that of Standard Italian (e.g., Algherese Catalan [45] or Tuscan dialects [43]). It should also be noted that in replications, the magnitude of the Stroop effects might well differ on statistical grounds and/or due to certain methodological aspects of our study: our sample sizes were modest; the block design (which strengthens the semantic activation of the concepts corresponding to the words [84]); the proportion of congruent trials was rather low; in cases of an initial error, RTs were estimated to the onset of the correct(ed) response rather than by repeating the trial. We have no reason to believe that the results depend on other characteristics of the participants, materials, or context.

8 | Conclusions

Italian has two basic “blue” terms, *blu* “dark blue” and *azzurro* “light blue.” We assessed their semantic power (“evocative strength”) using the Stroop task. The Stroop interference between the two “blue” terms was hypothesized to manifest one or more subjacent mechanisms: linguistic—the term’s cognitive salience and basic status (primary or secondary), and perceptual—difference in lightness of the terms’ denotata.

In three experiments in different combinations, the Stroop condition included words ROSSO, GIALLO, BLU, AZZURRO, VERDE, VIOLA, and ROSA, each in one of six ink colors, as were “X” strings in the control condition. The response set membership varied across the experiments; in particular, in Experiment 1, the four-word set included only BLU, while in Experiment 2 the six-word set included both BLU and AZZURRO matched to ink colors.

We found that in the critical incongruent combinations, BLU—light blue ink named *azzurro* and AZZURRO—dark blue ink named *blu*, absolute RTs were significantly longer than in the congruent combinations, confirming that both “Italian blues” have basic status. The main findings are estimates of Stroop effects for the two “blue” terms (measured by the speed of ink naming in the (in)congruent combinations in relation to the control condition). Specifically, we found that BLU showed neither interference nor facilitation effects; in contrast, AZZURRO revealed strong interference and facilitation effects.

We surmise that the demonstrated Stroop effects are linguistic in origin and indicative of stronger ideation of *azzurro* and faster lexical access to its semantic representation compared to *blu*. Greater semantic power of *azzurro* conceivably reflects its deep entrenchment in Italian, hence, highly routinized activation of an “azzurro” cognitive unit manifested in the Stroop task.

9 | Addendum: Linguistic Historical Background of the Two “Italian Blues”

Azzurro originates from Persian *lāzward* and is surmised to have entered Italian through Greek (*λαζούρ*, *lazour*), when it denoted a painting pigment obtained from lapis lazuli [104]. The term’s oldest

occurrence is dated to the 4th century AD (Frison, personal communication). The term's Latin transition, with the Graecism *lazurin*, is dated to the 9th century AD [105] denoting also an organic dye or a mixture of minerals. In the 13th century *azzurro* is attested in Old Italian with numerous formal variants; in the 14th century *azzurro* occurs twice in Dante's *Inferno* and three times in Boccaccio [33]. According to Kristol [39] and Uusküla [105], initially *azzurro* belonged solely to the written language and was absent in Italian dialects; it entered the spoken language after the political unification of Italy during *Risorgimento* (1815–1871), when school education became affordable to the general population. In diachronic corpora, *azzurro* is reported to be extremely frequent; it qualifies the color of various entities—eyes, cloths, clothes, heraldry elements, sky, sea, lakes, mountains, flowers, birds, and so forth. Diachronic and synchronic corpus analysis attests abundant occurrences of *azzurro* in a great variety of compounded and suffixed forms, collocations, metaphors and metonymies [33, 53, 102]. Metonymically, *azzurro* is considered the national color of the Republic of Italy: the color was originally used in the standards, flags, military scarves, and so forth of the Savoia royal family; more recently it became the official color of the Italian national sports teams.

