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Uusküla, M., Mohr, C., Epicoco, D., & Jonauskaite, D. (2023). Is Purple Lost in Translation? The Affective Meaning of Purple, Violet, and Lilac Cognates in 16 Languages and 30 Populations. *Journal of Psycholinguistic Research*, *52*(3), 853–868. https://doi.org/10.1007/s10936-022-09920-5

This article has been published in final form at https://doi.org/10.1007/s10936-022-09920-5.

Is purple lost in translation? The affective meaning of *purple*, *violet*, and *lilac* cognates in 16 languages and 30 populations

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Acknowledgments: This research was supported by the Swiss National Science Foundation, providing a Doc.CH and Postdoc.Mobility fellowship grants to DJ (P0LAP1_175055; P500PS_202956) and a project funding grant to CM (100014_182138), supporting DE's doctoral studies. We would like to thank collaborators of the International Colour-Emotion Association Survey who contributed to translations and data collection (also see them listed as co-authors in Jonauskaite et al., 2020, *Psychological Science*). We provide data in open access on OSF: https://osf.io/ea98m/ We have no competing interests to declare that are relevant to the content of this article.

Author contributions:
All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by Déborah Epicoco and Domicele Jonauskaite. The first draft of the manuscript was written by Mari Uusküla, Christine Mohr, and Domicele Jonauskaite, and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Abstract

Colour-emotion association data show a universal consistency in colour-emotion associations, apart from PURPLE. Possibly, its heterogeneity was due to different cognates used as basic colour terms between languages. We analysed emotion associations with PURPLE across 30 populations, 28 countries, and 16 languages (4,008 participants in total). Crucially, these languages used *purple*, *lilac*, or *violet* to denote the basic PURPLE category. We found small but systematic affective differences between these cognates. They were ordered as *purple* > *lilac* > *violet* on valence, arousal, and power biases. Statistically, the cognate *purple* was the most strongly biased towards positivity, and *lilac* was biased more strongly than *violet*. *Purple* was more biased towards high power emotions than *violet*, but cognates did not differ on arousal biases. Additionally, affective biases differed by population, suggesting high variability within each cognate. Thus, cognates partly account for inconsistencies in the meaning of PURPLE, without explaining their origins.

1. Introduction

"*All the other colours are just colours, but purple seems to have a soul – when you look at it, it's looking back at you*" Uniek Swain

Words are used to convey meaning so that individuals can communicate about concrete and abstract entities. If we want to tell a friend that we have just acquired a car, a house, or a dog, we can tell them using words instead of bringing the actual objects. In an ideal case, words within a given society and language unequivocally refer to the same entity, and they have the same meaning when translated. It should not matter if I acquired *a dog*, *ein Hund* (German), or *un chien* (French). In no instance should one be surprised when their friend brings along his or her new dog after speaking about the dog.

Certain entities of information are more easily conveyed than others via clearly defined words. Colour is a particularly interesting case. From a perceptual point of view, colour is a continuous three-dimensional entity, which can be described in terms of hue, saturation, and lightness (Witzel, 2019). This continuous entity is parsed into colour categories (abstract concepts) and named with colour terms. While most modern languages have at least 11 basic colour terms (Berlin & Kay, 1969; Kay et al., 2009), there is no guarantee that these terms have identical conceptual meaning. In fact, a recent study reported variability in conceptual meaning of colour terms across 2,474 spoken languages (Jackson et al., 2019). Furthermore, this variability might be larger for some colour categories than others. A particularly interesting case is PURPLE, a colour perceptually falling between RED and BLUE. While agreement on focal colours (i.e., the best examples) is high for most colour categories, there is substantial variability in focal colours of PURPLE both within (Berlin & Kay, 1969; Lindsey & Brown, 2014; Sturges & Whitfield, 1995) and between languages (Uusküla & Bimler, 2016a).

This variability in focal colours might suggest that PURPLE has not fully emerged as a basic colour category, as its meaning might be less well established than that of the other colour categories (e.g., see (Uusküla, 2007) for Finnish). Findings on colour-emotion associations are further supporting this possibility because these associations are particularly heterogenous for PURPLE. Jonauskaite, Abu-Akel, and colleagues (2020) assessed emotion associations with basic colour terms in 30 nations and 24 languages. Results showed fairly consistent cross-cultural associations with all colour terms but PURPLE (also see, (Hupka et al., 1997; Jonauskaite, Wicker, et al., 2019). Similarly, French speakers in Switzerland showed little agreement on which emotions should be associated with PURPLE, whether presented as a term or a patch, in contrast to the remaining colour terms (Jonauskaite et al., 2021; Jonauskaite, Parraga, et al., 2020).

We consider it a possibility that inconsistencies for PURPLE might originate from different lexical cognates used between languages, that is, words that are phonologically and/or orthographically similar and most probably have a common etymological origin. Most European languages refer to PURPLE using the cognate of *purple*, *violet*, or *lilac*. To give some examples, in English, the established basic colour term for the PURPLE category is *purple* (Berlin & Kay, 1969; Lindsey & Brown, 2014), while in Bulgarian it is *пурпурен,* a cognate of purple (Scatton, 2002). In the Romance group of the Indo-European language family, the established basic colour term for the PURPLE category is a cognate of violet: *violet* in French

(Forbes, 2006), *viola* in Italian (Uusküla, 2014), and *violeta* in Spanish (although, the term *morado* is also popular; (Lillo et al., 2018). In the Baltic group, Lithuanian and Latvian both use a cognate of *violet* – *violetinė* in Lithuanian (Uusküla & Bimler, 2016b) and *violeta* in Latvian (Uusküla & Bimler, 2016b). The Germanic group of languages uses a cognate of lilac: *lila* in German, Swedish, and Danish except from Dutch, which uses *paars,* a term unrelated to purple, lilac, or violet (Majid et al., 2015; Vejdemo, 2017). Finally, the same cognates also appear in the Uralic languages, spoken in Europe: *lilla* in Estonian and *violetti* in Finnish (Uusküla et al., 2012).

