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Bridging Colour Communication Across Languages

ABSTRACT

Colour naming bridges vision and language. We group colours into categories that we refer to by names such as yellow, turquoise, or periwinkle blue. The number of colour names in languages is often large, as finer distinctions allow colour to be communicated with greater precision (Gage, 1995). For brand owners, designers and colour technologists, this diversity has real consequences: a colour name that communicates clearly within one linguistic community may mislead, or fail to translate at all, in another — with direct effects for the intended audience across branding and visual communication design.

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Colour naming, cross-linguistic communication, Serbian, colour translation

Since 2009, we have led an international collaborative project to collect unconstrained colour names with their corresponding colour ranges in different languages and viewing conditions through crowdsourcing, laboratory, and field experimental methodologies (Mylonas & MacDonald, 2010; Mylonas, Griffin & Stockman, 2019; Mylonas, Caparos & Davidoff, 2022). We developed robust computational tools, trained on these multilingual datasets, that automate the colour naming task across the full colour gamut at different degrees of granularity, highlighting both the consistency and the development of colour languages (Mylonas et al., 2026). Our findings suggest that learned, linguistic processes, rather than innate perceptual mechanisms, are the driving force behind how colour lexicons expand (Mylonas, Caparos & Davidoff, 2022). This keynote reviews our colour naming research and its computational tools, before turning to its newest bridge — Serbian — and its connections to the other colour languages we studied.

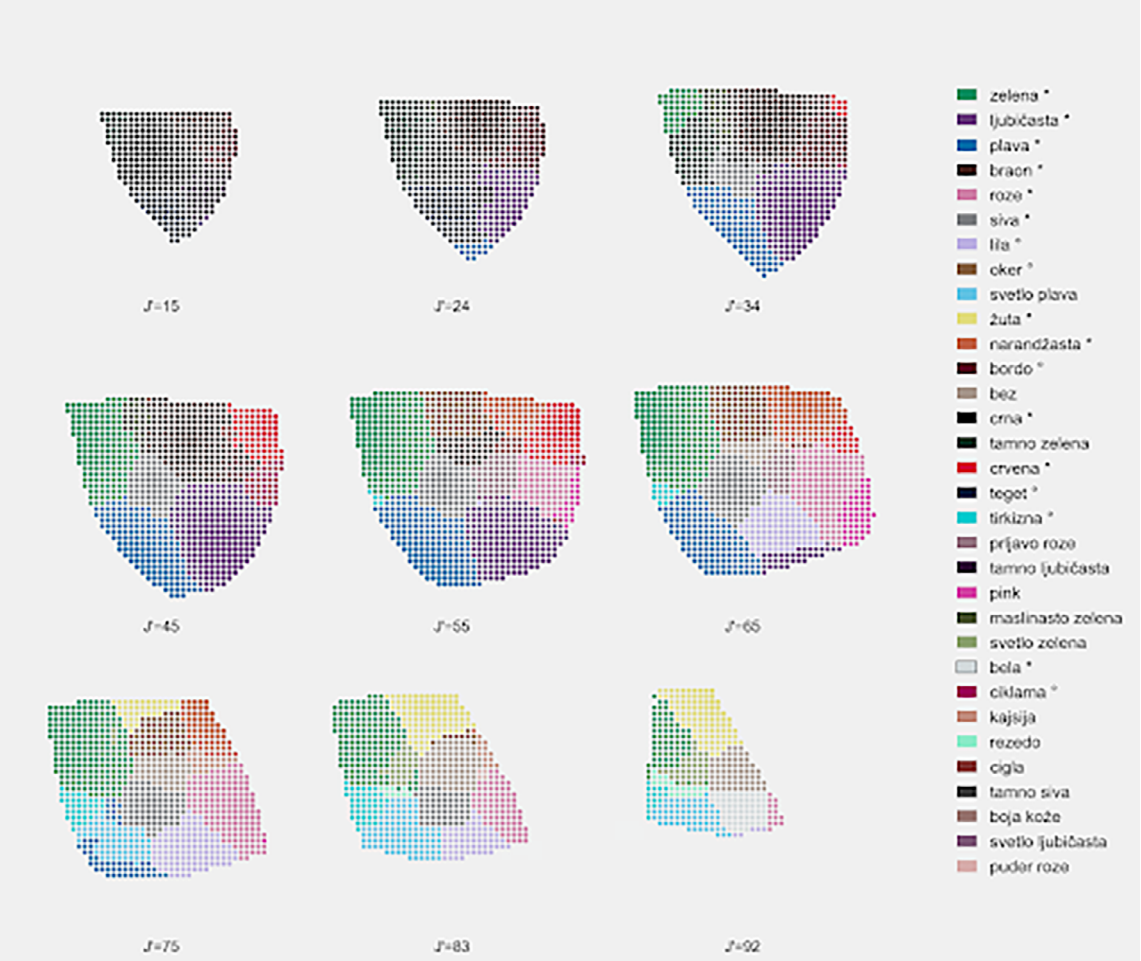
The core experimental methodology behind this research programme has stayed largely consistent across settings: observers view a sequence of colour patches, drawn from an approximately uniform sampling of the Munsell system spanning the full gamut, presented one at a time against neutral or chromatic backgrounds, and type an unconstrained colour name for each, with response time recorded. Standard controls include colour-vision screening, brightness calibration, and a background questionnaire (Mylonas & MacDonald, 2010). The same protocol carries over to laboratory settings and to fieldwork in unwritten languages, with calibrated monitors and verbal responses recorded (Mylonas, Griffin & Stockman, 2019; Mylonas, Caparos & Davidoff, 2022).

