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Color studies in applied psychology and social sciences: An overview

Abstract:

Our article presents a comprehensive overview of studies on colour from the perspective of applied psychology and social sciences. It discusses major findings from the psychology of colour applied to marketing, business, politics and sports as well as to problems connected with using color tests in psychological diagnoses. Moreover, we present an overview of particularly interesting colour studies on synaesthesia related to cognitive and applied psychology as well as psycholinguistics. Finally, we discuss the most recent trends in investigations into applied colour psychology as well as potential directions for further research.

Keywords:

color, psychological diagnosis, politics, sport, marketing, synaesthesia

Streszczenie:

Artykuł stanowi szczegółowy przegląd przeprowadzonych badań nad kolorem z perspektywy psychologii stosowanej i nauk społecznych. Omówione zostały główne wyniki badań dotyczących psychologii koloru z zakresu marketingu, biznesu, polityki i sportu jak i problemy związane z zastosowaniem testów kolorów w diagnozie psychologicznej. Ponadto analizie zostały poddane szczególnie interesujące studia nad synestezją z zakresu koloru będące na pograniczu psychologii kognitywnej i stosowanej jak i psycholingwistyki. Artykuł poglądowy kończy prezentacja najnowszych trendów w psychologii koloru oraz dyskusja dotycząca kierunków dalszych badań.

Słowa kluczowe:

kolor/barwa, diagnoza psychologiczna, sport, marketing, synestezja

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Introduction

An interest of psychology, and particularly applied psychology in the impact of colour on human functioning has a long history; however, it has fairly limited research achievements. Some more systematic empirical studies in the field appeared at the end of the last century; however, many of them suffer from methodological shortcomings and fail to encompass a correlational analysis which is a norm in modern psychology. To illustrate this fact let us consider the results of research on the colour red. For decades, various scholars have discussed the symbolical associations of red with fire, energy, passion and love as well as the common metaphor for war and rage (Mahnke, 1996). In this context it was expected that red should cause arousal in the human organism (Mahnke, 1996). Nonetheless, the vast majority of contemporary empirical investigations do not substantiate this assumption (e.g., Ainsworth, Simps, Cassell, 1993; Hatta et al., 2002). For this reason other most recent studies on red come to the fore, promoting empirically validated claims that the colour red influences, among other things, human motivational processes (Elliot, 2007; Lichtenfeld, 2009; Mehta, Zhu, 2009; Rutchick, Slepian, Ferris, 2010), can act as a distractor (Ioan et al., 2007), or has an impact on perceived sexual attractiveness (Elliot and Niesta, 2008; Elliot et al. 2010).

Elliot and Maier (2014) suggested that research on the psychology of colour has been conducted within the framework of applied psychology for a few decades (see many studies published in the *Journal of Applied Psychology* as early as the pre-war period (e.g., Katz, & Breed, 1922; Schiller, 1935; Philip, 1945; Walton & Morrison, 1931). However, due to a wide variety in terms of the covered topics as well as a limited replicability of the results, there are rather few comprehensive overview articles in the field. If such articles exist, they pertain mostly to a narrow range of topics, focusing primarily on marketing and business (e.g., Sable & Akcay, 2011). Overview articles on the psychology of colour that are published in psychological journals concern mostly issues unrelated to applied psychology. For instance, in the prestigious *Annual Review of Psychology* (ARP) the majority, if not all of the colour-related reviews focus on colour physics and physiology (Abramov & Gordon, 1994; Boynton, 1988; De Valois & Abramov, 1966; Jacobs, 1976; Jameson & Hurvich, 1989; Mollon, 1982).

Therefore, it seems particularly worthwhile for us to present a comprehensive review of research to date in applied psychology dealing with the issue of colour. In the following sections we discuss study findings from the psychology of colour applied to marketing, business, politics and sports as well as problems connected with using color tests in psychological diagnoses. In addition, we offer an overview of particularly interesting studies on synaesthesia bordering on cognitive and applied psychology, colour

research and linguistics. Finally, we describe the most recent trends in investigations into applied colour psychology as well as potential directions for further research.

Colour in marketing and business

Psychologically in the sellingsome goods, colours might fulfil many different functions: they attract attention, convey some information, or evoke certain emotions or motivations.

The first of the above-mentioned functions, that is, attracting attention through higher visibility of a certain colour is obvious. Research regarding perception has shown that especially red and purple fulfil this function well, since they are noticed more quickly than other colours in the horizontal perspective (e.g., Koslow, 1985).

Studies examining real advertisements have basically concentrated on black and white vs. colourful stimuli. In Fernandez and Rosen's (2000) study, colourful advertisements attracted greater attention among the participants – and so visibility in the telephone book's Yellow Pages was improved. However, it is important that when the participants were taking a decision which company to call, the colour of the commercial was an advantage only when it was consistent with the advertisement's content. In the opposite case, it decreased the effectiveness of the advertisement. In the follow-up study (Lose, Rosen, 2001) these outcomes were confirmed and, additionally, it was shown that if the colour does not convey any information about product quality (e.g., clear, blue water in the commercial of holidays in the Caribbeans), it is not more efficient than black and white commercials. Similar outcomes were obtained by Moore and others. (2005). Their research suggests that using incongruent colour schemes in banners compared to the rest of the website results in more attention being paid to the banner; however, the attitude towards such a banner is more negative than towards a banner whose colours are more congruent with its website. In summary, attitudes towards advertised products are influenced by the content of the commercial more than by bare attention paid to it. Therefore, it is highly probable that a bright red colour in the advertisement will increase the chance of noticing it, but in many cases – when it is inconsistent with the brand profile or the product itself, it can decrease the product rating.