We tested emotion associations with PURPLE as a function of different cognates. To this end, we extracted data from the ongoing International Colour-Emotion Association Survey (Jonauskaite, Abu-Akel, et al., 2020; Mohr et al., 2018) and selected 16 languages that have obvious etymological cognates of *purple* (two languages), *violet* (nine languages), and *lilac* (five languages), resulting in over 4,000 participants from 30 populations (28 countries, with Swiss participants separated in three language groups). In this ongoing survey, participants see 12 colour terms, and associate those with 20 possible emotion concepts. For simplicity, we have grouped these emotion concepts according to the underlying affective dimensions (Fontaine et al., 2007; Jonauskaite, Parraga, et al., 2020). The dimensions were valence (positive-negative), arousal (arousing-calming), and power (high power – low power).

We compared the affective dimensions between the three cognate groups as well as across 30 populations. In case differences arose by cognate, we analysed the data by population too, to get a more fine-grained insight into cultural differences. Historically, in ancient times, PURPLE was a symbol of status, royalty, and wealth simply because of preciousness and scarcity of the purple die produced from murex shells (Wharton, 2020). In medieval Christian Europe, purple was used for semi-mourning and considered similar to black, which itself was used for full mourning (Pastoureau, 2012). Thus, if these historical meanings continue to be true today, we expected PURPLE to be associated with negative and high-power emotions. All in all, we could test whether a cognate or a population would explain the inconsistent emotion associations with PURPLE, and in which way.

2. Method

2.1. Participants

We extracted data from 4,008 participants (921 men, 21 did not want to report their gender) from the ongoing International Colour-Emotion Association Survey. Most of these data have been published in a previous investigation of colour-emotion associations (Jonauskaite, Abu-Akel, et al., 2020) and are publicly accessible (accessed here: https://forsbase.unil.ch/project/study-public-overview/16941/0/). Participation was voluntary. The study was conducted in accordance with the principles expressed in the Declaration of Helsinki (World Medical Association, 2013). We received ethics approval from the Research Ethics Commission of the University of Lausanne (C_SSP_032020_00003).

Participants had a mean age of 28.5 years (*SD* = 8.9 years; range 16 to 49 years). The data had been pre-filtered according to self-reported colour blindness and survey completion time, in line with previous studies. Table 1 displays relevant demographic and cognate information per

studied population. Participants completed the International Colour-Emotion Survey online in their native language with two notable exceptions. Participants from Nigeria and Kenya completed the survey in English (national language) but would, respectively, also speak at least one of their native African languages of Igbo, Swahili and/or Luo. In line with their colonial past, these participants were fluent in English. On average, they rated their language fluency at 7.32, out of a maximum score of 8.

Table 1. Demographic and cognate information of the 30 studied populations.
Note that 21 participants (0.52%) across all populations chose not to report their gender.

Country of origin	Language	Cognate	Actual colour term	*N*	Gender		Age	
					% men	% women	*Mean*	*SD*
Australia (AU)	English	Purple	*Purple*	55	23.64	76.36	29.87	9.17
Bulgaria (BG)	Bulgarian	Purple	*Пурпурен*	57	29.82	70.18	36.30	5.65
Kenya (KE)	English	Purple	*Purple*	43	39.53	58.14	28.35	6.46
New Zealand (NZ)	English	Purple	*Purple*	163	23.93	74.85	23.04	6.28
Nigeria (NG)	English	Purple	*Purple*	71	38.03	61.97	32.27	6.46
Philippines (PH)	English	Purple	*Purple*	46	28.26	67.39	24.28	7.80
United Kingdom (GB)	English	Purple	*Purple*	144	27.78	72.22	32.67	9.63
USA (US)	English	Purple	*Purple*	219	26.94	72.60	26.74	9.78
Austria (AT)	German	Lilac	*Lila*	84	7.14	91.67	29.64	9.09
Denmark (DK)	Danish	Lilac	*Lila*	57	19.30	80.70	24.07	6.31
Estonia (EE)	Estonian	Lilac	*Lilla*	227	9.69	90.31	35.20	7.72
Germany (DE)	German	Lilac	*Lila*	312	17.31	82.37	28.83	8.26
Norway (NO)	Norwegian (Bokmål)	Lilac	*Lila*	262	14.89	84.35	31.64	8.92
Sweden (SE)	Swedish	Lilac	*Lila*	217	15.67	83.87	30.41	7.80
Switzerland (CH)	German	Lilac	*Lila*	62	19.35	80.65	25.15	6.58
Argentina (AR)	Spanish	Violet	*Violeta*	63	33.33	65.08	32.97	9.64
Colombia (CO)	Spanish	Violet	*Violeta*	80	45.00	55.00	28.55	8.39
Finland (FI)	Finnish	Violet	*Violetti*	119	9.24	89.08	27.55	7.22
France (FR)	French	Violet	*Violet*	114	26.32	72.81	29.43	9.69
Italy (IT)	Italian	Violet	*Viola*	93	30.11	69.89	30.63	9.36
Latvia (LV)	Latvian	Violet	*Violeta*	129	15.50	82.95	32.95	8.99
Lithuania (LT)	Lithuanian	Violet	*Violetinė*	147	15.65	84.35	31.72	10.33
Mexico (MX)	Spanish	Violet	*Violeta*	231	31.17	68.40	27.53	9.56
Poland (PL)	Polish	Violet	*Fioletowy*	156	20.51	79.49	26.49	7.24
Romania (RO)	Romanian	Violet	*Violet*	51	21.57	78.43	23.65	5.45

Russia (RU)	Russian	Violet	*Фиолетовый*	99	35.35	64.65	27.72	9.91
Spain (ES)	Spanish	Violet	*Violeta*	136	22.79	76.47	29.30	8.58
Switzerland (CH)	French	Violet	*Violet*	485	27.63	71.96	22.48	5.14
Switzerland (CH)	Italian	Violet	*Viola*	43	34.88	65.12	24.79	4.84
Uzbekistan (UZ)	Russian	Violet	*Фиолетовый*	43	44.19	55.81	24.91	5.40

2.2. Translation of PURPLE

As detailed in a previous study (Jonauskaite, Abu-Akel, et al., 2020) two bilingual speakers translated the survey into their respective language. One bilingual speaker translated the text, including the colour terms, from the original language (usually English) into the target language. The second bilingual speaker verified the translation. Thus, these two translators chose the basic colour terms, and when possible, we verified that these terms were basic according to the published literature (Forbes, 2006; Lindsey & Brown, 2014; Majid et al., 2015; Scatton, 2002; Uusküla, 2014; Uusküla et al., 2012; Uusküla & Bimler, 2016b; Vejdemo, 2017; Vejdemo et al., 2015). We encountered no disagreement when translating PURPLE (see Table 1 for the translations into 16 languages we tested).