In comparison, *blu* entered Italian much later, at the end of the 17th century; in diachronic corpora *blu* occurs with a limited frequency [33]. It is a loanword derived from an early form of French *bleu* and had been adopted from Germanic languages [105, 106]. From the perspective of diachronic lexical semantics, emergence of *blu* was motivated by the dyeing trade (cf. Ref [107, p. 127]): from the 16th century onwards indigo increasingly substituted woad as the fabric dyeing source and enabled achieving stable dark blue color of cloths. *Blu* was deployed to lexicalize deep (dark/navy) blue tied to fashion, military uniforms and banners [108], which cemented “branding” of the new term.

The emergence of *blu* implies that the enrichment of the Italian BCT inventory in the blue area was driven not only by the perceptual prominence of color in the natural environment (sea, sky) [39–41, 105] but also by changes in material culture (here: dyeing technology), as well as the usefulness of *blu* in communicative contexts and its symbolic significance [109].

Author Contributions

G.V.P.: conceptualization, methodology, supervision, project administration, writing – original draft, review and editing. G.P.: investigation, resources, data collection, visualization. D.P.A.C.: data curation, software, formal analysis, visualization, writing – review and editing. G.M.: funding acquisition, conceptualization, methodology, supervision, resources, project administration, writing – review and editing.

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Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The datasets generated during the current study are available online in the Open Science Framework (OSF) Repository of the Center for Open Science, https://osf.io/rp7z5/?view_only=94f2c825c1c14b8fb0712acd1fde5d09.

References

1. B. Berlin and P. Kay, *Basic Color Terms: Their Universality and Evolution* (University of California Press, 1969).
2. P. Kay, “Universality of Color Categorization,” in *Handbook of Color Psychology*, ed. A. Elliot, M. Fairchild, and A. Franklin (Cambridge University Press, 2015), 245–258.
3. P. Kay, B. Berlin, and W. Merrifield, “Biocultural Implications of Systems of Color Naming,” *Journal of Linguistic Anthropology* 1 (1991): 12–25.
4. D. Bimler, “Are Color Categories Innate or Internalized? Hypothesis and Implications,” *Journal of Cognition and Culture* 5 (2005): 1–28.
5. D. T. Lindsey and A. M. Brown, “Color Appearance, Language, and Neural Coding,” in *The New Visual Neurosciences*, ed. J. S. Werner and L. M. Chalupa (MIT Press, 2014), 511–531.
6. D. T. Lindsey and A. M. Brown, “Lexical Color Categories,” *Annual Review of Vision Science* 7 (2021): 605–631.
7. G. V. Paramei and D. L. Bimler, “Language and Psychology,” in *A Cultural History of Color. The Modern Age: From 1920 to Present*, vol. 6, ed. A. Steinvall and S. Street (Bloomsbury, 2022), 117–134.
8. F. Ratliff, “On the Psychophysiological Bases of Universal Color Terms,” *Proceedings of the American Philosophical Society* 120 (1976): 311–330.
9. K. Jameson and R. G. D'Andrade, “It's Not Really, Red, Green, Yellow, Blue: An Inquiry Into Cognitive Color Space,” in *Color Categories in Thought and Language*, ed. C. L. Hardin and L. Maffi (Cambridge University Press, 1997), 295–319.
10. P. Kay and T. Regier, “Resolving the Question of Color Naming Universals,” *Proceedings of the National Academy of Sciences of the United States of America* 100 (2003): 9085–9089.
11. T. Regier, P. Kay, and N. Khetarpal, “Color Naming Reflects Optimal Partitions of Color Space,” *Proceedings of the National Academy of Sciences of the United States of America* 104 (2007): 1436–1441.
12. S. Yendrikhovskij, “Computing Color Categories From Statistics of Natural Images,” *Journal of Imaging Science and Technology* 45 (2001): 409–417.