Research regarding another function of colour – evoking physiological reactions, emotions and motivations (which might indirectly influence customer behaviour) is relatively the least advanced. More than a dozen academic marketing studies (Mantua, 2007) agree on colour having an impact or effect on a brand's perception (identification, identity and awareness, attitudes, evaluation and choice). For example, blue appears to be a highly positive colour, as blue stores, products and websites are rated, among others

things, as more relaxing, and more trustworthy (Alberts & van der Geest, 2011; Lee & Rao, 2010). However, little is known about why a particular colour might be perceived and interpreted in a specific way (Whitfield & Wiltshire, 1990). The best conclusion regarding all these studies is Holmes, Fouty, Wurtz and Burdick's (1985) statement: "Enough studies have been reported to present a consistently inconsistent picture of the relationship". As indicated in the introduction, even the most commonly acknowledged observation used in popular science publications that "the red colour stimulates" is inconsistent with the majority of scientific studies on this topic (e.g., Ainsworth, Simpo, & Cassell, 1993; Hackney, 2006; Hatta et al. 2002).

It must be admitted, however, that it seems obvious that some colours have certain connotations. Even if the colour red does not stimulate at the physiological level, the whole history demonstrates that this colour is a symbol of fire, energy and is a metaphor of war, rage and anger (Mahnke, 1996). Therefore, modern business and marketing use colours to express the desired image, profile or character they want their stakeholders to associate with them (e.g., Van den Bosch, de Jong & Elving, 2006). However, it should be remembered that as colours are perceived more like symbols, they convey context-dependent messages. For example, the study by Rutchick, Slepian and Ferris (2010) showed that using a red pen can bias the evaluations of people. Participants using red pens to correct essays marked more errors and awarded lower grades than the people using blue pens. In another context, the colour red has quite the opposite connotation as it might enhance the perceived sexual attractiveness of a person (Elliot & Niesta, 2008).

Additionally, the symbolic value of colours is culturally dependent (Huang, 1993; Mantua, 2007; Oberascher, 2008). Of course, meanings attached to some colours may be more or less pan-cultural, such as the colours of traffic lights, or blue for sea and sky, and green for nature (Morgan & Welton 1987), while some are regional and unique to specific cultures. However, there have not been any systematic studies investigating this topic.

Summing up, in comparison to common beliefs about the functions and qualities of colours, their practical application is much narrower.

Colour in politics

According to Sawyer (2006), colours used by political parties have a very long history, going back to ancient Greece and Rome. At present, colours applied by particular ideologies usually have certain historical connotations. Red used to be generally the colour of revolution, war and radicalism, for example in the French Revolution. Today, modernising Labour parties tend to shy away from using red unless in the form of the red rose of the Socialist International rather than the blood-soaked flag of a popular revolt. On the

other hand, green has become a symbol of ecological parties. This symbolic shorthand may have had its origins in the ‘green bans’ imposed by the Builders Labourers Federation (BLF) on development projects in Sydney in the early 1970s (Sawer, 2006). However, green is also the colour of Islam and is used today by some Islamic political parties. Other colours also have their connotations; blue, particularly dark blue, is often associated with Conservative parties, whereas black is primarily associated with anarchism or nationalism.

In political marketing, using certain colours is even easier than in “traditional” marketing and business, because, as it was explained above, colours in politics have clear connotations. Colours play an important role not only as the cause’s visual symbols but also in the general emotional impression and image of different things. Politicians tend to take advantage of that by, for example, manipulating politicians’s clothing or their picture backgrounds. A person’s dressing style was found to be statistically significant and conceptually important (Johnson et al., 1977), but actually there exist only a few studies demonstrating how the colour of clothing, especially a politician’s, influences a viewer’s perception. Probably some political parties have conducted more studies, but their results are not available. Actually, it is only known that red enhances the physical attractiveness of a woman (Elliot & Niesta, 2008) and that black influences the perceived aggressiveness of an assessed suspect (Vrij, 1997). Nonetheless, because of the absolutely different context, it is not certain that such effects would be observed in judging a politician as well. In an experiment conducted before the elections to the European Parliament (Czerko, 2004), researchers manipulated the colour of a candidate’s shirt in his promotional materials. It was found that the candidate wearing a white or a blue shirt evoked more positive emotions, was liked more and received more declared support than the candidate wearing a green shirt. It could be questioned, however, if a candidate of an ecological party would also be perceived as worse, or if candidates of parties that are clearly associated with some colours would also benefit from wearing white or blue. Moreover, cross-cultural universality of such findings needs to be confirmed. Clearly the political meaning of colours varies across time and space and is culturally dependent (Fine et al. 1998) probably even more so than in “traditional” marketing. For example, in Poland, politicians of the populist and scandalous party Samoobrona (Self-defence) wore red-white ties symbolising the Polish national flag, which was supposed to demonstrate that they were patriots (Szarota, 2008). Such a symbol would probably be understood similarly only in Indonesia and Monaco because of the same colour coding of their flags.

