



Artificial Intelligence And Colour Psychology: A Systematic Review Of Algorithmic Colour Selection And Emotional Outcomes

1 Karpagam K, R&D Psychologist, ZenturioTech

2 Ajisha Bhasi, CEO, ZenturioTech

ABSTRACT

Despite the significant application of Artificial Intelligence (AI) in generating color palettes for digital communication, the emotional and psychological outcomes of these AI-selected colors remain largely unexplored. This systematic review is a part of the effort to find out the influence of AI-driven color selection methods on the emotional responses of humans in digital climate environments. Peer-reviewed studies published between 2020 and 2025 were identified across major scientific databases, focusing on research that links AI-based colour recommendation to emotional responses such as mood, arousal, and valence, etc. The quality of the studies and the eligibility criteria were judged based on predefined systematic review guidelines. The findings clarify in what ways AI-selected colors differ from those chosen by humans in terms of creating emotional experiences, with an emphasis on methodological difficulties and locating gaps for the upcoming studies. Hence, this review is expected to facilitate the development of a more human-centered and ethically sound approach to AI use in visual design.

Keywords: Artificial Intelligence, colour psychology, emotional response, colour palette generation, systematic review.

INTRODUCTION

The primary means by which people understand and interact with the visual world is through color, which has an impact on both cognition and feeling (Hemphill, 1996). Several psychological and design studies have been equally clear in their findings that color is the main factor that influences the emotional state, the length of the attention span, the behavior and the general preferences of humans (Kurilčik et al., 2024). According to color researchers like Yu, Wang, and Yang in 2023, color is a great helper in grasping the areas of the visuals, goods, and interfaces. One of the earliest works to color psychology indicates the most likely proposition that the link of certain colors with specific emotions. As an example, tranquility is almost always a blue association, a feeling of being rushed or excited is probably what red is going to cause, and yellow is seen as a happy or energizing color. Therefore, knowledge of these emotional connections is a must in such application sectors as branding, user interface creation, and the designing of the digital and physical environments (Deng, Zhou & Zhang, 2022). Understanding the influence of color on human emotions becomes even more required when someone intends to create the visual experiences that attract and resonate with people since digital content is getting progressively more immersive and complex.

In the meantime, the fast and significant changes brought about by artificial intelligence (AI) in how colours are created, analysed, and used in digital environments are very visible. AI-driven colour tools, which include deep learning models and machine learning predictors as well as evolutionary algorithms, are now able to do all these four tasks: extracting colour palettes from images, creating new palettes based on affective cues, optimising colour combinations for aesthetic harmony, and predicting user preferences (Nie & Lv, 2023; Deng, Zhou, & Zhong, 2022). Such procedures open to designers the almost endless possibilities of liberating and speeding up automated colour decision-making processes in design. By way of example, deep learning methods are able to produce colour palettes that match different emotional categories such as calm, warm, or energetic, thus giving a computational grasp of the colour emotion relationships (Nie & Lv, 2023). Machine learning models can also forecast user preferences for colour combinations (Yu et al., 2023), thus allowing for the generation of personalised or context-sensitive colour recommendations. These advancements imply that AI systems may gradually take over the roles of human designers that have been traditionally performed by human designers.

Despite all these technological improvements, the psychological and emotional effects of AI-generated colour selections have not been the centre of a thorough investigation. AI might be able to show statistical relationships between colour and emotion, however, it is still a question whether these algorithmic associations correspond to the human perception and emotional interpretation of colour. Research in psychology along with affective computing have come up with the point that there are cases where AI can have different perceptions as well as semantic interpretations as compared to humans (Dou & Xue, 2025).

As a matter of fact, a research article on differences in human and model-based colour metaphor processing indicates that large language models may understand colour terms semantically but lack a perceptual grounding, thus, they produce emotional interpretations that are different from those of humans (Dou & Xue, 2025). Similarly, a paper on the perceptual similarities of colours and emotions through image-based corpora disclosed that AI systems develop general emotional clusters but at the same time, they may misrepresent some of the subtle affective nuances if compared to human judgements. Such findings highlight that AI-driven colour selections should not still be looked at as fully capable of triggering human emotional reactions .

In addition, new studies suggest that the emotional significance of color depends largely on the context. In multimodal systems like comics, advertising, UI design, and virtual environments, the color combines with other visual and semantic cues to change the emotional perception. Research has indicated that AI models that use color along with facial expressions or text sentiment can raise emotion recognition to be more accurate, thus color is playing a significant role in affective inference. At the same time, emotional perceptions of colors can differ from one culture to another, personality traits, and sensory modalities, besides, there is more to this than just computational modelling. As an example, research in machine learning which discovers a connection between personality traits and color saturation preferences (Xue & Ding, 2025) is a way to explain that there are individual differences which AI should take into account when it is creating or recommending colors. Likewise, the sentiment of the color names on social media reveals the emotional color meanings that come out of cultural exposure and linguistic context (Guo, Westland & Lai, 2023), which are the two dimensions that most AI systems are not fully integrating.

