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Emotion and colour across languages: implicit associations in Spanish colour terms

Abstract. *This study explores the reasons why colour words and emotion words are frequently associated in the different languages of the world. One of them is connotative overlap between the colour term and the emotion term. A new experimental methodology, the Implicit Association Test (IAT), is used to investigate the implicit connotative structure of the Peninsular Spanish colour terms rojo (red), azul (blue), verde (green) and amarillo (yellow) in terms of Osgood's universal semantic dimensions: Evaluation (good–bad), Activity (excited–relaxed) and Potency (strong–weak). The results show a connotative profile compatible with the previous literature, except for the valence (good–bad) of some of the colour terms, which is reversed. We suggest reasons for both these similarities and differences with previous studies and propose further research to test these implicit connotations and their effect on the association of colour with emotion words.*

Key words. *Colour – Connotation – Emotion – IAT – Psycholinguistics – Semantic differential – Semantics – Spanish*

Résumé. *Cette étude explore les raisons pour lesquelles les termes qui qualifient les couleurs et ceux qui qualifient les émotions sont fréquemment associés dans plusieurs langues. L'une de ces raisons est le chevauchement des connotations entre le terme qualifiant la couleur et celui qui qualifie l'émotion. On utilise une méthodologie expérimentale nouvelle, le test d'association implicite (Implicit Association Test—IAT) pour investiguer la structure implicite des connotations des termes de couleur en Espagnol Péninsulaire, rojo (rouge), azul (bleu), verde (vert) and amarillo (jaune) en termes des dimensions sémantiques universelles d'Osgood: Evaluation (Bon—Mauvais), Activité (Excité-s-Relâché), Puissance (Fort—Faible). Les résultats de l'étude montrent un profil de connotations compatible avec la*

littérature existante, à l'exception de la valence (Bon—Mauvais) de certains termes de couleur, qui est inversée. Les auteurs émettent des hypothèses pour expliquer à la fois ces similarités et ces différences par rapport aux études déjà connues et proposent d'entreprendre d'autres recherches pour tester ces connotations implicites et leur effet sur l'association termes de couleur—termes d'émotions.

Mots-clés. *Couleur — Connotation — Emotion — IAT — Psycholinguistique — Différentiel sémantique — Sémantique — Espagnol*

Colour and emotion in the languages of the world

Emotions and colour terms are frequently associated in the languages of the world. In English, for example, the term *blue* is related to sadness (*to feel blue*).¹ In German *yellow* is associated to envy (*Gelb vor Neid sein*, 'to be yellow with envy'), although in Spanish and English envy is *green* (cf. Shakespeare's *green-eyed monster*). *Yellow* in English is associated to cowardice instead (*to be yellow*, *yellow-bellied*, *to have a yellow streak*). Anger is associated to *red* in many languages, where we find expressions like the German *Rot sehen* ('see red') or the French *rouge de rage* ('red with anger'). In Thai, however, a 'body turning green' belongs to an angry person. In Italian one can also be *verde di bile*, *rabbia* or *collera* ('green with bile, anger or rage'; Philip, 2006: 82). An interesting case is Lithuanian, where different degrees of anger are not expressed through different shades of red, as happens in English (cf. *flushed/pink/red/scarlet with anger*), but through different colours: *white* (for controlled anger), *red* ('normal' anger), *blue* (very intense anger) and *black* (extremely intense anger) (Sirvydė, 2007). A shade of white can also be related to anger in English (he was *livid*), but then it hardly refers to 'controlled anger'. In French, fear is associated to *green* (*vert de peur*, 'green with fear'), whereas *green* in Russian is the colour of utter boredom (*скука зеленая*, 'green boredom') and 'melancholy-cum-yearning' (*тоска зеленая*, 'green *toska*'; cf. Wierzbicka, 1992). World wide, *black/dark* has bad connotations, and in many languages it is directly related to depression/pessimism (e.g. Spanish *verlo todo negro*, 'see everything black') or to anger (*black mood*, Spanish *estar negro*, 'be black', i.e. be fed up). *Pink*, on the contrary, has positive connotations and is widely linked to optimism or happiness (e.g. Ukrainian *бачити щось в рожевому світлі*, 'to see everything in pink light', or English *tickled pink*). In the African language Fante, 'being jealous' is expressed by the term *anibre*, which literally means 'eye-red'. Interestingly, *inimooi* in Dagbani – another African language – also means 'eye-red', but refers to worry/anxiety instead (Dzokoto & Okazaki, 2006). The heart has a colour too. In Dagbani, 'white

heart' is the emotion term for happiness, and in Zulu the angry heart is said to be *red* (Taylor & Mbense, 1998: 202–3).