Colour in sports

Sports is a discipline in which psychological studies have relatively consistent and clear results. In the scientific literature there are many studies regarding the use of colours in sports. One of the most interesting observations is the “red wins” effect.

The influence of a sportsman’s red outfit on the result of a sports competition has been analyzed during the Olympic Games in Athens. The obtained results suggest that having a red outfit increased a sportsman’s chances of winning (Hill & Burton 2005). During boxing, taekwondo, Greco-Roman wrestling and freestyle wrestling tournaments, the colour of sportsmen’s outfit (red or blue) was chosen at random. Hence, the number of victories won by the competitors wearing blue and by those wearing red should be similar in the course of the whole tournament. Despite this fact, significantly more winners were wearing red (Hill & Burton 2005).

Hill and Burton (2005) suggested that a red outfit might stimulate the sportsmen wearing it, increasing their “will to fight” and dominate the opponent. Such an assumption is probably not true. For example, Hackney (2006) demonstrated that persons’ levels of testosterone did not alter only because they were wearing red or black T-shirts. It seems that the observed effect is rather dependant on the “observer”, in other words, the referee or the “red” sportsman’s opponent and not the person dressed in red. This hypothesis was confirmed by Hagemann, Strauss, and Leming (2008) who demonstrated that referees assessing the same taekwondo fight, in which the opponents’ colours were changed, assigned approximately 13% more points to the “red” sportsman than to the “blue” one. Additionally, Sorokowski & Szmajke (2007) found that the colour of T-shirts influenced only the competitors’ bravery and aggressiveness and not the perception of their technical and physical abilities. At the same time, Rowe, Harris and Roberts (2005) and Matsumoto, Konno, Hata (2007) showed that judokas in blue outfits won more often than the judokas in white outfits. The authors suggested that sportsmen’s successes in a certain colour t (also red over blue uniforms) might result from how movements of certain colours are perceived. However, see also the contradictory results of Dijkstra and Preenen (2008).

So far, there has been no convincing evidence confirming the “red wins” effect in team sports. Attrill and others (2008) suggested that this effect was observed in football. They demonstrated, for example, data from the English league since 1947 and an analysis of the results of the English national team playing in white or red T-shirts. However, no such effect was observed in two further studies – one investigating Polish football league results (Szmajke & Sorokowski, 2006) and another one German league results (Kocher & Sutter, 2008).

Summing up, the “red wins” effect is observable in martial arts, in which the opponents fight directly with each other rather than being on a sports team. Although its origin and mechanism is not fully clear, it seems to be primarily related with incorrectly perceiving sportsmen in red outfits as more active, brave and aggressive.

Colours in psychological diagnoses

Despite many methodological problems, colours have long been used in psychological diagnoses. Many instruments have been developed, such as the Pfister’s Colour Pyramid test (1950) (Schaie, 1963); the Rorschach Inkblot test (1927) (Klopfer & Davidson, 1962), the Lüscher Colour test (1948) (Lüscher, 1969), the Lowenfeld Mosaic test (Lowenfeld, 1952); and different tests used regionally, for instance the Frieling Test (Muths, 2001), the Weyssenhoff test (Weyssenhoff, 1991) or, recently developed the Manchester Colour Wheel (Carruthers, Morris, Tarrier, Whorwell, 2010). They have been designed mostly to interpret the human psyche, for instance personality. It should be highlighted, however, that all these methods are based on projection mechanisms proposed by Freud. Many experimental studies have shown that the results of projection methods are often far from reality (Lilienfeld, Wood, & Garb, 2000). What is more, even very early reviews have neglected the proposed relationships between response to colour and the majority of personality attributes (Cerbus & Nichols, 1963). Nevertheless, continuous interest in the above-mentioned methods has inspired further discussion of colour usage in psychological diagnoses.

In 1921, Rorschach as one of the first clinical psychologists noticed the relationship between colours and emotions. Having conducted many studies on reactions to black-and-white and colourful blots, he suggested, for example, that patients who did not notice colours during the test were emotionally inhibited, and people who had many associations involving colours were prone to frequent changes in mood (Schachtel, 1943). However, the test does not fulfil basic psychometric requirements for psychological diagnostic tools (Wood, Nezworski, Lilienfeld, & Garb, 2003). Its test validity has not been sufficiently proven, and as it is widely available on the Internet (Wikipedia), together with the analysis of potential answers, its application here seemed to make little sense.