13. A. Plebe and V. M. De La Cruz, "Color Seeing and Speaking. Effects of Biology, Environment and Language," in *Colour Studies: A Broad Spectrum*, ed. W. Anderson, C. P. Biggam, C. A. Hough, and C. J. Kay (John Benjamins, 2014), 291–306.
14. A. Puglisi, A. Baronchelli, and V. Loreto, "Cultural Route to the Emergence of Linguistic Categories," *Proceedings of the National Academy of Sciences of the United States of America* 105 (2008): 7936–7940.
15. A. Baronchelli, T. Gong, A. Puglisi, and V. Loreto, "Modeling the Emergence of Universality in Color Naming Patterns," *Proceedings of the National Academy of Sciences of the United States of America* 107 (2010): 2403–2407.
16. N. L. Komarova, K. A. Jameson, and L. Narens, "Evolutionary Models of Color Categorization Based on Discrimination," *Journal of Mathematical Psychology* 51 (2007): 359–382.
17. E. Gibson, R. Futrell, J. Jara-Ettinger, et al., "Color Naming Across Languages Reflects Color Use," *Proceedings of the National Academy of Sciences of the United States of America* 114 (2017): 10785–10790.
18. N. Zaslavsky, C. Kemp, N. Tishby, and T. Regier, "Color Naming Reflects Both Perceptual Structure and Communicative Need," *Topics in Cognitive Science* 11 (2019): 207–219.
19. G. V. Paramei, "Color Categorization: Patterns and Mechanisms of Evolution," in *Encyclopedia of Color Science and Technology*, 2nd ed., ed. R. Shamey (Springer, 2023), <https://doi.org/10.1007/978-3-642-27851-8>.
20. G. G. Corbett and G. Morgan, "Colour Terms in Russian: Reflections of Typological Restraints in a Single Language," *Journal of Linguistics* 24 (1988): 31–64.
21. G. V. Paramei, "Singing the Russian Blues: An Argument for Culturally Basic Color Terms," *Cross-Cultural Research* 39 (2005): 10–38.
22. J. Martinovic, G. V. Paramei, and W. J. MacInnes, "Russian Blues Reveal the Limits of Language Influencing Colour Discrimination," *Cognition* 201 (2020): 104281, <https://doi.org/10.1016/j.cognition.2020.104281>.
23. M. Jossierand, E. Meeussen, A. Majid, and D. Dediu, "Environment and Culture Shape Both the Colour Lexicon and the Genetics of Colour Perception," *Scientific Reports* 11 (2021): 19095, <https://doi.org/10.1038/s41598-021-98550-3>.
24. S. Kerttula, *English Colour Terms: Etymology, Chronology, and Relative Basicness. Mémoires de la Société Néophilologique de Helsinki*, vol. LX (Société Néophilologique, Helsinki, 2002).
25. S. Kerttula, "Relative Basicness of Color Terms: Modeling and Measurement," in *Anthropology of Color: Interdisciplinary Multilevel Modeling*, ed. R. E. MacLaury, G. V. Paramei, and D. Dedrick (John Benjamins, 2007), 151–170.
26. U. Sutrop, "List Task and a Cognitive Salience Index," *Field Methods* 13 (2001): 263–276.
27. Y. Jraissati, E. Wakui, L. Decock, and I. Douven, "Constraints on Colour Category Formation," *International Studies in the Philosophy of Science* 26 (2012): 171–196, <https://doi.org/10.1080/02698595.2012.703479>.
28. I. Douven and P. Gärdenfors, "What Are Natural Concepts? A Design Perspective," *Mind & Language* 35 (2020): 313–334.
29. N. Fider, L. Narens, K. A. Jameson, and N. L. Komarova, "Quantitative Approach for Defining Basic Color Terms and Color Category Best Exemplars," *Journal of the Optical Society of America. A, Optics, Image Science, and Vision* 34 (2017): 1285–1300.
30. N. Fider and N. L. Komarova, "Quantitative Study of Color Category Boundaries," *Journal of the Optical Society of America A, Optics, Image Science, and Vision* 35 (2018): B165–B183.
31. G. Paggetti, G. Menegaz, and G. V. Paramei, "Color Naming in Italian Language," *Color Research and Application* 41 (2016): 402–415.