2.3. Geneva Emotion Wheel

The Geneva Emotion Wheel (GEW version 3.0; Scherer, 2005; Scherer et al., 2013) is a self-report measure to assess the subjective feeling component of emotions. There are 20 emotion concepts, presented in a circular format (Figure 1). Relevant to the current study, these emotion concepts can be grouped by their underlying affective dimensions into valence, arousal, and power (see Table 2, Fontaine et al., 2007).

We decided on the affective loadings of the emotion terms according to the results of the GRID study, which collected data from 34 populations coming from 27 countries, speaking 28 languages (Fontaine et al., 2007, 2013; Soriano et al., 2013). In the GRID study, each participant rated four randomly selected emotion terms on 144 emotion features. For example, participants would rate how likely a member of their cultural group would be "smiling" if they said they felt "joy". Affective dimensions were extracted from aggregated ratings across participants. The GRID and our study share 10 languages – French, Italian, Spanish, English, German, Bulgarian, Polish, Russian, Estonian, and Finnish, which ensures that the affective loadings are valid. We additionally tested participants speaking Lithuanian, Latvian, Norwegian, Swedish, Danish, and Romanian.

Collaborators of the International Colour-Emotion Associations Survey translated and back-translated the GEW into 46 languages (see the Acknowledgment list in (Jonauskaite, Abu-Akel, et al., 2020), see https://www.colourexperience.ch/collaborations for the most recent list of collaborators). We present GEW emotion terms for our 16 relevant languages in Table S 1 and Table S 2. Our participants indicated the emotions and their intensities for 12 colour terms (see also, Jonauskaite, Abu-Akel, et al., 2020). Here, we analysed only emotions associated with PURPLE.

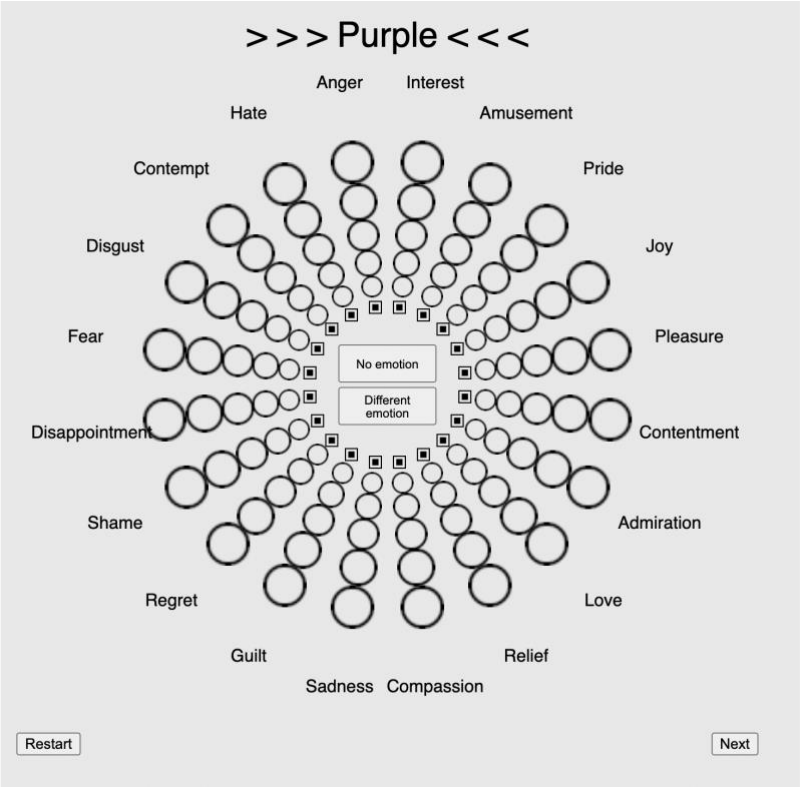


Figure 1. Geneva Emotion Wheel (GEW).
We used the GEW to assess associations between colour terms, including PURPLE, and emotion concepts. All participants completed the survey in their native language (there were 16 languages in the current study; see Table S 1 and Table S 2). The GEW was adapted from Scherer et al. (2013).

Table 2. Emotions, their affective loadings, and associations with the cognates of the category PURPLE.

The first column shows the 20 GEW emotion concepts, and the next three columns show their categorisations in terms of valence, arousal, and power (see Jonauskaite, Parraga, et al., 2020, for further details). The following columns show associations. Each cell indicates the percentage of participants who associated each emotion concept with the category PURPLE, separated by cognate, after controlling for uneven sample sizes across the 30 populations. In bold, we highlight associations endorsed by at least 20% of participants. We remind the reader that several emotions could be chosen for PURPLE.