The most famous colour test is probably the Lüscher Colour Test (Lüscher, 1969). In this test, the participant orders eight colours from those most liked and which evoke the most positive emotions, to those least liked and evoking the most negative emotions. On the basis of colour preferences the psychologist draws conclusions about the patient. Similarly as in Rorschach’s test, the Lüscher Colour Test has only good reliability (Donnelly, 1974) when the participants do not change their colour preferences. Such stability is not

related in any way to the tool's diagnostic qualities, and no data were presented regarding its validity. In addition, the theory upon which the author developed his tool is highly controversial in the context of contemporary knowledge, and studies confirming his theory, described by Lusher are rather anecdotal in nature since he did not present any bibliography or references.

Another test is the Pfister's Colour Pyramid test (Schaie, 1963). Again, no independent studies confirming its psychometric qualities or verifying its practical usage have been presented in the scientific literature (at least in English). In this test the patient, using 24 colourful blocks, is supposed to create a pyramid he or she likes and then a pyramid he or she does not like. Finally, the Lowenfeld Mosaic Test (Lowenfeld 1952, Woodcock, 1984) is the last relatively frequently used test. It is applied mainly to children. People create colourful pictures with the collection of mosaics, which are later interpreted by the psychologist.

In conclusion, despite many methodological problems, colours have long been used in psychological diagnoses. However using them is very controversial in the context of contemporary scientific knowledge.

Colour studies on synaesthesia

The earliest interest in the relationship between colour-vision and modulating human perception can be traced back to such scholars as Pythagorus or Sir Isaac Newton. They proposed hypotheses about the existence of a physical relationship between the light and sound frequencies that are responsible for the sub-modality of colour and pitch (Lyons 2001). This old concept of human perception non-modularity has received support from recent behavioural and brain imaging studies suggesting that cross-modal interactions are common in normal perception and that the cortical pathways previously considered to be sensory-specific are also modulated by signals from other modalities (Shimojo & Shams 2001).

Existence of relationships between sensory sub-modalities has been most extensively explored in studies on synaesthesia, a condition which involves involuntary physical experience of cross-sensory associations, particularly between words, letters or speech sounds and colour. The term synaesthesia is used to refer to a neurologically-based condition in which stimulation of one sensory or cognitive pathway leads to automatic, involuntary experiences in a second sensory or cognitive pathway; for example, letters, numbers or speech sounds may be perceived as inherently coloured (Simner et al. 2005, Ward et al. 2006).

Different existing forms of synaesthesia trigger cross-modal associations; however, they are usually idiosyncratic in nature. More non-arbitrary patterns of correspondence tend to be observed in the mappings between colours and speech sounds. As demonstrated in several studies on synaesthetic populations, there appears to be a strong correlation between auditory pitch and visual luminance, and a general tendency to associate high pitch sounds with light colours and low tones with darker hues (cf. Hubbard 1996, Simner et al. 2005, Ward et al. 2006). Some theoretical accounts of synaesthesia indicate that tendencies in cross-modal matching especially between auditory and visual stimuli were also found in a non-synaesthetic population (Marks 1975, Harrison 2001). Therefore, it was suggested that the results of synaesthetic research can be applied to inform theories of ‘normal cognition’, since people who report this condition are hypothesised to recruit analogous mechanisms instead of the ones used in non-synaesthetic cross-modal perception. The differences were reported to demonstrate the nature of sound-colour mappings, since in the general population they are strategic rather than automatic – as in the synaesthetic population where the perceptual experience is more explicit and vivid (Ward et al. 2006).

There is considerable synaesthesia research; however, in this article we focus on studies that associate sounds with colour attributes as they seem particularly interesting and offer potential insights into psychological aspects of speech perception. The idea of colour perception, from a psycholinguistic perspective, was first investigated by Jakobson (1962), who identified some regularities in vowel-to-colour associations from case studies in coloured hearing synaesthesia. According to his proposal, chromaticity corresponds to the vertical axis of the vowel chart; thus the maximally open vowels (i.e. compact in acoustic terms), for example /a/, are regarded as maximally chromatic, that is, red. On the other hand, the light vs. dark distinction seems to be related to the horizontal position of the tongue, – vowels /o/ and /u/ tend to be associated with darker colours, whereas /e/ and /i/ with brighter colours (Jakobson, 1962: 488).

Jakobson’s hypotheses correspond, to a large extent, to other scholars’ observations based on case reports of sound-colour synaesthesia. For instance, Marks (1975) noted that the black vs. white distinction is related to vowel ‘pitch’, while the red-green distinction correlates with the ratio of second to first formant frequency of vowels. Moreover, Jakobson’s (1962) claims are in line with synaesthetic research results that point to a strong correlation between auditory pitch and visual luminance as well as a general tendency to associate high pitch sounds with light colours and low tones with darker hues (e.g. Simner et al. 2005, Ward et al. 2006).

Relatively few studies to date have explored this synaesthetic-like phenomenon of making associations between colours and auditory stimuli. Flagg and Stewart (1985)

conducted a study on consonants perception by using primary colours, and their findings demonstrated that colour can be used to study speech perception. In another very interesting study Dailey and others (1997) investigated the relation between creativity, synaesthetic tendencies and physiognomic perception measured by rating colours using adjectives with emotional connotations. Their results showed that creative individuals have access to a primary thinking process that assumes a unity of different sensory modalities, since these persons exhibited stronger associations between colours and vowels, as well as tones and emotional terms.