This expanding research corpus illustrates, in equal measure, advances and issues in the discipline. To put it simply, AI systems are progressively more adept at identifying and producing colour patterns that have an emotional significance. However, the link between AI-generated colour choices and human emotional experiences has not yet been formally mapped out. The current research has different facets that include emotional computing, visual design, colour psychology, machine learning, and human-computer interaction. However, these results are still fragmented without any thorough review that links algorithmic colour selection with emotional or psychological effects. In the absence of such a synthesis, designers, researchers, and technologists are in the dark about whether AI-generated colour selections help or hinder the creation of the desired emotional experiences experiences.

As the use of AI in visual communication is skyrocketing from automated branding tools and digital marketing systems to generative design platforms and immersive environments, it becomes very important to know the impact of AI-driven colour selection on human emotional responses. The emergence of generative AI systems prompts a number of questions regarding the extent to which these tools support or

challenge existing emotional principles of colour psychology. The colour changes user engagement, trust, and even cognitive performance, along with aesthetic satisfaction, quite heavily. In case AI systems generate emotionally wrong or mismatched colours, the resulting designs may adversely affect user experience, cross-cultural communication, and emotional well-being.

Purpose of the Review

The current systematic review aims to fill this gap by summarising empirical results, reported in recent peer reviewed studies that are considering AI driven colour selection or generation with regards to emotional and psychological impacts. By reviewing research from 2020 to 2025, this paper provides a summary of the latest technique relevant trends in AI oriented colour modelling. The review attempts to uncover mass mysteries, including the problem of how AI chooses or generates color palettes, how these algorithmic choices impact on emotions, and whether they conform with commonly established color-emotional associations in humans.

Research Questions

To address some of these, the following research questions were developed to inform this review.

1. How do AI systems create, interpret or choose color palettes online?
2. What are the emotional and psychological effects of colors that have been chosen by AI or generated by it?
3. How closely do AI-driven colour decisions reflect those from known human colour emotion associations?
4. If any, what are the methodological issues and knowledge gaps of the studies in the literature?

Significance of the Review

This review consolidates evidence across AI, psychology, and design research to offer important understanding of the trustworthiness and limitations of emotion in AI-generated colour decisions. The results demonstrate the potential, and limitations of AI in visual design and reinforce the importance of human centred control. This review also points out knowledge gaps and discusses future research avenues, which advocates EI based-AI systems to be also perceptually-grounded and culturally-contextualized.

BACKGROUND AND LITERATURE REVIEW

- ***“Perceptual (dis)similarities between colors and emotions: An empirical investigation with the image based visual corpus analysis approach”*** by Dou, J., and Xue, W. (2025) is a pioneering study that explores colour emotion associations by utilizing an image based visual corpus method. The work mainly deals with perceptual (dis)similarities of the six basic colour terms (black, white, red, green, yellow, and blue) and 63 English emotion label words. To find out the degree of perceptual similarity or dissimilarity between each colour emotion pair, a large dataset comprising 63 emotion words, 6 colour terms, and 100 images for each word was analysed. The similarity metric was used as a measure of association strength between colours and emotional concepts.

The findings revealed two major outcomes:

1. The six colours differ significantly in their capability of reflecting affective (dis)similarities between emotional concepts and in their total strength of association with the emotional domain.
2. The valence and arousal ratings of emotion words were significantly correlated with their association strength for five of the six colour terms except for blue which was the only colour not to follow the same trend.

This research commits a loud voice in the debate on how different colours differ in their emotional mapping capacities and how emotional dimensions like valence and arousal affect the ways colours are semantically and visually associated with emotions by providing overwhelming empirical evidence.

- The research study ***“Exploring the association between personality traits and colour saturation preference using machine learning”*** by Xue, N., and Ding, J. (2025) delved into how object colour relationships and personality traits affect the choice of colour saturation levels. Each participant was asked to evaluate their preferred saturation levels of the objects displayed on the computer screen. The changes in personality were tested by applying the random forest regression model to identify which personality traits could best predict the saturation preference.

The outcomes indicated:

1. Saturation level choices vary according to different object types, with the ranking as follows: fictional objects being higher than natural objects, which in turn, are higher than artificial ones.
2. The study personality traits data were a significant predictor of the model for saturation preferences, thus, the model’s performance was confirmed.
3. Of all the traits, openness, extraversion, and neuroticism were the most significant in predicting saturation preference for particular objects, while agreeableness and openness were the main factors influencing the prediction of saturation preference for the three hue categories together.

4. Object colour associations also had a significant impact on saturation preferences, which is consistent with the view that both emotional and cognitive links between people and objects influence colour emotion perception.

The research conveys that personality traits have an especially differentiated and subtle emotional role in colour saturation preference, thus, it illustrates that emotional reactions to colour are psychological and dependent on the context.

- **“Deep Learning-based Machine color emotion generation”** by Nie, T., and Lv, X. (2023) is a study that seeks to answer the question: Can deep learning models create color combinations that align with human emotional categories? To achieve this, the authors trained a neural network on datasets that were labeled with the emotional descriptors such as warm, calm, romantic, energetic, and tense. The research utilized tagged artwork and images.

The findings revealed that the AI system is capable of generating colour palettes that correspond to the emotions expressed and are later judged by human participants. As an example, the colour schemes created for "calm" were mainly made up of cool, desaturated blues and greens, while "energetic" colour schemes were characterized by high saturation warm reds and yellows.