32. G. V. Paramei, M. D'Orsi, and G. Menegaz, "'Italian Blues': A Challenge to the Universal Inventory of Basic Colour Terms," *Journal of the International Colour Association* 13 (2014): 27–35.
33. M. Grossmann and P. D'Achille, "Italian Colour Terms in the BLUE Area: Synchrony and Diachrony," in *Colour and Colour Naming: Crosslinguistic Approaches*, ed. J. P. Silvestre, E. Cardeira, and A. Villalva (Centro de Linguística de Universidade de Lisboa, Universidade de Aveiro, 2016), 21–50.
34. G. Paggetti, G. Bartoli, and G. Menegaz, "Re-Locating Colors in the OSA Space," *Attention, Perception, & Psychophysics* 73 (2011): 491–503.
35. G. Paggetti and G. Menegaz, "Exact Location of Consensus and Consistency Colors in the OSA-UCS for the Italian Language," *Color Research and Application* 38 (2013): 437–447.
36. D. Bimler and M. Uusküla, "Analysing Listing Data With Multidimensional Scaling to Reconstruct the Cognitive Organization of the Colour Lexicon in 11 Languages," in *Colour and Colorimetry: Multidisciplinary Contributions, Vol. X B*, ed. M. Rossi (Associazione Italiana Colore, 2014), 179–190.
37. D. Bimler and M. Uusküla, "A Similarity-Based Cross-Language Comparison of Basicness and Demarcation of 'Blue' Terms," *Color Research and Application* 42 (2017): 362–377.
38. L. Albertazzi and O. Da Pos, "Color Names, Stimulus Color, and Their Subjective Links," *Color Research and Application* 42 (2017): 89–101.
39. A. M. Kristol, "Il Colore Azzurro nei Dialecti Italiani," *Vox Romanica* 38 (1979): 85–99.
40. G. S. Philip, "Collocation and Connotation: A Corpus-Based Investigation of Colour Words in English and Italian," 2003, Unpublished PhD Thesis, University of Birmingham.
41. M. Uusküla, "Linguistic Categorization of Blue in Standard Italian," in *Colour Studies: A Broad Spectrum*, ed. W. Anderson, C. P. Biggam, C. A. Hough, and C. J. Kay (John Benjamins, 2014), 67–78.
42. D. Bimler and M. Uusküla, "'Clothed in Triple Blues': Sorting Out the Italian Blues," *Journal of the Optical Society of America A, Optics, Image Science, and Vision* 31 (2014): A332–A340.
43. M. M. Del Viva, I. Mariani, C. D. Caro, and G. V. Paramei, "Florence 'Blues' Are Clothed in Triple Basic Terms," *Perception* 13, no. 5 (2022): 20416695221124964, <https://doi.org/10.1177/20416695221124964>.
44. M. M. Del Viva, S. Castellotti, and G. V. Paramei, "The Italian Colour Lexicon in Tuscany: Elicited Lists, Cognitive Salience, and Semantic Maps of Colour Terms," *Humanities & Social Sciences Communications* 10 (2023): 900, <https://doi.org/10.1057/s41599-023-02393-4>.
45. G. V. Paramei, M. D'Orsi, and G. Menegaz, "Diatopic Variation in Referential Meaning of 'Italian Blues'," in *Progress in Colour Studies: Cognition, Language and Beyond*, ed. L. W. MacDonald, C. P. Biggam, and G. V. Paramei (John Benjamins, 2018), 83–105.
46. M. Grossmann, *Colori e Lessico: Studi Sulla Struttura Semantica Degli Aggettivi di Colore in Catalano, Castigliano, Italiano, Romeno, Latino ed Ungherese* (Gunter Narr Verlag, 1988).
47. I. L. Ronga, "L'eccezione Dell'azzurro. Il Lessico Cromatico: Fra Scienza e Società," *Cuadernos de Filología Italiana* 16 (2009): 57–79.
48. I. Ronga, C. Bazzanella, E. Strudsholm, and L. Salvati, "Black as Night or as a Chimney Sweep? Color Words and Typical Exemplars," *Intercultural Pragmatics* 11 (2014): 485–520.
49. J. L. Sandford, "A Cognitive Linguistic Usage Perspective: What Is Italian *Blu*, *Azzurro*, *Celeste*? Do English Agree on BLUE Semantics?," *Cultura e Scienza del Colore—Color Culture and Science* 4 (2015): 22–30.