	Affective dimensions			Associations with			
Emotion	Valence	Arousal	Power	Purple	Lilac	Violet	All cognates together
Interest	Positive	Low	Strong	**23.69**	**24.57**	**22.22**	**23.16**
Amusement	Positive	High	Strong	**34.06**	**26.05**	**20.24**	**25.28**
Pride	Positive	Low	Strong	**40.37**	**23.39**	**24.85**	**28.65**
Joy	Positive	High	Strong	**22.64**	**22.43**	16.87	19.71
Pleasure	Positive	High	Strong	**33.97**	**28.59**	**20.79**	**26.12**
Contentment	Positive	Low	Weak	**23.10**	**24.22**	17.71	**20.66**
Admiration	Positive	High	Weak	**20.58**	**21.72**	16.08	18.60
Love	Positive	High	Weak	**20.94**	18.48	13.86	16.83
Relief	Positive	Low	Weak	14.95	12.31	13.30	13.51
Compassion	Positive	Low	Weak	**20.53**	**20.26**	17.18	18.79
Sadness	Negative	Low	Weak	12.88	13.90	**20.59**	16.98
Guilt	Negative	High	Weak	9.29	9.81	18.75	14.14
Regret	Negative	Low	Weak	9.92	11.76	19.79	15.28
Shame	Negative	High	Weak	8.44	10.62	16.59	13.03
Disappointment	Negative	Low	Weak	8.04	9.96	17.62	13.28
Fear	Negative	High	Strong	8.11	6.84	15.54	11.53
Disgust	Negative	Low	Strong	7.36	7.20	9.72	8.50
Contempt	Negative	Low	Strong	7.20	11.60	14.56	11.91
Hate	Negative	High	Strong	5.35	5.66	9.38	7.44
Anger	Negative	High	Strong	7.34	6.64	11.97	9.49

2.4. Procedure of the International Colour-Emotion Association Survey

Participants completed the online survey in their native language (http://www2.unil.ch/onlinepsylab/colour/main.php; see Jonauskaite, Abu-Akel, et al., 2020) for a detailed description of the translation procedure. The survey started by stating its main goal, providing ethical information (i.e., participation is anonymous and strictly confidential, responses are to be used for research purposes and its dissemination, participants can stop the survey at any time with no consequences) and collecting informed consent. Participants consented to participation by clicking on the "Let's go" button. We explained the task and the GEW in the following pages. After checking that participants understood the task, participants were presented with 12 colour terms, including purple, above the GEW in a randomised order. They had to associate the GEW emotion concepts with the given colour terms. Participants could select one, several, or none of the GEW emotions as well as indicate a different emotion. They also evaluated emotion intensities by choosing circles of increasing size on the GEW, but we did not analyse them in this study.

After associating the 12 colour terms with emotion concepts, participants reported their demographic information: age, gender, colour vision impairments ("Do you have any trouble seeing certain colours?"), colour importance in their life, country of origin and country of residence ("What is your country of residence? The most recent country you have been living in for at least 2 years"), native language, and fluency of the language in which they completed the survey. A "do not want to answer" option was available for all questions. On the final page, participants were thanked and graphically presented with the results from a previous, related study. Participants were further able to contact us via an e-mail address. On average, our participants took 12.9 minutes to complete the survey.

2.5. Bias calculations

We calculated the valence bias in the following way. First, we counted the number of emotions (n_{total}) that each participant associated with PURPLE. Then, we calculated the number of positive ($n_{positive}$) and negative ($n_{negative}$) emotions, according to the previous grouping method (Jonauskaite et al., 2021; Jonauskaite, Parraga, et al., 2020); see Figure 1). Finally, we subtracted the number of negative emotions from positive emotions and divided the difference by the total number of associated emotions. Formally, the calculation can be described as such,

$$\text{Valence bias} = (n_{positive} - n_{negative})/\ n_{total}$$

There are 20 emotions in the GEW, without considering additional emotions mentioned by the participants. Ten emotions are positive and ten are negative. Hence, the valence bias varies from -1 to 1. The extreme negative bias (-1) indicates that a participant associated only negative emotions with PURPLE while the extreme positive bias (1) indicates that a participant associated only positive emotions.

In analogy, we calculated arousal and power biases, by exchanging positive and negative emotions, with high and low arousal, and high and low power emotions, respectively. Formally, the calculation can be described as such,

$$\text{Arousal bias} = (n_{\text{high arousal}} - n_{\text{low arousal}})/\ n_{\text{total}}$$

$$\text{Power bias} = (n_{\text{high power}} - n_{\text{low power}})/\ n_{\text{total}}$$

Arousal bias varied from -1 and 1, respectively indicating that a participant chose only low arousing or high arousing emotions for PURPLE. Power bias varied from -1 and 1, respectively indicating that a participant chose only low power or high power emotions for PURPLE[1].

2.6. Data analysis

To compare emotion associations across the three cognates, we performed a multiple analysis of variance (MANOVA). We grouped participants' responses according to the cognate that their native language uses to denote PURPLE – *purple*, *violet*, or *lilac* (see Table 1). The predictor variable was cognate (three levels: *purple*, *violet*, or *lilac*) and the outcome variables were the three biases (valence, arousal, and power biases). Significant results were interpreted using simple linear regressions per predictor. When significant, we further interpreted the effects with Welsh-s two samples *t*-tests, and Cohen's *d* values as indicators of the effect size. We interpreted Cohen's *d* values according to norms: |d| < 0.147 – "negligible", |d| < .330 – "small", |d| < .474 – "medium", and |d| ≥ .474 – "large" (Cohen, 1988). With large sample sizes like ours, effect sizes are more informative than significance levels, because the latter is affected by the sample size. Furthermore, we ran Welsh-s one sample *t*-tests and calculated Cohen's *d* values to establish whether the cognates were overall biased by comparing each bias index to 0 (i.e., no bias).