Such research is a stepping stone for AI to be seen as one that can even go as far as "internalizing" emotional structures in terms of colour and thus, is a strong support for automated emotional color generation in digital design and emotional computing.

- The paper **“Analyzing and predicting colour preference of colour palettes”** published by Yu, S., Wang, L., and Yang, Y. (2023) explores if machine learning models can foresee users' emotional and aesthetic preferences for multi-colour palettes. To this end researchers got humans to rate and colour palettes and then created a prediction model by extracting features from the rated colour palettes such as hue relationships, saturation balance, luminance contrast, and palette harmony scores.

It turned out that the predictive model was very close to the human ratings, thus confirming the idea that emotional and aesthetic responses to colour palettes can be described by computational models. The paper also demonstrated that preference to an extent depended on the emotional side of the impression like comfort, harmony, vibrancy, and visual warmth.

Basically, the research work showed that AI can be used as a tool for the emotional side of colour choosing and that it can also be used for forecasting individual and group preferences, thus being a very valuable instrument for automated colour design in UI/UX and creative applications.

- The paper "*Interactive Genetic Color Matching Design of Cultural and Creative Products considering Color image and Visual Aesthetics*" published in 2022 and authored by Deng, L., Zhou, F., and Zhang, Z. explores how the use of an interactive genetic algorithm (IGA) can facilitate colour design based on emotional response for cultural and creative products. The authors have designed an AI-aided colour matching solution that is able to produce optimised colour palettes to achieve the emotional goals and aesthetic requirements set by the users.

The system consists of:

1. Colour image theory
2. Visual aesthetics evaluation
3. The evolutionary search capability of genetic algorithms

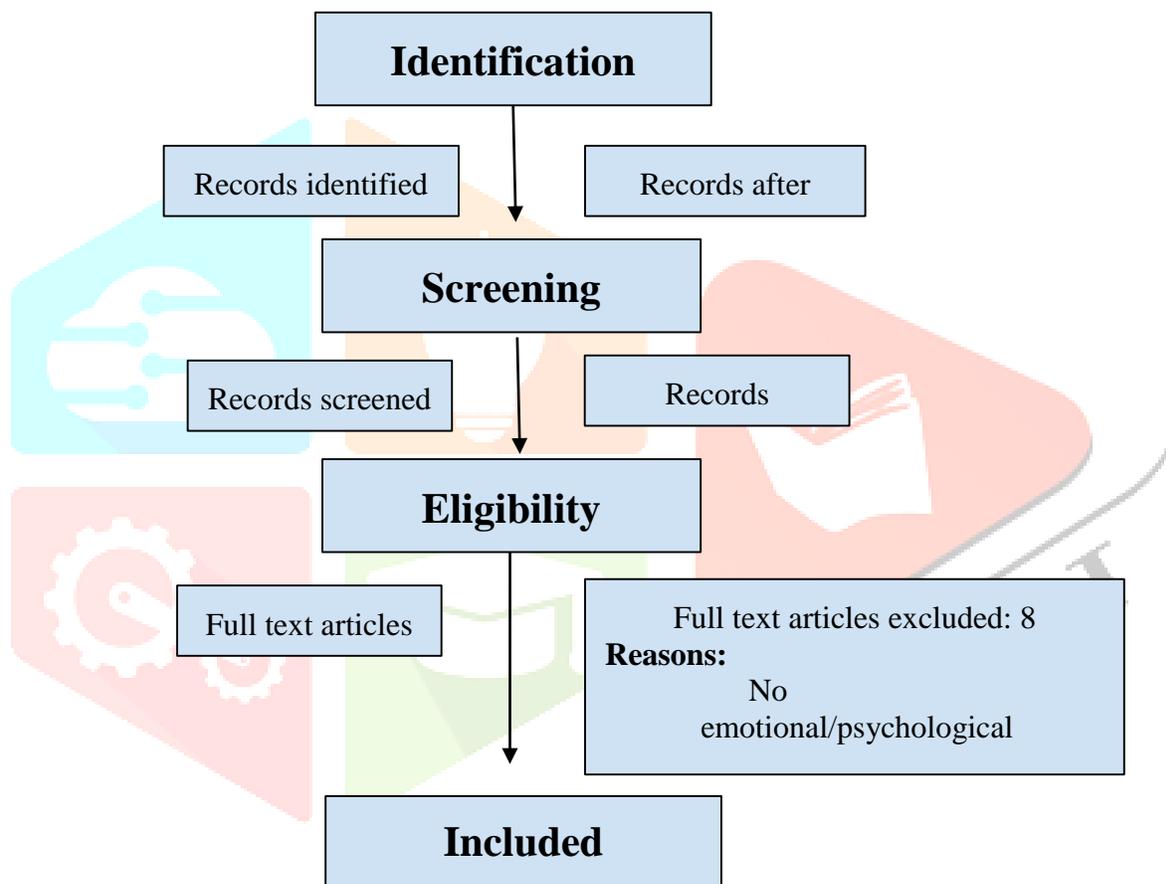
By repeatedly involving human evaluators in the loop, the algorithm was able to generate colour combinations that the users found to be more emotionally relevant and aesthetically attractive. The paper shows that IGAs have the potential to capture human emotional feedback in a computational colour design process, thus they are able to act as a bridge between algorithmic generation and human perceptual judgement.