50. B. Mazzone and M. Grossmann, "Analisi Semantico-Strutturale dei Termini di Colore in Italiano," in *Attes du XIII^e Congrès International de Linguistique et Philologie Romanes*, vol. 1, ed. M. Boudreault and F. Möhren (L'Université Laval, 1988), 869–890.
51. M. Grossmann and P. D'Achille, "Compound Color Terms in Italian," in *Lexicalization Patterns in Color Naming: A Cross-Linguistic Perspective*, ed. I. Raffaelli, D. Katunar, and B. Kerovec (John Benjamins, 2019), 61–79.
52. C. Viti, "Semantic Variation and Semantic Change in the Color Lexicon," *Linguistics* 63 (2025): 949–1027, <https://doi.org/10.1515/ling-2023-0161>.
53. P. D'Achille and M. Grossmann, "I Termini di Colore Nell'area AZZURRO-BLU in Italiano: Sincronia e Diacronia," *Annali Del Dipartimento Di Studi Letterari, Linguistici e Comparatei. Sezione Linguistica* 6 (2017): 109–143.
54. V. Valdegamberi, G. Paggetti, and G. Menegaz, "On the Perceptual/Linguistic Origin of the Twelfth Basic Color Term in the Italian Color Lexicon," *Cultura e Scienza del Colore—Color Culture and Science* 4 (2015): 8–13.
55. M. Uusküla and D. Bimler, "From Listing Data to Semantic Maps: Cross-Linguistic Commonalities in Cognitive Representation of Colour," *Folklore EJF* 64 (2016): 57–90, <https://doi.org/10.7592/FEJF2016.64.colour>.
56. D. Bimler and M. Uusküla, "Individual Variations in Color-Concept Space Replicate Across Languages," *Journal of the Optical Society of America A, Optics, Image Science, and Vision* 35 (2018): B184–B191.
57. G. S. Klein, "Semantic Power Measured Through the Interference of Words With Color Naming," *American Journal of Psychology* 77 (1964): 576–588.
58. L. A. Fox, R. E. Shor, and R. J. Steinman, "Semantic Gradients and Interference in Naming Color, Spatial Direction, and Numerosity," *Journal of Experimental Psychology* 91 (1971): 59–65.
59. J. R. Stroop, "Studies of Interference in Serial Verbal Reactions," *Journal of Experimental Psychology* 18 (1935): 643–662.
60. C. M. MacLeod, "Half a Century of Research on the Stroop Effect: An Integrative Review," *Psychological Bulletin* 109 (1991): 163–203.
61. C. M. MacLeod and P. A. MacDonald, "Interdimensional Interference in the Stroop Effect: Uncovering the Cognitive and Neural Anatomy of Attention," *Trends in Cognitive Sciences* 4 (2000): 383–391.
62. C. M. MacLeod, "Stroop Effect," in *Encyclopedia of Color Science and Technology*, ed. R. Luo (Springer, 2016), 1181–1186, https://doi.org/10.1007/978-3-642-27851-8_67-1.
63. R. W. Proctor, "Sources of Color-Word Interference in the Stroop Color-Naming Task," *Perception & Psychophysics* 23 (1978): 413–419.
64. T. L. Brown, "The Relationship Between Stroop Interference and Facilitation Effects: Statistical Artifacts, Baselines, and a Reassessment," *Journal of Experimental Psychology: Human Perception and Performance* 37 (2011): 85–99.
65. W. R. Glaser and M. O. Glaser, "Context Effects in Stroop-Like Word and Picture Processing," *Journal of Experimental Psychology: General* 118 (1989): 13–42.
66. J. D. Cohen, K. Dunbar, and J. L. McClelland, "On the Control of Automatic Processes: A Parallel Distributed Processing Account of the Stroop Effect," *Psychological Review* 97 (1990): 332–361.
67. M. O. Glaser and W. R. Glaser, "Time Course Analysis of the Stroop Phenomenon," *Journal of Experimental Psychology: Human Perception and Performance* 8 (1982): 875–894.