In case affective meaning differed by cognate, to further understand these differences, we performed an analogue multilevel linear regression, with population (*n* = 30) as a predictor variable (see Table 1). When the model was significant, we interpreted biases with one-sample t-tests comparing the index to 0. We provide data in open access on OSF: https://osf.io/ea98m/

3. Results

In Table 2, we display percentages of participants who associated each emotion concept with PURPLE overall, and as a function of cognate. We observed that associations endorsed by at least 20% of participants were mostly with positive emotion concepts (*interest*, *amusement, pride, pleasure, contentment*). The only negative concept frequently associated with PURPLE was *sadness*. The association between the *purple* cognate and *pride* (40.3%) had numerically the highest agreement (23.4% for the cognate *lilac* and 24.9% for the cognate *violet*). The next most prominent associations were again for the cognate *purple,* namely with *amusement*

[1] We followed a reviewer suggestion by calculating an alternative bias score, which weighs the average number of associated emotions by intensity. For valence, we calculated the valence intensity bias = average $\text{intensity}_{\text{positive}}$ – average $\text{intensity}_{\text{negative.}}$ We calculated analogue intensity biases for arousal and power scores. Repeating the statistical analyses with these alternative intensity bias scores, we obtained comparable results to those with our initial intensity bias scores. We report results on these initial scores to facilitate comparability between studies (Jonauskaite, Parraga, et al., 2020; Jonauskaite, Camenzind, et al., 2021). We provide the alternative intensity bias scores in our data file in open access: https://osf.io/ea98m/

(34.1%) and *pleasure* (34.0%). The other associations were endorsed by fewer than 30% of participants.

The MANOVA test with cognate as a predictor variable was overall significant; Pillai's Trace value = 0.049, $F(6, 8008) = 33.78$, $p < .001$. The separate ANOVA tests showed that cognate was a significant predictor of valence bias, $F(2, 4005) = 103.5$, $p < .001$, $R^2_{adj} = .049$, and power bias, $F(2, 4005) = 4.64$, $p = .010$, $R^2_{adj} = .002$, but not arousal bias, $F(2, 4005) = 2.23$, $p = .108$, $R^2_{adj} < .001$ (Figure 2). In all cases, the model explained a small amount of variance (between 0.1% and 4.9%).

For valence bias, Welsh's two samples *t*-tests showed that emotions associated with the cognate *purple* were more positively biased than those with the cognate *violet*, $t(1807.9) = 14.6$, $p < .001$, Cohen's $d = 0.560$ (medium effect), and *lilac*, $t(1824.7) = 5.95$, $p < .001$, Cohen's $d = 0.265$ (small effect). Emotions associated with the cognate *lilac* were also more positively biased than those with the cognate *violet*, $t(2797.5) = 8.90$, $p < .001$, Cohen's $d = 0.315$ (small effect). When compared to zero (no bias), all cognates were significantly biased towards positivity, with *purple* and *lilac* cognates showing large effect sizes while *violet* showed a small bias: *purple*, $t(797) = 24.61$, $p < .001$, Cohen's $d = 0.871$; *lilac*, $t(1220) = 18.51$, $p < .001$, Cohen's $d = 0.530$; *violet*, $t(1988) = 7.64$, $p < .001$, Cohen's $d = 0.171$ (Figure 2).

For arousal, as expected, Welsh's two samples *t*-tests did not show any significant comparisons between cognates, $p's \geq .073$, Cohen's $|d's| \leq .072$. When compared to zero, the cognate *violet* was significantly biased towards emotion concepts of low arousal, $t(1988) = -4.77$, $p < .001$, Cohen's $d = -0.107$ (negligible effect). No other comparisons were significant, $p's \geq .088$, Cohen's $|d's| \leq 0.049$ (Figure 2).

For power bias, Welsh's two samples *t*-tests showed that the cognate *purple* was more strongly biased towards high power emotion concepts than the cognate *violet*, $t(1623.5) = 3.09$, $p = .002$, Cohen's $d = 0.124$ (negligible effect). No other comparisons were significant, $p's \geq .099$, Cohen's $|d's| \leq 0.060$. Comparisons to zero indicated that the cognate *purple* was significantly biased towards high power emotion concepts, $t(797) = 3.25$, $p = .001$, Cohen's $d = 0.115$ (negligible effect). No other comparisons were significant, $p's \geq .131$, Cohen's $|d's| \leq 0.043$ (Figure 2).

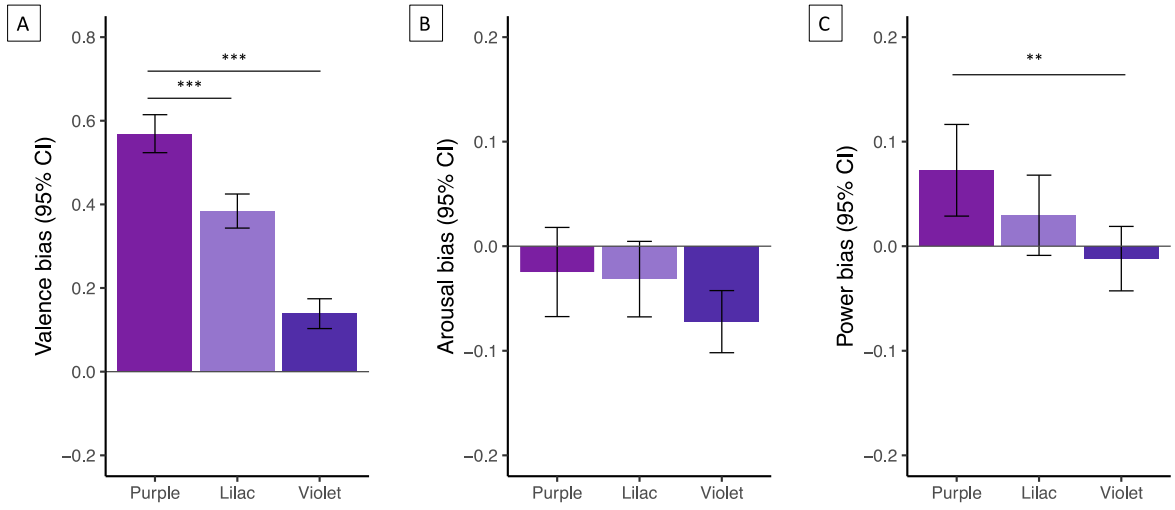
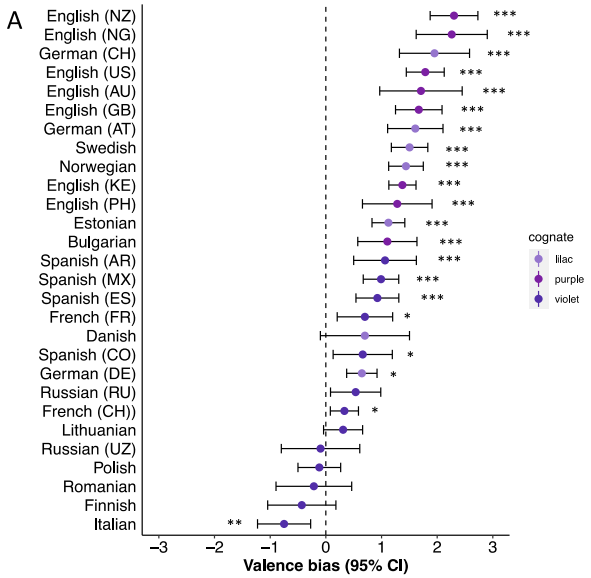