A series of experiments investigating sound-colour associations in Polish and English sound systems in a non-synaesthetic population were conducted by Wrembel (2009), Wrembel and Rataj (2008), Wrembel and Grzybowski (2011). The results demonstrated the statistical significance of sound-colour interactions for all the tested Polish vowel sounds and the vast majority of the English vowels. Moreover, the patterns of cross-modal correspondence were also found for specific colour attributes, namely, for hue, saturation and lightness. This series of studies indicated that vowel-sound mappings were consistent and non-arbitrary in a non-synaesthetic perception, and they followed a more universal tendency in which bright colours tend to be associated with high front vowel sounds (e.g. /i/, /e/), dark colours are attributed to back vowels (e.g. /u/, /o/), while open sounds like /a/ tend to be perceived as red, and central vowels such as /ə/ are mapped onto achromatic grey.

This line of studies on the significance of colour perception in psycholinguistics provides some further evidence for the non-arbitrary nature of cross-modal mappings in speech perception. The potential applications range from insights into psychological underpinnings of human perception to pedagogical implications for foreign language pronunciation instruction (Wrembel 2007).

Future research

It seems that future research on the psychology of colour or, placed in a wider perspective, social studies on the role of colour stand a chance of a rapid development. Therefore, our intention is to present to the reader several areas of recent research, that appear particularly promising. In the following paragraph we will also discuss some methodological issues connected with further studies in the field.

First of all, studies on culturally-related differences and universal tendencies in colour perception and preferences seem to be particularly interesting (Elliot et al., 2013; Sorokowski et al., 2014; Taylor, Clifford, & Franklin, 2013). These studies began a discussion

about the universality of color preferences, and possible mechanisms underlying these preferences.

Other interesting studies demonstrated that the colours of clothing, especially red, can influence the perceived sexual attractiveness of a person (Elliot & Niesta, 2008). The most recent replications of this study showed that it is not only men who tend to interpret a woman's red clothing as a sexual signal (Guéguen, 2012), but also women actually use red in this way (Elliot and Pazda, 2012; Beall and Tracy (2013).

Another new line of research concerns the perceived colour of food packaging on one's willingness to eat it, on its apparent taste and other properties. For example, a study by Guéguen and Jacob (2013) demonstrated that coffee was perceived to be warmer when served in a red cup, whereas Ross, Bohscheid, and Weller (2009) found that red wine was perceived to have a better flavour when it was served in a blue glass. Other interesting findings in similar experiments were reported by Geier, Wansink, & Rozin, (2013) or Piqueras-Fiszman and Spence (2012).

From a methodological standpoint, the literature on colour psychology has seen several improvements in the past decade. However, the need for further modifications remains, and it concerns several areas, two of which will be briefly discussed here. First of all, researchers other than those representing the social sciences and humanities allow for the distinctions between various attributes of colours, such as saturation, in other words, how "intense" or "concentrated" a color is; hue (adding white and black pigment); and brightness/lightness, or, how light or dark a given colour is (Berns, 2011). Each of these colour attributes may influence psychological functioning (Camgoz, Yener, & Guvenc, 2003); so only one of them should be allowed to vary in a well-controlled experiment. However, the vast majority of research on colour in social studies has failed to allow for these distinctions. Therefore, we cannot fully explain which independent variables are responsible for the generated results of such studies.

Secondly, researchers select colour stimuli unsystematically – which is very problematic – and introduce some bias in colour studies as different shades of yellow, blue or red are used as stimuli. Controlling colour attributes at the spectral level by using pre-matched stimuli or a spectrophotometer is necessary to conduct truly rigorous colour research.

Conclusions

In conclusion, psychology and other social sciences have long been interested in the influence of colours on individuals (Mahnke, 1996), but research results are rather limited. Experimental studies often have had contradictory outcomes and their theoretical background is frequently inconsistent with modern neuroscience. For example, Steinhardt's

work about colour therapy (1997) was based on, among others, Lüscher's theory, Kandinsky's 100 year-old theory and even Indian beliefs but did not take into account modern colour-related experimental knowledge. Additionally, many studies regarding colours are conducted inadequately (Smith, Bell and Fusco, 1986). Finally, the majority of the application or cognitive studies in the social sciences ignore the fact that colours consist of three elements: lightness, saturation and hue (Berns, 2011). Therefore, it is generally unclear which "green" or "red" colour was used in which study or even if the observed effect was not reliant upon the saturation of the employed stimuli. Readers must be aware of all these problems while reading this article.

On the other hand, modern psychology as well as other social studies or humanities have started to pay more and more attention to color-related research; such studies are growing in number and are being conducted at a higher methodological level. New lines of research have started to emerge, including for example, the aforementioned 'red wins' issue. It allows us to anticipate with hope future research on the applied psychology of colour.