68. E. L. Coderre, W. J. B. van Heuven, and K. Conklin, "The Timing and Magnitude of Stroop Interference and Facilitation in Monolinguals and Bilinguals," *Bilingualism: Language and Cognition* 16 (2013): 420–441.
69. A. Roelofs, "Attention and Facilitation: Converging Information Versus Inadvertent Reading in Stroop Task Performance," *Journal of Experimental Psychology: Learning, Memory, and Cognition* 36 (2010): 411–422.
70. R. Venturini, M. Lombardo Radice, and M. G. Imperiali, *II "Color-Word Test" o Test di Stroop* (Organizzazioni Speciali, 1983).
71. M. P. Amato, E. Portaccio, B. Goretti, et al., "The Rao's Brief Repeatable Battery and Stroop Test: Normative Values With Age, Education and Gender Corrections in an Italian Population," *Multiple Sclerosis Journal* 12 (2006): 787–793.
72. S. Valgimigli, R. Padovani, C. Budriesi, M. E. Leone, D. Lugli, and P. Nichelli, "Test di Stroop: Dati Normativi Italiani di una Versione Cartacea per l'uso Clinico," *Giornale Italiano di Psicologia* 37 (2010): 945–953.
73. A. Brugnolo, F. De Carli, J. Accardo, et al., "An Updated Italian Normative Dataset for the Stroop Color Word Test (SCWT)," *Neurological Sciences* 37 (2016): 365–372.
74. R. Barbarotto, M. Laiacona, R. Frosio, M. Vecchio, A. Farinato, and E. Capitani, "A Normative Study on Visual Reaction Times and Two Stroop Colour-Word Tests," *Neurological Sciences* 19 (1998): 161–170.
75. F. Scarpina and S. Tagini, "The Stroop Color and Word Test," *Frontiers in Psychology* 8 (2017): 557, <https://doi.org/10.3389/fpsyg.2017.00557>.
76. C. Simoncelli, P. Gréa, and M. Kihlstedt, "From Color Naming to Color Perception: Cross-Linguistic Differences of the Chromatic Information Processing in Monolingual and Bilingual Speakers," *Color Research and Application* 50 (2025): 98–118.
77. G. Paggetti and G. Menegaz, "Is Light Blue (Azzurro) Color Name Universal in the Italian Language?," in *ECCV 2010 Workshops, Part II, Color and Reflectance in Imaging and Computer Vision Workshop*, ed. K. N. Kutulakos (Springer, 2012), 90–103.
78. G. D. Logan and N. J. Zbrodoff, "When It Helps To Be Misled: Facilitative Effects of Increasing the Frequency of Conflicting Stimuli in a Stroop-Like Task," *Memory & Cognition* 7 (1979): 166–174.
79. F. N. Dyer, "Color-Naming Interference in Monolinguals and Bilinguals," *Journal of Verbal Learning and Verbal Behavior* 10 (1971): 297–302.
80. E. Dalrymple-Alford, "Associative Facilitation and Interference in the Stroop Color-Word Task," *Perception & Psychophysics* 11 (1972): 274–276.
81. L. Ziaka, D. Skoteinou, and A. Protopapas, "Task Format Modulates the Relationship Between Reading Ability and Stroop Interference," *Journal of Experimental Psychology: Human Perception and Performance* 48 (2022): 275–288.
82. D. Sharma and F. P. McKenna, "Differential Components of the Manual and Vocal Stroop Tasks," *Memory and Cognition* 26 (1998): 1033–1040.
83. Y. Levin and J. Tzelgov, "What Klein's "Semantic Gradient" Does and Does Not Really Show: Decomposing Stroop Interference Into Task and Informational Conflict Components," *Frontiers in Psychology* 7 (2016): 249, <https://doi.org/10.3389/fpsyg.2016.00249>.
84. W. T. Neill and R. L. Westberry, "Selective Attention and the Suppression of Cognitive Noise," *Journal of Experimental Psychology: Learning, Memory, and Cognition* 13 (1987): 327–334.
85. M. Augustinova, L. Silvert, N. Spatola, and L. Ferrand, "Further Investigation of Distinct Components of Stroop Interference and of Their Reduction by Short Response-Stimulus Intervals," *Acta Psychologica* 189 (2018): 54–62.