Figure 2. Valence (A), arousal (B), and power (C) biases of the three cognates.
Error bars indicate 95% confidence intervals of the means. Zero marks no bias; when error bars do not cross zero, the biases can be interpreted as significantly different from zero. ** < .010, *** < .001

The MANOVA test with population as a predictor variable showed overall a significant effect; Pillai's Trace value = 0.126, $F(87, 11934) = 6.03$, $p < .001$ (Figure 3). Population was a significant predictor of each of the biases separately: valence bias, $F(29, 3978) = 12.97$, $p < .001$, $R^2_{adj} = .080$; arousal bias, $F(29, 3978) = 3.47$, $p < .001$, $R^2_{adj} = .018$; and power bias, $F(29, 3978) = 2.93$, $p < .001$, $R^2_{adj} = .014$ (Figure 3). The ANOVA models explained a relatively small amount of variance (between 1.4% and 8.0%).

When comparing biases to zero (i.e., no bias), associations of participants from the majority of populations were significantly positively biased. An exception was Italian speakers from Italy, who provided significantly negatively biased associations. Emotion associations of most populations did not have significant arousal or power biases with a few notable exceptions. Lithuanian, Romanian, Russian, Finnish, Latvian, and German (from Germany) speakers provided emotion associations significantly biased towards low arousal. German speakers from Germany provided associations biased towards low power. Estonian, Swedish, and English speakers from Australia and New Zealand provided associations biased towards high power. See Figure 3 for further details and levels of significance.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Valence bias (95% CI)
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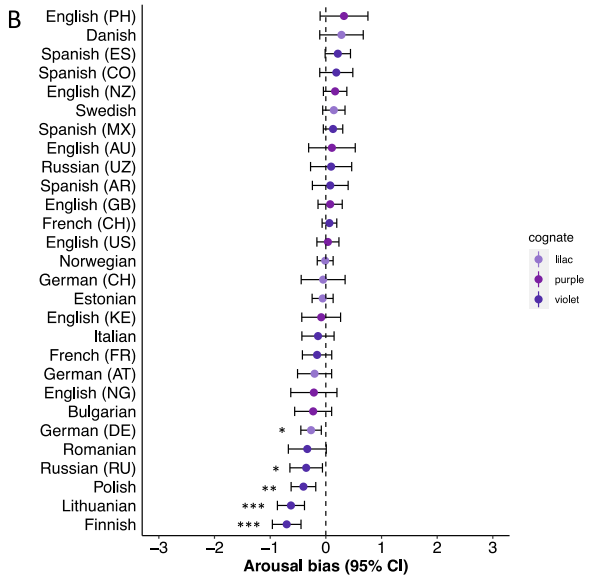
lilac
purple
violet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Arousal bias (95% CI)
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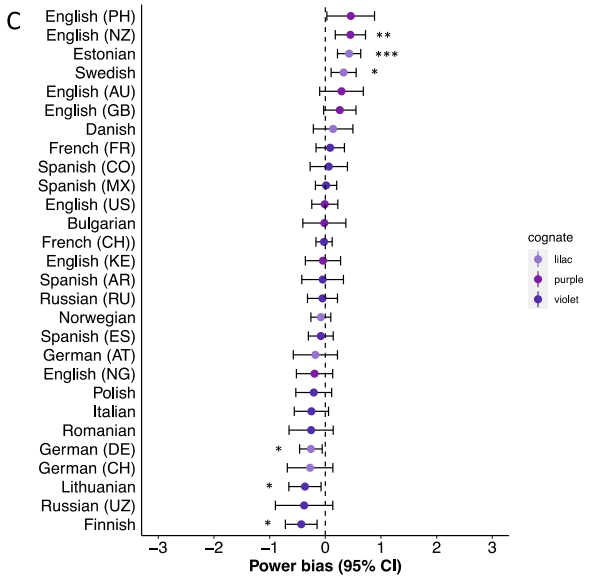
lilac
purple
violet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Power bias (95% CI)
cognate
lilac
purple
violet

Figure 3. Valence (A), arousal (B), and power (C) biases, separated by native language of each population and ordered by cognate.
Populations are colour-coded and ordered by cognate (*purple*, *lilac*, *violet*). See Table 1 for country codes. Error bars indicate 95% confidence intervals of the means; zero marks no bias; stars mark significant deviations from zero, FDR corrected for multiple comparisons. * < .050, ** < .010, *** < .001

4. Discussion

We investigated whether cognates could explain inconsistencies in the affective meanings of the colour category PURPLE. This colour category describes shades of colours lying between those described by the colour categories RED and BLUE. Purple stands out from the other basic colour terms by being much less homogeneous both in terms of the location of focal colours (Lindsey & Brown, 2014; Uusküla & Bimler, 2016a) and its emotional meaning within (Jonauskaite et al., 2021; Jonauskaite, Parraga, et al., 2020) and between countries (Hupka et al., 1997; Jonauskaite, Abu-Akel, et al., 2020; Jonauskaite, Wicker, et al., 2019).