References:

- Abramov, I., & Gordon, J. (1994). Color appearance: On seeing red-or yellow, or green, or blue. *Annual Review of Psychology*, 45, 451-485.
- Ainsworth, R.A., Simps, L., & Cassell, D. (1993). Effects of three colors in an office interior on mood and performance. *Perceptual and Motor Skills*, 76, 235-241.
- Alberts, W., & van der Geest, T.M. (2011). Color matters: Color as trustworthiness cue in web sites. *Technical Communications*, 58, 149-60.
- Attrill, M.J., Gresty, K.A., Russell, A. Hill, R.A., & Barton, R.A. (2008). Red shirt colour is associated with long-term team success in English football. *Journal of Sports Sciences*, 26, 577-582.
- Beall, A.T., & Tracy, J.L. (2013). Women more likely to wear red or pink at peak fertility. *Psychological Science*, 24, 1837-1841.
- Berns, R.S., (2001). *Principles of Color Technology*. Wiley, New York.
- Boynton, R. M. (1988). Color vision. *Annual Review of Psychology*, 39, 69-100.
- Camgoz, N., Yener, C., & Guvenc, D. (2003). Effects of hue, saturation, and brightness: Part 2. *Color Research & Applications*, 29, 20-28.

- Carruthers, H.R., Morris, J.M., Tarrier, N., & Whorwell, P.J. (2010). The Manchester Color Wheel: development of a novel way of identifying color choice and its validation in healthy, anxious and depressed individuals. *Medical Research Methodology*, 10, 12.
- Cerbus, G., & Nichols, R.C. (1963). Personality variables and response to color. *Psychological Bulletin*, 60, 566-575.
- Czerko, W. (2004). *Influence of clothes color on assessment of politicians*. Unpublished M.A. thesis, Warsaw School of Social Sciences and Humanities, Warsaw.
- Dailey, A., Martindale, C., & Borkum, J. (1997). Creativity, Synaesthesia, and Physiognomic Perception. *Creativity Research Journal*, 10, 1-8.
- De Valois, R. L., & Abramov, I. (1966). Color vision. *Annual Review of Psychology*, 17, 337-362.
- Dijkstra, P.D., & Preenen, P. (2008). No effect of blue on winning contests in judo. *Proceedings of Royal Society, B.*, 275, 1157-1162.
- Donnelly, F. A. (1974). The Luscher Color Test: Reliability and selection preferences by college students. *Psychological Reports*, 34, 635-638.
- Elliot, A. J., & Maier, M. A. (2014). Color psychology: Effects of perceiving color on psychological functioning in humans. *Annual Review of Psychology*, 65, 95-120.
- Elliot, A.J, Maier, M.A., Moller, A.C., Friedman, R., & Meinhardt, J. (2007). Color and psychological functioning: The effect of red on performance attainment. *Journal of Experimental Psychology: General*, 136, 154-168.
- Elliot, A.J. & Niesta, D. (2008). Romantic red: red enhances men's attraction to women. *Journal of Personality and Social Psychology*, 95, 1150-1164.
- Elliot, A.J., Niesta, D., Kayser D., Greitemeyer T., Lichtenfeld S., Gramzow R.H., et al. (2010). Red, rank, and romance in women viewing men. *Journal of Experimental Psychology: General*, 139, 399-417.
- Elliot, A.J., & Pazda, A.D. (2012). Dressed for sex: Red as a female sexual signal in humans. *PLoS One*, 7, 4.
- Fernandez, K., & Rosen, D. L., (2000). The effectiveness of information of and color in Yellow Pages advertising. *Journal of Advertising*, 29, 59-73.
- Fine, G. A., Montemurro, B., Semora, B., Stalp, M.C., Claussen, D.S. & Sierra, Z. (1998). Social Order through a Prism: Color as Collective Representation. *Sociological Inquiry*, 68, 443-457.

- Flagg, L., & Stewart, J. (1985). Studying speech perception in adolescent school-age children by utilizing primary colour perception”, *Journal of Psycholinguistic Research*, 14, 67-80.
- Geier, A., Wansink, B., & Rozin, P. (2013). Red potato chips: Segmentation cues can substantially decrease food intake. *Health Psychology*, 31, 398-401.
- Guéguen, N. (2012). Color and women attractiveness: When red clothed women are perceived to have more intense sexual intent. *Journal of Social Psychology*, 152, 261-265.
- Guéguen, N., & Jacob, C. (2014). Coffee cup color and evaluation of a beverage’s “warmth quality”. *Color Research & Applications*, 39, 79-81.
- Hackney, A. C. (2006). Testosterone and human performance: influence of the color red. *European Journal of Applied Physiology*, 96, 330-333.
- Hagemann, N., Strauss, B., & Leming, J. (2008). When the referee sees red... *Psychological Science*, 19, 769-771.
- Harrison, J. (2001). *Synaesthesia. The strangest thing*. Oxford: Oxford University Press.
- Hatta, T., Yoshida, H., Kawakami, A., & Okamoto, M. (2002). Color of computer display frame in work performance, mood, and physiological response. *Perceptual and Motor Skills*, 94, 39-46.
- Hill, R.A., & Burton, R.A. (2005). Red enhances human performance in contests. *Nature*, 435, 293.
- Holmes, C. B., Fouty, H., Wurtz, P. J., & Burdick, B. M. (1985). The relationship between color preference and psychiatric disorders. *Journal of Clinical Psychology*, 41, 746-749.
- Huang, J.H (1993). Color in U.S. and Taiwanese industrial advertising. *Industrial Marketing Management*, 22, 195-198.
- Hubbard, T. L. (1996). Synesthesia-like mappings of lightness, pitch and melodic interval. *American Journal of Psychology*, 109, 219-238.
- Ioan, S., Sandulache, M., Avramescu, S., Ilie, A., Neacsu, A., Zagrean, L., et al., (2007). Red is a distractor for men in competition. *Evolution and Human Behavior*, 2007, 28, 285-293.
- Jacobs, G. H. (1976). Color vision. *Annual Review of Psychology*, 27, 63-89.
- Jakobson, R. (1962). *Selected Writings: I Phonological Studies*. The Hague: Mouton.