86. R. Ratcliff, "Methods for Dealing With Reaction Time Outliers," *Psychological Bulletin* 114 (1993): 510–532.
87. J. P. Simmons, L. D. Nelson, and U. Simonsohn, "False-Positive Psychology: Undisclosed Flexibility in Data Collection and Analysis Allows Presenting Anything as Significant," *Psychological Science* 22 (2011): 1359–1366.
88. M. G. Heckman, J. M. Davis, and C. S. Crowson, "Post Hoc Power Calculations: An Inappropriate Method for Interpreting the Findings of a Research Study," *Journal of Rheumatology* 49 (2022): 867–870.
89. A. E. Kazak, "Editorial: Journal Article Reporting Standards," *American Psychologist* 73 (2018): 1–2.
90. R Core Team, *R: A Language and Environment for Statistical Computing* (R Foundation for Statistical Computing, 2022), <https://www.R-project.org/>.
91. H. Wickham, *ggplot2: Elegant Graphics for Data Analysis* (Springer, 2016).
92. R. M. Boynton and C. X. Olson, "Salience of Chromatic Basic Color Terms Confirmed by Three Measures," *Vision Research* 30 (1990): 1311–1317.
93. S. Monsell, T. J. Taylor, and K. Murphy, "Naming the Color of a Word: Is It Responses or Task Sets That Compete?," *Memory and Cognition* 29 (2001): 137–151.
94. J. S. K. Nedergaard, M. Wallentin, and G. Lupyan, "Verbal Interference Paradigms: A Systematic Review Investigating the Role of Language in Cognition," *Psychonomic Bulletin & Review* 30 (2023): 464–488.
95. M. J. Kane and R. W. Engle, "Working-Memory Capacity and the Control of Attention: The Contributions of Goal Neglect, Response Competition, and Task Set to Stroop Interference," *Journal of Experimental Psychology: General* 132 (2003): 47–70.
96. O. Entel, J. Tzelgov, Y. Bereby-Meyer, and N. Shahar, "Exploring Relations Between Task Conflict and Informational Conflict in the Stroop Task," *Psychological Research* 79 (2015): 913–927.
97. G. V. Paramei, Y. A. Griber, and D. Mylonas, "An Online Color Naming Experiment in Russian Using Munsell Color Samples," *Color Research and Application* 43 (2018): 358–374.
98. K. Uchikawa and R. M. Boynton, "Categorical Color Perception of Japanese Observers: Comparison With That of Americans," *Vision Research* 27 (1987): 1825–1833.
99. R. W. Langacker, *Cognitive Grammar: A Basic Introduction* (Oxford University Press, 2008).
100. H.-J. Schmid, "A Framework for Understanding Linguistic Entrenchment and Its Psychological Foundations," in *Entrenchment and the Psychology of Language Learning: How we Reorganize and Adapt Linguistic Knowledge*, ed. H.-J. Schmid (De Gruyter Mouton, 2017), 9–36.
101. C. Simoncelli and M. Kihlstedt, "Lexical Color Categories in Balanced Proficient Bilinguals: The Case of Blue," *Bilingualism: Language and Cognition* (2025), <https://doi.org/10.1017/S1366728925100710>.
102. P. D'Achille and M. Grossmann, "I Composti <Colorati> in Italiano tra Passato e Presente," in *Actas del XXVI Congreso Internacional de Lingüística y de Filología Románicas III*, ed. E. Casanova Herrero and C. Calvo Rigual (De Gruyter, 2013), 523–537.
103. I. R. L. Davies, G. G. Corbett, G. Laws, H. McGurk, A. E. S. G. Moss, and M. W. Smith, "Linguistic Basicness and Colour Information Processing," *International Journal of Psychology* 26 (1991): 311–327.
104. G. Frison and G. Brun, "Lapis Lazuli, Lazurite, Ultramarine 'Blue', and the Colour Term 'Azure' up to the 13th Century," *Journal of the International Color Association* 16 (2016): 41–55.
105. M. Uusküla, "Blue in Italian: Usage and Meaning of *Blu*, *Azzurro*, and *Celeste* in Dictionaries, the Dialect Atlas, and Linguistic Research up to 1990s," in *Color and Other Constructions. Writings for Jodi L. Sandford*, ed. M. Bagli (Edizioni dall'Orso, 2025), 271–286.
106. A. Giacalone Ramat, "Colori Germanici nel Mondo Romano," in *Atti e Memorie dell'Accademia Toscana di Scienze e Lettere La Colombaria*, vol. 32 (Leo S. Olschki, 1967), 105–212.
107. M. Pastoreau, *Blue: The History of a Color* (Princeton University Press, 2001), 62–63.
108. A. Dardi, *Dalla Provincia all'Europa: L'infusso Dell Francese Sull'italiano tra il 1650 e il 1715* (Le Lettere, 1992).
109. E. Wnuk, A. Verkerk, S. C. Levinson, and A. Majid, "Color Technology Is Not Necessary for Rich and Efficient Color Language," *Cognition* 229 (2022): 105223, <https://doi.org/10.1016/j.cognition.2022.105223>.