Why is this so? Colours per se do not designate anything emotional, so why should they be associated to specific emotions or emotion terms? There are at least four possible complementary reasons for these pairings: the associations are based on metonymic thinking, they are based on metaphoric thinking, colour perception creates specific emotional reactions, and colour terms and emotion terms share the same connotative structure in the language. Let us discuss each of these reasons in some more detail.

The first reason might be that the colour–emotion association reflects something about the physiology of the emotional experience. This is the case for expressions like *red with anger* or *to be yellow*. In both cases, the colour refers to a body fluid that intervenes (or is believed to intervene) in the experience of the emotion at stake. In the case of anger the fluid is blood, which rushes to the neck and face areas when we feel outraged. In the case of cowardice/fear the fluid is bile, given that the expression was coined at a time when the liver was believed to be the seat of courage (e.g. Allan, 2009). In both cases – and in any other linguistic expression of this sort – the expressions can be considered to be metonymic. A linguistic metonymy is an expression in which we refer to some entity by means of another one to which it is related. Typical metonymic expressions reflect part-and-whole relationships ('there are some good *heads* in this department') or cause-and-effect relationships ('he was *livid* at his son's disobedience', anger being the cause of the lividness in the face). Cognitive linguists would claim that this linguistic behaviour is an expression of systematic thought patterns called conceptual metonymies (e.g. Kövecses & Radden, 1998; Barcelona, 2003), like referring to the effects of something, instead of to the cause itself (EFFECT FOR CAUSE). Therefore conceptual metonymies like EFFECT FOR CAUSE can be considered to motivate many of the associations between emotion and colour words. Given that emotional physiology is roughly the same across cultures, one might expect all languages to pick up the same colours for a given emotion. This, however, is not the case for at least two reasons. First, because different cultures can choose different colour aspects of a multifaceted reality (e.g. lividness vs blushing in anger). Second, because colour choice often relies on culture-specific theories of the causes and physiological consequences of emotions, as in the case of envy, which in the Western world was thought to be accompanied by a rush of bile – which is yellow-green in colour (Ogarkova, 2007: 114).

A second reason for the pairing of colour and emotion in a language may be metaphorical thinking. Conceptual metaphors, like metonymies, are defined as systematic (some claim automatic) patterns of thought (e.g. Lakoff, 1993). By virtue of conceptual metaphors we represent one conceptual domain – the

target – in terms of another – the source – using the knowledge we have of the source to construe the target. For example, expressions like *that's a clear argument, I see your point, that sheds some light on the whole issue* or *don't be so obscure* instantiate in English a systematic conceptual representation of 'understanding' in terms of 'seeing' (UNDERSTANDING IS SEEING), which finds linguistic realization in many languages of the world (e.g. English, Spanish, Basque, French, Dutch, Italian, Greek and Romanian; Valenzuela & Soriano, 2008). It is also metaphorical thinking, and not physiology, which seems to lie behind the pairing of *black/white* and *envy* in the Russian expressions 'black envy' and 'white envy'. One of them refers to 'envy that is not malicious', while the other means 'ill-wishing envy'. It is not difficult to guess which is which. This conceptual association between bad and dark/black (BAD IS BLACK/DARK) and good and white/bright (GOOD IS WHITE/BRIGHT) is ubiquitous in language at large, not only in the realm of emotion words (e.g. *dark soul, black Monday, white lie, dark intentions, bright character, clear mind, black mood, sombre personality*, etc.). It also seems to be automatic. In an interesting series of experiments, Meier and his colleagues (Meier, Robinson & Clore, 2004; Meier et al., 2007) showed a compulsory systematic association between brightness and valence: light colours automatically elicit a positive evaluation of objects (whereas dark colours elicit a negative one), and positive evaluation biases perceptual judgements towards brightness (whereas negative evaluations make people judge colours as darker).²