- Jameson, D., & Hurvich, L. M. (1989). Essay concerning color constancy. *Annual Review of Psychology*, 40, 1-24.
- Johnson, B. H., Nagasawa, R. H., & Peters, K. (1977). Clothing style differences: Their effect on the impression of sociability. *Home Economics Research Journal*, 6, 58-63.
- Katz, S. E., & Breed, F. S. (1922). The color preferences of children. *Journal of Applied Psychology*, 6, 255-266.
- Klopfer, B., & Davidson, H.H. (1962). *The Rorschach Technique: an introductory manual*. New York: Harcourt, Brace & World.
- Kocher, M.G., & Sutter, M. (2008). Shirt colour and team performance in football. In P. Andersson, P. Ayton, & C. Schmidt (Eds.) *Myths and facts about football: The economics and psychology of the World's Greatest Sport*. Cambridge Scholars Publishing, 125-131.
- Koslow, R.E. (1985). Effects of ball color on horizontal perimetry detection. *Perceptual and Motor Skills*, 60, 351-354.
- Lee, S., & Rao, V.S. (2010). Color and store choice in electronic commerce: The explanatory role of trust. *Journal of Electronic Commerce Research*, 11, 110-26.
- Lilienfeld, S.O., Wood, J.M., & Garb. H.N. (2000). The scientific status of projective techniques. *Psychological Science in the Public Interest*, 1, 27-66.
- Lohse, G.L., & Rosen, D. L. (2001). Signaling quality and credibility of Yellow Pages advertising: The influence of color and graphics on choice. *Journal of Advertising*, 30, 73-85.
- Lowenfeld, M. (1952). The Lowenfeld Mosaic Test. *Journal of Projective Techniques*, 16, 200-202.
- Lüscher, M. (1969). *The Lüscher Color Test*. Scott IA, editor and translator. New York: Washington Square Press.
- Lyons, A. (2001). Synaesthesia - a cognitive model of cross-modal association. *Consciousness, Literature and the Arts*, 2, 1-10.
- Mahnke, F.H. (1996). *Color, Environment, Human Response*. New York: Van Nostrand Reinhold Co.
- Mantua, K. (2007). Is green the colour of cash or conviction? Colour Culture in China as Seen by Managers of Finnish MNCs: Report on a Pilot Study. *Proceedings of the Association for Business Communication 7th Asia-Pacific Conference*, Hong Kong, 102-105.

- Marks, L. (1975). On coloured-hearing synaesthesia: cross-modal translations of sensory dimensions, *Psychological Bulletin*, 82, 303-331.
- Matsumoto, D., Konno, J., Hata, S., & Takeuchi, M. (2007). Uniform color and sport competition outcomes. *Research Journal of Budo*, 39, 1-8.
- Mehta, R., & Zhu, R.J. (2009). Blue or Red? Exploring the Effect of Color on Cognitive Task Performances. *Science*, 323, 1226-1229.
- Mollon, J. D. (1982). Color vision. *Annual Review of Psychology*, 33, 41-85.
- Moore, R.S., Stammerjohan, C.A. & Coulter, R.A. (2005) Banner advertiser – web site context congruity and color effects on attention and attitudes. *Journal of Advertising*, 34, 71-84.
- Morgan, J., & Welton, P. (1987). *See what I mean. An introduction to visual communication*. London: Edward Arnold Ltd.
- Muths, Ch. (2001). *Farbtherapie: Mit Farben heilen, der sanfte Weg zur Gesundheit - Farben als Schlüssel zur Seele*. Verlag, Munchen.
- Oberascher, L. (2008). Regional colour preferences. *Colour – Effects & Affects: Proceedings of the Meeting of International Colour Association*, Stockholm, paper no 028.
- Philip, B. R. (1945). A method for investigating color preferences in fashions. *Journal of Applied Psychology*, 29, 108-114.
- Piqueras-Fizman, B, & Spence, C. (2012). The influence of the color of the cup on consumers' perceptions of a hot beverage. *Journal of Sensory Studies*, 27, 324-31.
- Ross, C.F., Bohscheid, J, & Weller, K. (2008). Influence of visual masking technique on the assessment of 2 red wines by trained and consumer assessors. *Journal of Food Science*, 73, 279-285.
- Rowe, C., Harris, J.M., & Roberts, S.C. (2005). Sporting contests: Seeing red? Putting sportswear in context. *Nature*, 437, E10-E11.
- Rutchick, A.M., Slepian, M.L., & Ferris, B.D. (2010). The pen is mightier than the word: Object priming of evaluative standards. *European Journal of Social Psychology*, 40, 704-708.
- Sable, P., & Akcay, O. (2011). Response to Color: Literature Review with Cross-Cultural Marketing Perspective. *International Bulletin of Business Administration*, 11, 34-41.