The present study is a first step toward the future of human-AI hybrid systems, which are capable of supporting emotionally significant colour decision making. Such systems are especially applicable to situations where cultural symbolism and aesthetic preferences are of paramount importance.

METHODOLOGY

Study Design:

This research followed a systematic review methodology to synthesise on how artificial intelligence (AI) driven colour selection methods influence human emotional outcomes in digital environments. The review adhered to established systematic review guidelines, including PRISMA principles for transparency in study identification, screening, eligibility assessment and synthesis. The methodological framework was defined a priori to ensure consistency, replicability and rigour across all steps of the review process.



Search Strategy:

A systematic search was undertaken to identify peer reviewed literature between 2020 and 2025 related to AI, colour selection or generation and emotional or psychological effects. The search timeframe was selected to focus on recent progress in AI based colour modelling, machine learning design and computational affective research.

Databases searched:

The following major scientific databases and digital libraries were searched:

- ScienceDirect
- Wiley Online Library
- AAI/ACM digital collections
- Google Scholar
- Frontiers, MDPI, SpringerLink.

Search Keywords:

Boolean combination of the following terms were used:

- “artificial intelligence” OR “machine learning” OR “deep learning” OR “algorithmic” OR “Computational”
- “colour palette” OR “color palette” OR “colour generation” OR “color selection” OR “colorization”
- “emotion” OR “affect” OR “valence” OR “arousal” OR “mood” OR “psychological response”
- “visual design” OR “UI design” OR “aesthetic preference” OR “perception”

Example search string:

(“artificial intelligence” OR “machine learning”) AND (“color palette” OR “colour selection”) AND (“emotion” OR “affective response”)

Inclusion and Exclusion Criteria:**Inclusion Criteria:**

Studies were included if they met all of the following criteria:

- Published between 2020 - 2025
- Peer reviewed journal articles or conference papers.
- Explicitly examined colour selection, generation, prediction or analysis using AI or algorithmic models.
- Reported human emotional, psychological, cognitive or aesthetic outcomes related to colour (e.g., emotion recognition, colour emotion mapping, preference prediction, affective ratings)
- Provided empirical results, computational modelling results, or multimodal analysis relevant to colour emotion mapping.

Exclusion Criteria:

Studies were excluded if they:

- Focused solely on AI technical colour processing (e.g., colour constancy, colour segmentation) without emotional/psychological outcomes.
- Addressed colour theory or colour psychology without AI involvement.
- Were thesis manuscripts, preprints not peer reviewed, book chapters, or non-english publications.
- Used AI only as a tool for data management rather than colour analysis.

Data Extraction:

A Structured extraction sheet was developed to collect relevant information from each study:

- Bibliographic details like authors, year, journal
- AI or algorithmic models used like neural networks, GANs, LLMs, fuzzy logic, CNNs, clustering, etc.
- Colour methodology such as palette generation, hue manipulation, palette prediction, colour feature extraction.
- emotional/psychological outcomes measured like valence/arousal, sentiment, semantic emotion mapping, preference ratings, personality correlations.
- Stimulus type like images, UI designs, comics, product designs, VR environments
- Participation or dataset type like human participants, psychological surveys, large scale image datasets, or LLM based analyses
- Key findings such as emotional patterns, alignment with human colour emotion associations, divergences.
- Limitations identified.

Quality Assessment:

Quality of studies was assessed using modified JBI (Joanna Briggs Institute) critical appraisal checklists for:

- Experimental studies
- Cross sectional psychological studies
- Computational model evaluation studies.

Criteria assessed included:

- Clarity of aims and methodology
- Appropriateness of AI models
- Validity of emotional measures
- Transparency in data sources and number of samples
- Robustness of statistical analyses
- Clarity when mapping AI colour outputs to psychological concepts.

Very high methodological quality studies were those:

- Emotion measures that have been validated (e.g., valence/arousal scales)
- Explainable AI models for colour emotion mapping
- Empirical comparison of human-vs.-algorithmic colour choices.

Data Synthesis Approach:

Given the heterogeneity of methods (machine learning modelling, psychological experiments, computational colour analysis, affective computing), a qualitative thematic synthesis was used instead of meta analysis.

Three overarching synthesis categories were defined:

1. AI methods for colour selection and generation
2. Emotional outcomes of AI selected colours
3. Alignment vs divergence between AI and human emotional responses

RESULTS:

Study Selection:

A first search on scientific databases (ScienceDirect, Wiley Online Library, MDPI, Springer Link, Frontiers and Google Scholar) resulted in a wide array of studies related to AI and Colour published between 2020 and the time of the search. Following excluding irrelevant studies by title and abstract, articles were screened by full text on the basis of predefined inclusion and exclusion criteria.

Ten studies from the entire candidate pool detailed in the uploaded search table were identified that met all inclusion criteria and were included in final synthesis. These studies directly addressed both:

1. AI based color picking, generation or identification.
2. Emotional, cognitive or affective responses to colour.

PRISMA Flow:

- Records identified - 40+ candidate studies
- Records screened - 30 after removing duplicates and irrelevant titles
- Full text articles assessed for eligibility - 18
- Studies included in qualitative synthesis - 10

Characteristics of Included Studies:

The 10 studies selected differed in methodology, AI models applied, and emotional outcomes evaluated. They represent a broad spectrum of AI colour emotion intersections.