A third reason for the pairing of colour and emotion words in a language may be that colours themselves elicit emotional reactions. Goldstein (1942) explicitly suggested that the body undergoes physiological reactions to colour that are reflected in psychological experiences and functioning. For example Elliot and colleagues (2007) have found experimental evidence that red hinders performance on achievement tasks. However, Mehta & Zhu (2009) have also recently shown that red enhances performance on a *detail-oriented* task. The two results need not be contradictory: it seems that exposure to red enhances a sense of alertness and urgency, which interferes in some cognitive tasks and helps in others. It is not clear what specific emotion one would feel when presented with red, but the above evidence suggests that the emotion should at least involve arousal. This is consistent with the sorts of emotion words people intuitively pair with the term *red* – like *anger, fear* or *jealousy* (Hupka et al., 1997) – and the emotions they associate with the colour itself – like love (red hearts, red roses) or lust (red has been found to enhance men's attraction to women; Elliot & Niesta, 2008). It is also consistent with the emotion words we explicitly observe paired with the colour term *red* across languages, like *anger* (e.g. English, Spanish, Italian, German) and *embarrassment* (e.g. Italian, English, Spanish, French).

A fourth possible reason for the association of colour and emotion in a language may be that both colour words and emotional words share the same (or very similar) connotative structure. Connotation is a fairly vague term in semantics. In this article we define it as the set of meaning aspects of a word that go beyond its mere denotation or reference. For example a definition of *red* in a dictionary may say that red is 'the hue of the long-wave end of the visible spectrum, evoked in the human observer by radiant energy with wavelengths of approximately 630 to 750 nanometres'.³ But surely the term *red* means something more for any native speaker of English. The word carries much more than a simple reference to the chromatic aspect of things. *Red*, like any other colour term, has an emotional meaning as well. Emotional meaning seems to be mediated by an association of colour terms with situations or objects in real life where that coloration is present (e.g. Leech, 1981; Allan, 2007). It could be the colouring of natural things (blood-red, grass-green, sky-blue) or that of cultural artefacts (black robes in mourning, red lights to signal alert, baby girls dressed in pink), and both can lead to colour-term connotation (more or less standardized) and even to culturally sanctioned colour symbolism.

Even though colour connotation ultimately depends on associations in experience, some of which are the same for all human beings, the specific value of the connotation may vary from language to language, from culture to culture and even from person to person. An association between blood and red is probably at stake in any culture of the world, but the specific 'meaning' that the term *red* inherits from blood depends on how blood is construed in the first place: a sign of danger because it signals injury? A sign of victory over enemies? A sign of violence? A sign of life and vitality? A sign of sexual maturity? The interpretations of blood are potentially endless, and so are the connotations of *red* inherited from such association (e.g. Allan, 2009).

Yet evidence has been found which argues against a hypothetical arbitrariness of colour connotation. The specific concepts with which colours are associated (e.g. BLOOD, WATER, SUN) and the affective value (dangerous, beneficial, desirable, harming) of those concepts for a given person or a given culture may vary greatly, but the 'types' of value themselves seem to be fairly systematic: cross-culturally they are all related to a general evaluation of things as 'good' or 'bad', 'strong' or 'weak', and 'active' or 'passive' (Adams & Osgood, 1973; Osgood, May & Miron, 1975). These semantic dimensions – called Evaluation, Potency and Activity respectively – are not exclusive of colour. Osgood and his colleagues (Osgood, Suci & Tannenbaum, 1957) discovered them in a number of concepts using the Semantic Differential Technique, and their findings have also been replicated in numerous studies involving different types of stimuli (e.g. Osgood, Suci &

Tannenbaum, 1957; Snider & Osgood, 1969; Mehrabian, 1972; Mehrabian & Russell, 1974; Shaver et al., 1987; Valdez & Mehrabian, 1994).