- Sawer, M. (2006). Wearing your politics on your sleeve: The role of political colours in parties and social movements. Paper presented to the Australasian Political Studies Association conference, Newcastle, 25-27 September 2006.
- Schachtel, E. (1943). On color and affect: contributions to an understanding of Rorschach's test, II. *Psychiatry*, 6, 393-409.
- Schaie, K.W. (1963). The color pyramid test: a nonverbal technique for personality assessment. *Psychological Bulletin*, 60, 530-547.
- Schiller, G. (1935). An experimental study of the appropriateness of color and type in advertising. *Journal of Applied Psychology*, 19, 652.
- Shimojo, S., & Shams, L. (2001). Sensory modalities are not separate modalities: plasticity and interactions. *Current Opinion in Neurobiology*, 11, 505-509.
- Simner, J., Ward, J., Jansari, A., Noonan, K., & Oakley, D. (2005). Non-random associations of graphemes to colours in synaesthetic and non-synaesthetic populations. *Cognitive Neuropsychology*, 22, 1-17.
- Smith, J. M., Bell, P. A., & Fusco, M. E. (1986). The influence of color and demand characteristics on muscle strength and affective ratings of the environment. *The Journal of general psychology*, 113, 289-297.
- Sorokowski, P., Sorokowska, A., & Witzel, C. (2014). Sex differences in color preferences transcend extreme differences in culture and ecology. *Psychonomic Bulletin and Review*, DOI: 10.3758/s13423-014-0591-8.
- Sorokowski P., & Szmajke A. (2007). How does "red win" effect works? The role of sportswear colour during sport competitions. *Polish Journal of Applied Psychology*, 5, 71-79.
- Steinhardt, L. (1997) The implications of blue as the color of the inner surface of the sandtray in sandplay. *The Arts in psychotherapy*, 24, 455-469.
- Szarota, P. (2008). *Od skarpetek Tyrmanda do krawata Leppera*. Wydawnictwa Akademickie i Profesjonalne.
- Szmajke, A., & Sorokowski, P. (2006). Permit support in sport: the influence of sportmen's wear colour on competitions in sport. *Medicina Sportiva*, 10, 119-122.
- Van den Bosch, A. L. M., de Jong, M. D. T., & Elving, W. J. L. (2006). Managing corporate visual identity. *Journal of Business Communication*, 43, 138-157.
- Vrij, A. (1997). Wearing Black Clothes: the impact of offenders' and suspects' clothing on impression formation. *Applied Cognitive Psychology*, 11, 47-53.

- Walton, W. E., & Morrison, B. M. (1931). A preliminary study of the affective values of colored lights. *Journal of Applied Psychology*, 15, 294.
- Ward, J., Huckstep, B., & Tsakanikos, E. (2006). Sound-colour synaesthesia: to what extent does it use cross-modal mechanisms common to us all? *Cortex* 42, 264-280.
- Whitfield, T. W., & Wiltshire, T. J. (1990). Color psychology: A critical review. *Genetic, Social and General Psychology Monographs*, 116, 387-412.
- Wood, J.M., Nezworski, M.T., Lilienfeld, S.O., & Garb, H.N. (2003). *What's wrong with the Rorschach? Science confronts the controversial inkblot test*. New York: Jossey-Bass.
- Woodcock, T., (1984). The use of the lowenfeld mosaic test in child psychotherapy. *Projective Psychology*, 29, 11-18.
- Wrembel, M. (2007). Still sounds like a rainbow - a proposal for a coloured vowel chart. *Proceedings of the Phonetics Teaching and Learning Conference PTLC2007*. London: UCL. 1-4.
- Wrembel, M. (2009). On hearing colours - cross-modal associations in vowel perception in a non-synaesthetic population. *Poznań Studies in Contemporary Linguistics* 45, 595-612.
- Wrembel, M., & Grzybowski, A. (2011). Reinvestigating sound-colour mappings in L1 and L2 vowel perception. In: M. Wrembel, M. Kul, and K Dziubalska-Kołaczyk (Eds.). *Achievements and perspectives in SLA of speech: New Sounds 2010*. Frankfurt: Peter Lang, 317-329.
- Wrembel, M., & Rataj, K. (2008). Sounds like a rainbow - sound-colour mappings in vowel perception. In A. Botinis (Ed.). *Proceedings of the 2nd ISCA Workshop on Experimental Linguistics, ExLing 2008*, Athens: University of Athens, 237-240.