AI models used:

- Deep learning (CNNs, GAN like ... models)
- Theoretical machine learning techniques (SVM, regression models, clustering) LOCALITY ML based prediction
- Genetic algorithms + neural networks
- Fuzzy logic multimodal emotion recognition
- Large Language Models
- Computation corpus analysis techniques

Research contexts:

- Colour emotion generation models
- Colour palette preference prediction
- Colour emotion semantic mapping
- AI-based emotional tone evaluation for visual media
- Personality colour saturation ML modeling
- UI design color optimisation
- Sentiment of social media as related to colour usage
- The colour metaphor between AI and humans
- Sound colour emotion ML modeling
- Image, two-way color emotion association.

Types of emotional measures:

- Valence and arousal
- Semantic emotion categories
- Sentiment polarity preference ratings
- Personality colour correlations
- Emotional inference in multimodal media

Table 1: summary of Included Studies on AI driven colour selection and Emotional outcomes (2020 - 2025)

Authors & Year	Purpose/ Study Focus	AI / Computational Method	Emotional or Psychological Measures	Key Findings
Dou & Xue (2025)	Examine perceptual similarities between colour terms and emotion words	Image-based visual corpus analysis	Valence, arousal, colour emotion similarity	Significant differences in colour emotion strength; blue showed weakest emotional correlation.
Xue & Ding (2025)	Predict colour saturation preferences using personality traits	Random forest ML regression	Personality traits; saturation preference	Openness, extraversion and Neuroticism strongly predict saturation preference; object colour associations influence emotional perception.
Nie & Lv (2023)	Generate emotionally aligned colour palettes	Deep neural networks	Emotion labels	AI generated palettes aligned with intended emotional categories based on human evaluations.
Yu, Wang, & Yang (2023)	Predict emotional and aesthetic palette preferences	Machine learning prediction models	Harmony, warmth, comfort, preference ratings	Models accurately predicted user preferences; emotional palettes appeal follows computational patterns
Deng, Zhou, & Zhang (2022)	Generate emotionally meaningful colour schemes for cultural terms on social media	Interactive Genetic Algorithm (IGA)	Emotional suitability; aesthetic evaluation	AI human iterative process produces emotionally coherent palettes; supports hybrid design workflows.
Guo, Westland & Lai (2023)	Analyse emotional polarity of colour terms on social media	NLP + sentiment analysis	Sentiment polarity	Red is linked to high arousal; blue/green to positive emotion; black to negative emotional content.

Rishu & Kukreja (2025)	Improve emotion recognition using colour + text + facial cues	Multimodal ML classification	Emotion categories	Adding background colour improved multimodal emotion recognition accuracy.
Nadler et al. (2025)	Compare metaphorical colour emotion understanding in humans vs LLMs	Large Language Models (LLMs)	Semantic emotion interpretation	LLMs recognise semantic patterns but lack perceptual grounding, leading to emotional mismatches
Kurilčik et al., (2024)	Model cross modal emotional associations	ML regression & classification	Emotional state judgements	AI captured general emotion pattern but mismatched human cross-modal interpretations
Yeh (2020)	Optimise emotional product colour design	ANN + Genetic ALgorithm	Aesthetic and emotional suitability	AI generated colour combinations aligned with user emotional evaluations

Thematic Synthesis of Findings:

Across the 10 included studies, three overarching themes emerged.

Theme 1: AI Systems can Generate Emotionally Distinct Colour Palettes:

Researches demonstrated that AI can generate or judge the color scheme fitting well in known emotional classes.

Key Findings:

- Machine emotion generation by means of Deep Learning based on color (2023): Deep models were successful in producing palettes for emotional labels such as `calm`, `energetic` or `romantic`, indicating the applicability of learning colour emotion structures algorithmically.
- Design of interactive genetic color matching (2022): Color matching to aesthetic/emotional categories in cultural product design: Genetic algorithms as a valid option.
- ANN + Genetic Algorithm for Sports Show colour design (2020) : AI models suggested colour combinations that people found emotionally appropriate, proving the potential for algorithms to be trained with the human emotional preference data.

Interpretation:

AI can learn such emotional or semantic colour associations not too badly, especially if it was pre-trained with:

- Labelled human data
- Colour emotion corpora
- Semantic prompt

Theme 2: AI can predict Emotional Preferences or Psychological Patterns Related to Colour:

The AI's capabilities aren't restrained to famous paintings and their color schemes, it can also sense emotional leans or predict what humans may find pleasing based on psychology.

Key Findings:

- Predicting colour palette preference (2023): Whereas ML models always accurately predicted the palettes that users preferred, suggesting emotional appeal could be learned from patterns in your dataset.
- Color saturation liking & personality traits (2025): Statistical learning models found robust associations between personality profiles and saturation preferences, suggesting that emotional personality profiles can be deduced computationally.
- Sentiment Analysis of colour names (2023): Colour-against-sentiment polarities were embedded in NLP models, facilitating the emotional understanding of colours in big-scale social data.