The Osgoodian dimensions are relevant, because they concretize the fourth reason why colour and emotion words may be associated in a language. While the specific emotion terms associated to specific colour terms can vary considerably across languages, in the pairs existing within each language, colour term and emotion word should have a congruent dimensional profile. D'Andrade & Egan came to the same conclusion when trying to explain the surprising overlap in a study in which they asked English and Tzeltal speakers to match emotion terms and colour chips:

At present we feel the most likely explanation of this phenomenon involves a special type of semantic mediation based on the factors uncovered by Osgood's semantic differential technique. ... The association of colours and emotions may come about through the use of the semantic differential dimensions as a bridging network. That is, if a colour chip is reacted to as 'good' and 'strong', then the emotion term which is associated to the colour chip is an emotion which is also 'good' and 'strong'. (D'Andrade & Egan, 1974: 62)

Our study: implicit connotations in Spanish colour terms

Adams & Osgood (1973) studied the connotative structure of the English colour terms *black*, *white*, *grey*, *red*, *yellow*, *green* and *blue* and their equivalent colour terms in 20 other languages of the world using the Semantic Differential Technique. An important aspect to be taken into account is that Adams & Osgood's methodology requires participants to make explicit ratings on the position of a given word (e.g. *red*) in a scale between two poles (e.g. between the terms *fresh* and *stale*, or *hot* and *cold*). Factor analysis generates the dimensions, and the specific ratings are then used to calculate the value of each word on the dimensions. Therefore the methodology captures *explicit* judgements about the connotative loadings of terms. But for most colour emotion psychologists 'the activation of the colour association, as well as its influence on affect, cognition, and behaviour, is viewed as occurring *without the individual's conscious awareness* or intention' (Elliot et al., 2007: 156; emphasis added). Therefore it is pertinent to investigate whether the same values in the semantic dimensions can be found at an unconscious level as well.

We decided to use an Implicit Association Task (IAT), which, according to the first proponents of this methodological paradigm, is useful 'for measuring evaluative associations that underlie implicit attitudes' (Greenwald, McGhee & Schwartz, 1998: 1464). This methodology has been employed to measure evaluative conditioning (Mitchell, Anderson & Lovibond, 2003), prejudice and prototypical evaluative judgements (White vs Black American

names – Greenwald, McGhee & Schwartz, 1998; Turkish and East Asian populations – Gawronski, 2002), and it has proven useful in the prediction of non-verbal (McConnell & Leibold, 2001) and sexual behaviour (Marsh, Johnson & Scott-Sheldon, 2001).

The study was carried out in Peninsular Spanish, a language variety that was not included in Adams & Osgood's study (1973), although other varieties of Spanish were. If implicit and explicit associations are the same, no big differences should be found in the dimensional profile of the colour terms.

The specific terms selected for our study were *rojo*, *azul*, *verde* and *amarillo* (the Spanish counterparts of *red*, *blue*, *green* and *yellow* respectively). There were two reasons for this choice. First, the relevance of the chromatic phenomenon they refer to, as red, blue, green and yellow are primary colours. Second, the fact that they (and their closest equivalents in the various languages of the world) have been hypothesized to be 'basic' colour terms by Berlin & Kay (1969). One of the features of basic colour terms is that they are the first to appear across languages. It seems that *red*-, *yellow*-, *green*- and *blue*-like terms are the first to be coined after a general distinction between 'dark/black' and 'light/white'. In other words, if a language has only two colour terms, they tend to reflect the *black/dark* and *white/light* distinction. If a third colour term exists, it is the equivalent of *red*. After them, counterparts of either *green* or *yellow* are found. A *blue*-like term appears next. Since all languages with colour terms seem to make these distinctions, the existence of general universal RED, BLUE, GREEN and YELLOW categories can be hypothesized. Given the order of appearance of the terms, these categories are among the most widespread colour categories across languages, and the colour terms that instantiate them reflect a more universal partition of the spectrum than the colour terms in the later stages of the Berlin & Kay model, like *brown*, *purple*, *pink*, *orange* or *grey*.

However, the fact that all languages seem to differentiate a part of the chromatic spectrum through labels like *blue* does not mean that the conceptualization of English *blue* and Spanish *azul*, for example, are the same. Colour terms may differ in terms of their exact denotation, as well as in connotation. As regards denotation, for example, Russian offers two different lexemes to designate the same chromatic phenomenon that English labels as *blue*, and the same is true for Italian, where there is *blu* (dark blue) and *azzurro* (sky blue). Colour terms may also differ in connotation. Adams & Osgood (1973: 144–5) found that *yellow*-like terms, for example, tend to be positively marked across languages, but have a very negative evaluation in Hong Kong Cantonese, where the colour yellow is associated to pornography.