This lineage underpins two related recent outputs: a modelling paper establishing Spin Colour Forest (SCF) — a novel ensemble colour naming method that applies partial orthogonal transformations to perceptual colour space to capture complex category boundaries — and a colour translation benchmark across five languages (Mylonas et al., 2026); and Colour Spinner, a deployed visualisation tool making these naming distributions explorable through six linked views — Picker, Namer, Thesaurus, Translator, Mapper, and Profiler — spanning six languages, with Spanish added as the sixth (Sinkeviciute et al., 2026) just before the current Serbian extension. Together this work has shown that the minimal set of terms necessary to name all colours in a display gamut — what we call indispensable colour terms — ranges from just 7 in OtjiHimba, a remote society in Namibia, to 47 in American English. For the written, well-resourced languages, large language models translate colour names fluently while mapping them onto near-invariant focal colours — the single 'best example' of a colour category — regardless of target language, producing very large mean perceptual errors. For OtjiHimba, the failure is more basic still — as an unwritten language, it could not be translated at all, with AI unable to produce any usable output. Serbian sits at neither

extreme: unlike OtjiHimba, it is a written language with a substantial web presence, yet until this study empirical unconstrained colour-naming datasets were limited.

For bridging the gap with the Serbian colour language, we used the same unconstrained naming paradigm, and we collaborated with Serbian native-speaking colour researchers (Jakovljev & Zdravković, 2018; Martinovic, 2024) to collect and analyse a large dataset from 1,049 speakers, producing 34,781 clean responses across 454 unique terms. We replicate earlier results (Jakovljev & Zdravković, 2018) of the 11-term Serbian basic colour term (BCT; Berlin & Kay, 1969/1991) inventory (bela, crna, crvena, žuta, zelena, plava, braon, ljubičasta, roze, narandžasta, siva). We extend it with 21 further terms identified by SCF grid-coverage modelling, together forming a 32-term indispensable vocabulary (Figure 1). This count of indispensable colour terms matches British English, Greek and Spanish (32 each) — though the actual categories across languages differ — is richer than French (27) and OtjiHimba (7), and considerably smaller than American English (47). Six of these non-basic 21 terms form a converging near-basic tier (teget, bordo, tirkizna, oker, lila, ciklama): the first four independently corroborate the candidate categories flagged by our own composite behavioural scoring — a ranking that combines naming frequency, consensus, and response time — while lila and ciklama emerge from the model alone. Two of the six, teget (dark blue) and bordo (dark red), correspond directly to the categories Jakovljev and Zdravković identified through colour-term elicitation (2018); our grid-coverage evidence offers a complementary, model-based confirmation that these occupy separate, irreducible regions of colour space. A full statistical analysis is in preparation as a separate journal article, and in parallel we are now extending Colour Spinner to Serbian, including corpus data (Kostić, 1999), so that users can explore the Serbian colour vocabulary directly alongside the other six.

Effective colour communication draws on principles of visual perception (MacDonald, 1999) and can be further enhanced by knowledge of the addressed speakers' language (Schirillo, 2001). Across the languages, speakers divide the same perceptual colour space with vocabularies of different size and with category boundaries



» **Figure 1:** *Serbian indispensable colour names across nine CAM16-UCS lightness slices (J' = 15–92), from the darkest (left) to the lightest (right) colours. Terms marked with asterisks are the 11 BCTs; degree-marked terms are the converging near-basic tier. Legend entries are ordered by size in colour space*

that do not necessarily align. The practical consequence is straightforward: effective colour communication cannot be assumed to perfectly translate across languages simply because the words do. Our translation benchmark reinforces this distinction, showing that lexical fluency in current AI systems does not guarantee perceptual correspondence between the colour categories used by different linguistic communities.