Interpretation:

AI would be able to recognise broader patterns of psychological and emotional responses to colour preferences and colour naming, all of which adds further weight to its role in personalised design.

Theme 3: AI and Humans do not always align in Colour emotion associations:

Quite a few studies have demonstrated that there are mismatches or divergences in the matter of AI colour reasoning versus human emotional perception.

Key Findings:

- **Perceptual (Dis)Similarities Between Colours and Emotions (2025):** The emotion-related clustering had significant differences from the AI-based image corpus analysis of the human-like patterns, which suggests that AI extracts patterns from digital data, not from the embodied experience.
- **Colour Metaphor Processing in AI vs Humans (2025):** AI large language models grasped colour metaphors but their emotional interpretations were different from those of the colourblind or painter groups, thus indicating that AI employs abstract semantic associations rather than perceptual ones.
- **Sound - colour - Emotion ML Model (2024):** Machine learning predictions of colour-emotion-sound relations were not entirely in agreement with human psychological judgments, thus revealing the possibility of cross-modal inconsistencies.

Interpretation:

AI is often close to human emotional responses but still lacks the capability to fully replicate the complexity of human perceptual and cultural colour emotion mapping.

This gap suggests:

AI generated colour selections might, without the designer realizing it, have the effect of emotionally influencing the audience in a way that the designer did not intend.

Colour algorithmic tool users may still need to be overseen by humans.

Summary of Emotional Outcomes Across Studies:

The emotional outcomes associated with AI generated or AI analysed colours included:

Positive Outcomes:

- Increased accuracy in emotion recognition
- Improved aesthetic satisfaction
- Predictive modelling for user preference
- Structured mapping of colour emotion semantics

Negative or Ambiguous Outcomes:

- Divergence between AI and human perceptual emotion mapping
- Cultural variations not fully captured by algorithms
- High arousal colours misclassified by ML models
- Dependence on training dataset limits generalisation

Overall Synthesis:

The combined results indicate that:

- AI is competent at learning and generating emotion relevant colour patterns, especially when trained on labelled emotional or semantic datasets.
- AI cannot fully replicate human emotional responses to colour, due to:
- AI colour tools are promising but require human centred oversight to ensure emotional appropriateness
- Future research should integrate psychology datasets, cross cultural samples and hybrid human AI colour evaluation frameworks for better emotional alignment.

DISCUSSION:

The systematic review analysed 10 peer-reviewed articles published between 2020 and 2025 that focused on the impact of AI-driven color selection or generation on human emotional or psychological changes. Individually, these papers show that AI is progressively able to simulate, forecast, and create colour configurations that have an emotional impact. However, the results also show that there are significant

differences and contradictions in how the algorithmic models interpret the color and how humans perceive the emotion, thus pointing to the necessity of more human-centered and psychologically informed AI colour systems.

AI's growing capability to model emotionally meaningful colour patterns:

By using different methodologies like deep learning, genetic algorithms, machine learning classifiers, corpus analysis, and multimodal affective computing, AI systems have shown a consistent capability of learning and imitatively exhibiting emotional features that are linked to colour.

As an illustration, a study on deep learning color emotion generation (2023) revealed that neural networks could create a set of colours that conform to standard emotional categories such as calm, energetic, or romantic merely by learning the associations. In the same way, genetic algorithms and ANN based optimisation have been able to predict colour combinations in such a way that participants found them as emotionally appropriate in product and interface design contexts. These results imply that AI has the capacity to internalise a consistent framework of colour emotion rules that come from human labelled datasets, thus opening the way for computational models to not only be co-workers in but also as a source of inspiration in the aesthetic and emotional domain of decision making in design environments.

Besides that, machine learning techniques as implemented in studies on colour palette preference prediction (2023) and personality colour saturation modelling (2025) have led to the conclusion that AI is capable of detecting psychological patterns and recognising individual differences in emotional colour experience. The models in question have proficiently established the co-relations between the Big Five personality traits, emotional preferences, and colour characteristics such as saturation and brightness. In fact, they have unveiled the potential of AI as a tool that can be harnessed to generate tailor-made colour solutions for digital interfaces, branding and user experience design.

AI can predict, Infer, and Classify emotional meaning from colour in context:

Contextual emotion recognition studies have been quoted as evidence of AI's involvement in affective computing. For example, the multimodal emotion recognition framework in comics (2025) combined background color with facial expressions and text sentiment to determine the emotional tone more accurately than by any single modality alone. This implies that AI considers color as a significant affective cue just like humans, who need contextual color information to understand the emotional content of the media.

The research based on the sentiment analysis of color names in social media (2023) revealed that large scale linguistic data have systematic emotional biases towards colour terms. Positive sentiment was often attributed to colours like blue and green, whereas red and black were associated with negative or high arousal contexts most of the time. These discoveries confirm the potential of AI in getting the emotional meaning from colour and even quantifying it in the digital world in such a way that it becomes a natural environment for the argument of colour selection associations to be computationally modelled.

Therefore, AI is not just a maker of emotionally meaningful colours but also a decoder that can interpret and recognise emotional cues from colour patterns that are hidden in complex multimedia systems.