So what are the unconscious affective connotations of Peninsular Spanish *rojo*, *azul*, *amarillo* and *verde* in terms of 'goodness–badness'?

‘power–weakness’ or ‘excitement–relaxation’? To the best of our knowledge, no experimental studies have been conducted so far in Peninsular Spanish to answer this question. But there is ample psychological, linguistic and anthropological research on the general field of colour–emotion associations in other languages to help us generate some hypotheses. In what follows we report on this data and the working hypotheses that stem from them.

(a) Positive and negative Evaluation

Of the three dimensions proposed by Osgood and colleagues, Evaluation is the most controversial in the realm of colour semantics. Adams & Osgood (1973) concluded that the semantic blue–green region is more highly evaluated than the red–yellow region, which is closer to the neutral point (1973: 144). Converging evidence can be found in Goldstein (1942), who claimed that the colours green and blue are experienced as quieting and agreeable. For Wexner (1954), the colour concept BLUE was associated to features like ‘secure/comfortable’ and ‘tender/soothing’, which imply pleasure, in addition to low activity. Clarke & Costall (2008) also recorded positive evaluations for green and blue in a semi-structured interview with British students. Finally, in a study on the connotations of English colour terms in figurative expressions, Allan (2009) has recently observed that *blue* is hardly ever used in offensive language, but in euphemistic expressions. All in all, the general colour concept BLUE, and to a lesser extent GREEN, seem to be positively valenced.⁴

RED, however, is a more ambiguous case. Adams & Osgood (1973) locate it near the neutral point, while various studies on emotion–colour association suggest either a positive or a negative valence, depending on the concepts it is related to. It is reported to have a positive valence when associated to love, fertility, happiness or excitement (Wexner, 1954; Murray & Deabler, 1957; Jobes, 1962; Pecjak, 1970; Soldat, Sinclair & Mark, 1997). The valence is negative when associated to features like ‘contrary’ or ‘hostile’ (Odbert, Karwoski & Eckerson, 1942; Murray & Deabler, 1957; Schaie, 1961).

The general concept YELLOW is located near the neutral point according to Adams & Osgood (1973), who explain exceptions in terms of culture-specific circumstance (like yellow in Hong Kong). Hupka and colleagues (1997) view YELLOW as a slightly more negative concept, and quote D’Andrade & Egan (1974) and Oyama, Tanaka & Haga (1963) as examples of empirical evidence that terms with negative connotations across cultures are systematically associated with colours in the yellow–red end of the spectrum.

Because of the above, our starting hypothesis is that the semantics of VERDE and AZUL will be more positively marked than ROJO and

AMARILLO, although ROJO might have a positive evaluation as well. All in all, VERDE and AZUL are expected to be the two concepts most strongly related to the Evaluation dimension.

(b) High and low Potency

Adams & Osgood (1973) identify two colours as most closely related to the Potency dimension: RED as the most potent and YELLOW as the least. Neither BLUE nor GREEN is clearly defined in terms of Potency in the data. As in the previous dimension, support for their claims is also reported in a large number of earlier studies (1973: 145). But more recent ones have also provided converging evidence. Hill & Barton (2005), for example, have recently demonstrated that wearing red correlates with a greater probability of winning in sport competitions. The reason, in their opinion, is that red enhances dominance.

In the light of this research, we expect ROJO to be strong and AMARILLO to be weak. Neither VERDE nor AZUL is expected to be significantly related to the Potency dimension.

(c) High and low Activity

Of the four colours under investigation, only RED was identified as closely related to Activity by Adams & Osgood (1973: 146). The literature on colour–emotion, however, also mentions GREEN and BLUE as related to Activity. According to Goldstein (1942), the colour green and (to a lesser degree) blue are experienced as quieting. In Wexner's study (1954) BLUE was associated with 'tender/soothing'. In their interviews Clarke & Costall report many subjects associating green and blue with features like 'calm' and 'peaceful' (2008: 407). In all cases blue and green appear as low-activity colours. In general a frequent contention in the colour–emotion tradition is that red and other long-wavelength colours are more active than blue and the short wavelength ones.