Supporting Information

Additional supporting information can be found online in the Supporting Information Section "Details of the Design". **Table S1:** Experiments 1–3. Control condition: Mean(SE) of RTs (ms) of naming ink color of "X" strings. **Table S2:** Experiment 1. Stroop condition: Mean(SE) of RTs (ms) of naming six ink colors of four color words. Critical combinations of the word BLU rendered in dark and light blue ink are in bold; congruent combinations are gray-shaded. **Table S3:** Experiment 2. Stroop condition: Mean(SE) of RTs (ms) of naming six ink colors of six color words. Critical combinations of the words BLU and AZZURRO rendered in dark and light blue ink are in bold; congruent combinations are gray-shaded. **Table S4:** Experiment 3. Stroop condition: Mean(SE) of RTs (ms) of naming six ink colors of four color words. Critical combinations of the word VERDE in dark and light green ink are in bold; congruent combinations are gray-shaded. **Table S5:** Overview of the processing speed in Stroop conditions in the "blue series" (Experiments 1–2): Mean(SE) of RTs (ms) of naming ink color of the 'blue' word(s), BLU and AZZURRO, rendered in dark and light blue ink. For comparison, shown are RTs of naming ink color in the control condition, "X" strings, as well as of the word VERDE 'green' rendered in dark and light green ink (Experiment 3, "green series"), and 'red' words, ROSSO and ROSA, rendered in red and pink ink (Experiments 1–3). **Figure S1:** Experiment 1. Stroop condition: Mean RTs (ms) of naming ink color for each of the four color words in the congruent and aggregated incongruent combinations. Error bars indicate standard error. **Figure S2:** Experiment 2. Stroop condition: Mean RTs (ms) of naming ink color for each of the six color words in the congruent and aggregated incongruent combinations. Error bars indicate standard error. **Figure S3:** Experiment 3. Stroop condition: Mean RTs (ms) for each of the four color words in the congruent and aggregated incongruent combinations. Error bars indicate standard error.