Despite these strengths, AI does not fully replicate human emotional colour perception:

AI models tend to approximate human colour emotion associations, but some of the studies in them have shown systematic divergences.

However, a study on perceptual (dis)similarities in colours and emotions (2025) demonstrated that image based corpus analysis well-captured human-like clusters of emotion, the algorithmic clustering diverged subtly but significantly from psychological maps of emotional space (Buss et al., 2016) obtained from human rating studies. Such divergences may be due to the fact that AI models learn statistical properties of digital image distributions, rather than from perceptual experience as a whole organism (Botvinick et al., 2019).

In the same vein, research investigating colour figurative meaning between humans and LLMs showed that while LLMs seemed to process colours metaphorically based on their semantics, it was divorced from direct grounding in perception for emotional metaphors which led them to map emotions differently than human subgroups as painters or colourblind ones. This suggests that AI models could generalise meaning semantics and not perceive much of the visual nuances or cultural varieties.

The sound colour emotion machine learning model (2024) similarly documented discrepancies in reported vs. human rated emotional associations across modalities, indicating that the computational integration of multisensory emotional cues is still far from perfect. Taken together, these findings suggest that although AI could learn statistically valid associations it fails to recapitulate the original cognitive, cultural and affective embedding through which we experience colour.

This difference is crucial because color psychology is not only a semantic or statistical system of colors, but human color experience is partly determined by its biological realization influencing cultural symbolism, emotional memory and contextual cues that are underrepresented in algorithmic training data

Implications for Visual design and Human computer interaction:

The findings of this review will inevitably have significant implications for AI applied to visual communication, UI/UX, branding and digital media production.

First, AI-derived colour palettes could improve design productivity by enabling the automated selection of emotionally appropriate colours. Designers may use the AI tools to quickly generate emotionally consistent palettes, particularly in the case of customisation or real-time adaptation (e.g. virtual world scenes, interactive media).

Second, the results caution against leaving all colour decisions to AI systems. As AI has its own emotional interpretation of colour, which doesn't always align with human emotion, particularly in different cultural contexts or less-frequent emotional categories, designers still need to interject as keepers and modifiers. Human oversight is necessary to guarantee emotional adequacy, perceptual coherence and cultural acceptability -facets for which AI may also be lacking on its own.

Thirdly, AI systems should be trained on much more diverse datasets that include not only cross-cultural emotional associations but also perceptual color properties and contextual emotion cues. Present datasets might have the biases of the limited user populations or image sources and thus may not be very representative.

Also, the differences in emotional perception between AI and humans indicate the necessity of hybrid human-AI decision models in which AI suggests designs and humans adjust emotional nuances. This is in line with the ethics of using AI responsibly in creative and psychological applications.

Methodological Strengths and current gaps in literature:

Strengths across existing research:

- AI models demonstrate strong predictive capability for colour emotion labels.
- Several studies used validated psychological measures such as valence arousal ratings
- Multimodal approaches strengthen emotional inference accuracy.
- Large scale corpus and sentiment studies provide ecological validity.

Gaps and weakness:

1. **Limited integration of psychological theory:** Checklist of the AI research community is dataset-driven and learning associations but less ground colour emotion model in established psychological frameworks.
2. **Lack of cross-cultural samples:** The majority of datasets have been reflecting western or digital platform colour emotion biases that limit generalisability.
3. **Few studies directly compare human vs AI emotional responses:** A few of them only explicitly evaluate divergence between human judgements and algorithmic decisions.
4. **Emotional categories vary across studies:** Some use discrete categories, others use valence/arousal, and others rely on sentiment polarity, thus making it difficult to compare.
5. **Biases in training data:** When AI models are trained on limited or unbalanced datasets, they may inherit emotional colour biases, which do not generalise to real human populations.
6. **Scarcity of applied design research:** Only a few studies have been conducted to examine the effect of AI-selected colours in real UI applications, product design, or immersive digital environments environments.

Future Directions for Research:

Based on the identified gaps, future work should:

- Incorporate cross cultural emotional colour datasets to improve generalisability.
- Compare human, AI, and hybrid colour decision systems directly.
- Examine ethical and psychological risks of automated colour decisions in persuasive design.
- Investigate how AI colour decisions influence behavioural outcomes
- Develop explainable AI models that show why certain colours were selected for emotional purposes.
- Integrate physiological emotional measurement into AI colour training data.
- Expand multimodal emotional modelling to include shape, texture, motion and typography alongside colour.

Overall Interpretation:

The data generally indicate that AI can mimic a great number of the human emotional reactions to colour and thus, it is a very strong tool for the automation of colour selections in design. Nevertheless, the emotional models of AI are still not firmly based on perception and are missing the cultural aspects, which in turn cause inconsistencies that restrain the complete emotional accuracy. The research outcome is in favour of the creation of such AI tools as human centred ones, which are based on psychological knowledge and in

which colour decisions made by algorithms would only support but not substitute human emotion judgement.