To investigate the potential role of cognates on affective meaning, we analysed emotion associations with the category PURPLE as assessed in the International Colour-Emotion Association Survey (Jonauskaite, Abu-Akel, et al., 2020; Mohr et al., 2018). We used data from 16 languages (30 populations) that have obvious etymological cognates of *purple* (English and Bulgarian), *violet* (Finnish, French, Italian, Spanish, Lithuanian, Latvian, Polish, Romanian, and Russian), and *lilac* (German, Estonian, Danish, Norwegian, and Swedish).

Our major results were that cognates explained a small but significant part of the variance in valence and power biases, but not in arousal bias. Furthermore, for all affective biases, cognates were ordered the same way with *purple* having the most positive bias scores, followed by *lilac*, then *violet.* When looking at the associated emotions individually, we found large diversity. For all participants together, no single emotion was associated with PURPLE by more than 30% of the population tested. When looking at emotions selected by at least 20% of the sample, we found an array of positive emotions associated with PURPLE, namely *interest*, *amusement*, *pride*, *pleasure*, and *contentment*.

We observed that results on affective dimensions for cognates followed the same order (*purple* > *lilac* > *violet*), which would indicate that there is some systematic variation in their affective meaning. The cognate *purple* received the highest scores on all three affective dimensions, followed by *lilac* and finally *violet*. This observation was the strongest for the valence bias. Although all cognates showed an overall positivity bias, *purple* was associated with the most positive emotions and *violet* with the least positive emotions, even if the majority of associated emotions was still positive. The difference between the cognates was also evident when looking at the populations individually. From nine populations having no positivity bias, eight had *violet* as a cognate (Russian speakers in Russia and Uzbekistan, Italian speakers in Switzerland, Finnish, Lithuanian, Polish, and Romanian speakers), one had *lilac* as a cognate (Danish speakers), and none had *purple* as a cognate. One population (Italian speakers in Italy), also with *violet* as a cognate, had a negativity bias. The cognate *purple* was also associated with emotions more strongly biased towards powerful emotions than *violet*

but did not differ from *lilac*. Indeed, only the cognate *purple* showed an overall high power bias, and, on the population level, two *purple* (English speakers in Australia and New Zealand) and two *lilac* (Estonian and Swedish speakers) populations had high power biases. Finally, for arousal biases, cognates did not statistically differ from each other. Yet, *violet* showed a low arousal bias, when compared to zero, which was also evident on the population level. The five populations showing a low arousal bias had *violet* as a cognate (Finnish, Latvian, Lithuanian, Romanian and Russian speakers in Russia) and one population had *lilac* as a cognate (German speakers in Germany).

All in all, our results indicate that some inconsistencies in the meaning of PURPLE can be accounted for by the cognate denoting this basic colour category. Our statistics showed, however, that cognates cannot be the only reason for the large variability in the meaning of PURPLE, because cognates explained only a small amount of variance. Worth consideration is the variation of affective associations we observed in the data per cognate. For instance, Spanish and Italian, both closely related Romanic languages, use *violet* as a cognate for PURPLE. Yet, Spanish speakers in Spain, Argentina, and Mexico associated positively biased emotions, while Italian speakers in Italy and Switzerland associated negatively biased emotions with the cognate *violet*.

4.1. Other candidates to explaining heterogeneity in the affective meaning of PURPLE

We conjecture that other factors in addition to cognates are important in explaining the heterogenous affective meanings of PURPLE. A recent semantic association study is promising in this regard (Epicoco et al., 2021). The latter study applied a newly developed coding scheme for free associations with colours. The authors presented results on French speakers. For the category PURPLE (*violet* cognate), participants mainly associated natural elements and objects (e.g., *flower*) as well as other colour terms (e.g., *mauve*). Participants also produced diverse affectively charged associations (e.g., *beautiful*, *blood*). To further understand where the heterogeneity of the colour category PURPLE is coming from such coding schemes could be applied to association data by considering different populations.

Heterogeneous mental representations of PURPLE might account for some variability in its affective meaning. Participants from different countries and/or speaking different languages might imagine different shades of purple when treating the basic term for PURPLE in their language. Consequently, they might also associate different emotions. A previous study showed that focal colours for PURPLE varied between 13 languages from different language families and groups (Uusküla & Bimler, 2016a). Therefore, participants in our study with a mental representation of PURPLE of a lighter shade might have more positive emotion representations (e.g., Dael et al., 2016; Jonauskaite, Althaus, et al., 2019; Specker et al., 2018; Valdez & Mehrabian, 1994).

Furthermore, there always remains a possibility that the meaning of emotion terms varies across languages and individuals, and this variability influences affective associations. If we take one language, some people might think that the term *love* refers to parental love while others might imagine the passionate romantic kind of love. The first type of love would lead to less arousing connotations than the second type. Fontaine and colleagues (2007) graphically reported that emotion terms like *compassion*, *pleasure*, or *contentment* had more diverse meanings in terms of valence, arousal, and power than terms like *surprise*, *jealousy*,

or *joy*. If we consider several languages, a previous study showed notable heterogeneities in the semantic meanings of emotion terms across 2474 languages (Jackson et al., 2019). For example, the latter authors reported that in some languages, the concept of *anxiety* was more closely related to *fear*, while in other languages it was more closely related to *grief* and *regret*. Therefore, the semantic meaning of emotion terms can vary between people speaking the same language as well as different languages, and this variability seems larger for some emotion terms than others. In the current study, we grouped individual emotion terms on affective dimensions based on the results of an earlier study with 28 languages (Fontaine et al., 2013). This approach was not aimed to test for inter-individual or cross-linguistic variability in the semantic meaning of emotion terms.

Heterogeneity in the affective meaning of PURPLE might be further intensified by the existence of different words for the shades of PURPLE within the same language. In fact, while we only tested the associations with the basic terms for PURPLE, all three cognates exist in all our tested languages. In English, there are words *purple*, *violet*, and *lilac*. All three English terms are listed quite frequently in colour naming tasks (Lindsey & Brown, 2014; Mylonas & MacDonald, 2015). Mylonas and MacDonald (2015) even suggested that *lilac* might be an emerging basic colour term in English due to its wide use and high consensus across British English speakers. However, in American English, *violet* was spontaneously produced by more participants than *lilac* (Lindsey & Brown, 2014), hinting at the existence of local differences within the same language. When looking at mental representations of these terms, the focal colours of the American English words *purple*, *lilac*, and *violet* were partly overlapping (Lindsey & Brown, 2014). However, mental representations of *violet* and *purple* seemed closer than those of *lilac*, with the latter representing the lightest shades. How exactly these basic and non-basic terms affect affective associations with the category PURPLE remains to be investigated.