For graphic engineering and design in an international context, this shifts the problem from asking what is the translation of this colour name? to asking how will this colour be recognised, understood, and named by the people for whom we are designing? Serbian's near-basic tier is a clear case in point: these distinctions would be obscured by a universal eleven-category account, whereas Colour Spinner makes them directly inspectable rather than reducing colour translation to a one-to-one correspondence between words.

Our broader direction is therefore towards language-aware colour tools grounded in human naming behaviour (Mylonas & MacDonald, 2012). For designers working across markets and languages — in marketing, graphic communications, image processing and quality control — our tools can expose where a colour choice is robust across linguistic communities and where communication becomes uncertain. Colour management gives us increasingly precise ways to reproduce a stimulus while colour-naming research complements it by asking whether that reproduced colour carries the same communicative distinction for its intended audience. Together, these two forms of precision — the colour we reproduce and the colour we intend to communicate — define the bridge this symposium is helping us build.

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2. References

Berlin, B. and Kay, P. (1969) *Basic Color Terms: Their Universality and Evolution*. Berkeley, CA: University of California Press.

Gage, J. (1995) *Colour and Culture: Practice and Meaning from Antiquity to Abstraction*. London: Thames and Hudson.

Jakovljev, I. and Zdravković, S. (2018) 'The colour lexicon of the Serbian language – a study of dark blue and dark red colour categories Part 1: Colour-term elicitation task', *Psihologija*, 51(2), pp. 197–213. DOI: 10.2298/PSI160521002J

Kostić, Đ. (1999) *Frekvencijski rečnik savremenog srpskog jezika*. Vols. I–VII. Belgrade: Institute for Experimental Phonetics and Speech Pathology and Laboratory for Experimental Psychology, Faculty of Philosophy, University of Belgrade.

MacDonald, L. W. (1999) 'Using color effectively in computer graphics', *IEEE Computer Graphics and Applications*, 19(4), pp. 20–35. DOI: 10.1109/38.773961

Martinovic, J. (2024) 'Acquisition of colour categories through learning: Differences between hue and lightness', *Cognition*, 242, 105657. DOI: 10.1016/j.cognition.2023.105657

Mylonas, D. S. and MacDonald, L. (2010) 'Online Colour Naming Experiment Using Munsell Colour Samples'. In: *Proceedings of the 5th European Conference on Colour in Graphics, Imaging, and Vision (CGIV)*, 14–17 June 2010, Joensuu, Finland. Springfield, IS&T, pp. 27–32.

Mylonas, D. and MacDonald, L. (2012) 'Colour naming for colour communication'. In: Best, J. (ed.) *Colour Design: Theories and Applications. Cambridge*, Woodhead Publishing, pp. 254–270. DOI: 10.1533/9780857095534.2.254

Mylonas, D., Ahmed, R., Sinkeviciute, A. and Koliousis, A. (2026) 'Colour in Translation: Data, Models, and Benchmarking for Cross-Linguistic Colour Naming'. In: *Proceedings of the 2026 CHI Conference on Human Factors in Computing Systems (CHI '26)*, 13–17 April 2026, Barcelona, Spain. New York, ACM, pp. 1–21. DOI: 10.1145/3772318.3791626

Mylonas, D., Caparos, S. and Davidoff, J. (2022) 'Augmenting a colour lexicon', *Humanities and Social Sciences Communications*, 9, 29. DOI: 10.1057/s41599-022-01045-3

Mylonas, D., Griffin, L. D. and Stockman, A. (2019) 'Mapping colour names in cone excitation space'. In: *25th Symposium of the International Colour Vision Society (ICVS)*, 5–9 July 2019, Riga, Latvia. p. 52.

Schirillo, J. A. (2001) 'Tutorial on the importance of color in language and culture', *Color Research & Application*, 26(3), pp. 179–192. DOI: 10.1002/col.1016

Sinkeviciute, A., Ahmed, R., Stutters, J., Koliousis, A. and Mylonas, D. (2026) 'Colour Spinner: Making Cross-Linguistic Colour Naming Diversity Visible'. Manuscript under review, *IEEE Transactions on Visualization and Computer Graphics.*



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