CONCLUSION:

The systematic review drew together evidence from ten peer-reviewed studies published between 2020 and 2025, which explored the use of artificial intelligence in the selection or generation of colour and the resulting emotional or psychological effects. The research examined in this article (e.g., Nie & Lv, 2023; Dou & Xue, 2025; Xue & Ding, 2025; Yu et al., 2023; Deng et al., 2022) reveals that AI is progressively becoming capable of modelling, practicing, and generating colours that not only emotionally make sense but are also preferred by the user. Various deep learning models, genetic algorithms, machine learning predictors, and multimodal systems have demonstrated their ability to find the significant relationships between colour characteristics and human affective responses. This, in turn, positions AI as a potential tool to support designers, enhance aesthetic decision-making, and personalise visual experiences across digital interfaces, virtual environments, and creative industries.

AI still falls short of humans Ability to Feel Emotionally Evocative colour: From the same review, it seems AI is currently not able to mimic, in complex depth and nuance, human emotional experience of a given colour. In a few studies, algorithmic predictions and human beliefs were judged not to match, in particular for sentence content involving metaphorical meaning, cross-modal emotional associations or perceptual grounding. These differences serve to remind us that human emotional reactions to colour emerge not only from statistical regularities but also from embodied sensory encounter, cultural symbolism and psychological situation - all of which are dimensions that current AI models struggle to model.

Collectively, these results suggest that AI generated colour systems are most successful when used as augmentative tools that generate and analyse quickly, but remain reliant on human intervention for guiding the emotional connection to content as well as in maintaining cultural sensitivity and perceptual coherence. Because of this, designers and researchers should implement a human centered AI perspective, inasmuch as algorithmic outputs are informed suggestions more than authoritative decisions.

The review also pinpoints methodological weaknesses among the studies, such as lack of cross-cultural data and inconsistent emotional responses. Filling these gaps will be vital for the development of the field. Interesting leads for further research include cross-cultural datasets of emotional colour, physiological evidence for how we respond to colour as a function of emotion and what are the decision making processes underlying our choice of colours in AI. Extending multimodal emotional modelling – colour with shape,

texture, motion and semantics included – will also deepen AI's ability to comprehend and modulate emotional experience.

In summary: "Applies AI to supporting a human in generating emotionally charged color designs In sum, AI provides us with promising tools for understanding and creating emotional meaningful colour designs, but our use should continue rooting on the human emotional insight; Future AIs may allow us to engage in more responsible, expressive and emotionally intelligent visual design.

REFERENCE

1. Dou, J., & Xue, W. (2025). Perceptual (dis)similarities between colors and emotions: An empirical investigation with the image-based visual corpus analysis approach. *Acta Psychologica*, 253, Article 105447. <https://doi.org/10.1016/j.actpsy.2025.105447>
2. Xue, N., & Ding, J. (2025). Exploring the association between personality traits and colour saturation preference using machine learning. *Acta Psychologica*, 253, Article 104752. <https://doi.org/10.1016/j.actpsy.2025.104752>
3. Nie, T., & Lv, X. (2023). Deep learning-based machine colour emotion generation. *Journal of visual communication and Image Representation*, 14(1), 1-14. <https://doi.org/10.4018/IJMCMC.325349>
4. Yu, S., Wang, L., & Yang, Y. (2023). Analyzing and predicting colour preference of colour palettes using machine learning. *Heliyon*, 9(3), Article e14080. <https://doi.org/10.1016/j.heliyon.2023.e14080>
5. Deng, L., Zhou, F., & Zhang, Z. (2022). Interactive genetic colour matching design of cultural and creative products considering colour image and visual aesthetics. *Heliyon*, 8(9), Article e10768. <https://doi.org/10.1016/j.heliyon.2022.e10768>
6. Guo, J., Westland, S., & Lai, A. (2023). Sentiment analysis of colour names in social media: A computational approach to emotional colour meaning. *Color Research & Application*, 48(4), 325-334. <https://doi.org/10.1002/col.22837>
7. Rishu, A., & Kukreja, S. (2025). A novel multimodal framework for emotion recognition in comics using background colour, facial expressions, and text sentiment. *Expert systems with Applications*, 269, Article 128267. <https://doi.org/10.1016/j.eswa.2025.128267>
8. Kurilčik, J., Połom, M., Jankowski, M., Kozłowska, O., Łabich, A., Skiba, E., Spierewka, P., Śliwiński, P., & Kostek, B. (2024). Analyzing the relationship between sound, color, and emotion based on subjective and machine learning approaches. *Procedia Computer Science*, 258, 438-447. <https://doi.org/10.1016/j.procs.2024.09.226>
9. Nadler, E. O., Guilbeault, D., Ringold, S. M., Williamson, T. R., Bellemare-Pepin, A., Comşa, I. M., Jerbi, K., Narayanan, S., & Aziz-Zadeh, L. (2025). Statistical or embodied? Comparing colorseeing,

colorblind, painters, and large language models in their processing of color metaphors. *Cognitive Science*. Advance online publication. <https://doi.org/10.1111/cogs.70083>

10. Yeh, Y. - E. (2020). Prediction of Optimized Color Design for Sports Shoes Using an Artificial Neural Network and Genetic Algorithm. *Applied Sciences*, 10(5), Article 1560.
11. <https://doi.org/10.3390/app10051560>
12. Hemphill, M. (1996). A note on the effect of colour on customer reactions to apparel. *Journal of Fashion Marketing and Management*, 1(1), 3-12.