To conclude, affective meanings of PURPLE are diverse in terms of associated emotions and affective dimensions, and they vary as a function of cognate and population. Here, we focussed on the role of the three cognates denoting the basic category PURPLE and reported small but meaningful differences between the cognates. Yet, a large part of variability remained unaccounted for, calling for future in-depth studies into the meanings of purple. Associations studies (e.g., Epicoco et al., 2021) would be particularly informative in this regard.

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6. Appendix

Table S 1. Emotion terms used in the Geneva Emotion Wheel in the 16 studied languages (the first 8 languages ordered alphabetically).

Bulgarian	Danish	English	Estonian	Finnish	French	German	Italian
Заинтересованост	Interesse	Interest	Huvi	Kiinnostus	Intérêt	Interesse	Interesse
Разсвеселеност	Morskab	Amusement	lõbu	Huvittuneisuus	Amusement	Belustigung	Divertimento
Гордост	Stolthed	Pride	Uhkus	Ylpeys	Fierté	Stolz	Orgoglio
Радост	Glæde	Joy	Rõõm	Ilo	Joie	Freude	Gioia
Удоволствие	Nydelse	Pleasure	Nauding	Mielihyvä	Plaisir	Vergnügen	Piacere
Задоволство	Tilfredshed	Contentment	Rahulolu	Tyytyväisyys	Contentement	Zufriedenheit	Contentezza
Възхищение	Beundring	Admiration	Imetlus	Ihailu	Admiration	Bewunderung	Ammirazione
Любов	Kærlighed	Love	Armastus	Rakkaus	Amour	Liebe	Amore
Облекчение	Lettelse	Relief	Kergendus	Helpotus	Soulagement	Erleichterung	Sollievo
Съчувствие	Medfølelse	Compassion	Kaastunne	Myötätunto	Compassion	Mitgefühl	Compassione
Тъга	Tristhed	Sadness	Kurbus	Suru	Tristesse	Trauer	Tristezza
Вина	Skyldfølelse	Guilt	Süü	Syyllisyys	Culpabilité	Schuld	Colpa
Разкаяние	Fortrydelse	Regret	Kahetsus	Katumus	Regret	Bereuen	Rimpianto
Срам	Skam	Shame	Häbi	Häpeä	Honte	Scham	Vergogna
Разочарование	Skuffelse	Disappointment	Pettumus	Pettymys	Déception	Enttäuschung	Delusione
Страх	Frygt	Fear	Hirm	Pelko	Peur	Angst	Paura
Отвращение	Væmmelse	Disgust	Vastikus	Inho	Dégoût	Ekel	Disgusto
Презрение	Foragt	Contempt	Põlgus	Halveksunta	Mépris	Verachtung	Disprezzo

Омраза	Had	Hate	Vihkamine	Viha	Haine	Hass	Odio
Гняв	Vrede	Anger	Viha	Suuttuminen	Colère	Wut	Collera

Table S 2. Emotion terms used in the Geneva Emotion Wheel in the 16 studied languages (the last 8 languages ordered alphabetically).

Latvian	**Lithuanian**	**Norwegian (Bokmål)**	**Polish**	**Romanian**	**Russian**	**Spanish**	**Swedish**
Interese	Susidomėjimas	Interesse	Zainteresowanie	Interes	Заинтересованность	Interés	Intresse
Uzjautrinājums	Linksmumas	Fornøyelse	Rozbawienie	Amuzament	Весёлость	Diversión	Underhållning
Lepnums	Išdidumas	Stolthet	Duma	Mândrie	Гордость	Orgullo	Stolthet
Prieks	Džiaugsmas	Glede	Radość	Bucurie	Радость	Alegría	Glädje
Bauda	Malonumas	Nytelse	Przyjemność	Plăcere	Удовольствие	Placer	Njutning
Apmierinājums	Pasitenkinimas	Tilfredshet	Zadowolenie	Mulțumire	Удовлетворенность	Satisfacción	Belåtenhet
Apbrīna	Žavėjimasis	Beundring	Podziw	Admirație	Восхищение	Admiración	Beundran
Milestība	Meilė	Kjærlighet	Miłość	Iubire	Любовь`	Amor	Kärlek
Atvieglojums	Palengvėjimas	Lettelse	Uczucie ulgi	Uşurare	Облегчение	Alivio	Lättnad
Līdzjutība	Užuojauta	Medfølelse	Współczucie	Compasiune	Сострадание	Compasión	Medkänsla
Skumjas	Liūdesys	Tristhet	Smutek	Tristețe	Грусть	Tristeza	Ledsamhet
Vaina	Kaltė	Skyldfølelse	Poczucie winy	Vinovăție	Чувство	Culpabilidad	Skuld
Nožela	Apgailestavimas	Anger	Żal/Żałowanie	Regret	Вины	Arrepentimiento	Ånger
Kauns	Gėda	Skam	Wstyd	Rușine	Сожаление	Vergüenza	Skam
Vilšanās	Nusivylimas	Skuffelse	Rozczarowanie	Dezamăgire	Стыд	Decepción	Besvikelse

Bailes	Baimė	Frykt	Strach	Teamă	Разочарование	Miedo	Rädsla
Riebums	Pasibjaurėjimas	Avsky	Obrzydzenie	Dezgust	Страх	Asco	Avsmak
Nicinājums	Panieka	Forakt	Pogarda	Dispreț	Отвращение	Desprecio	Förakt
Naids	Neapykanta	Hat	Nienawiść	Ură	Презрение	Odio	Hat
Dusmas	Pyktis	Sinne	Złość	Furie	Ненависть	Cólera	Ilska