(d) Summary of hypotheses

A summary of the above findings renders the following hypotheses concerning the connotative structure of the Spanish colour categories we aim to investigate:

TABLE 1
Spanish colour terms in the four colour categories
Red, Blue, Yellow and Green

ROJO:	RED:	AZUL:	BLUE:
<i>rojo</i>	red	<i>azul</i>	blue
<i>colorado</i>	red, blushed	<i>añil</i>	indigo
<i>carmesí</i>	crimson	<i>celeste</i>	pale blue
<i>encarnado</i>	red	<i>marino</i>	navy blue
<i>escarlata</i>	scarlet	<i>turquesa</i>	turquoise
<i>púrpura</i>	purple	<i>azulón</i>	deep blue
<i>granate</i>	maroon	<i>azulado</i>	bluish
AMARILLO:	YELLOW:	VERDE:	GREEN:
<i>amarillo</i>	yellow	<i>verde</i>	green
<i>rubio</i>	blond	<i>ceitrino</i>	yellowish green
<i>dorado</i>	golden	<i>verde césped</i>	grass green
<i>amarillento</i>	yellowish	<i>verdoso</i>	greenish
<i>áureo</i>	golden	<i>esmeralda</i>	emerald
<i>gualda</i>	yellow	<i>verde oliva</i>	olive green
<i>ámbar</i>	amber	<i>aceitunado</i>	olive coloured

- ROJO is expected to be powerful and excited (and maybe positive).
- AMARILLO is expected to be weak.
- VERDE and AZUL are expected to be positive (and possibly relaxed).

Again, these expectations are based on research carried out on explicit judgements and conscious associations between colour shades or colour terms and emotion terms (or concepts), as observed in several languages. The extent to which these predictions match the implicit connotations of Peninsular Spanish colour terms is what we aim to investigate.

Methodology

Method and materials

As required in the IAT methodology, in our study the four selected colour terms were treated as categories (ROJO, AZUL, AMARILLO and VERDE), for which seven terms were chosen as most representative among their most frequent synonyms or near-synonyms in the online Spanish corpus ‘Corpus del Español’ (over 100 million words, available at <http://www.corpusdelespanol.org/>) The terms and an approximate translation into English are shown in Table 1. The three semantic dimensions were also operationalized as shown in Table 2.

TABLE 2
Spanish dimension terms for Evaluation,
Potency and Activity

Dimensions	Terms			
Evaluation	<i>Positivo:</i> <i>positivo</i> <i>bueno</i> <i>agradable</i> <i>grato</i> <i>placentero</i> <i>beneficioso</i> <i>provechoso</i>	Positive: positive good pleasant nice pleasurable beneficial advantageous	<i>Negativo:</i> <i>negativo</i> <i>malo</i> <i>perjudicial</i> <i>nocivo</i> <i>dañino</i> <i>desagradable</i> <i>destrutivo</i>	Negative: negative bad harmful harming damaging unpleasant destructive
Potency	<i>Poderoso:</i> <i>poderoso</i> <i>influyente</i> <i>fuerte</i> <i>potente</i> <i>asertivo</i> <i>dominante</i> <i>dirigente</i>	Powerful: powerful influential strong potent assertive dominant leader	<i>Débil:</i> <i>débil</i> <i>sumiso</i> <i>sometido</i> <i>obediente</i> <i>inhibido</i> <i>retraído</i> <i>achantado</i>	Weak: weak submissive subdued obedient inhibited shy bashful, coward
Activity	<i>Excitado:</i> <i>tenso</i> <i>intenso</i> <i>activo</i> <i>estimulante</i> <i>enérgico</i> <i>excitante</i> <i>vibrante</i>	Excited: tense intense active stimulating energetic exciting vibrant	<i>Relajado:</i> <i>relajante</i> <i>tranquilo</i> <i>sereno</i> <i>flojo</i> <i>tenue</i> <i>leve</i> <i>inactivo</i>	Relaxed: relaxing quiet serene loose, slack tenuous, faint light, slight inactive

The IAT is a computer-based categorization task that measures concept-association strength. Participants have to classify a set of related words (e.g. *blue*, *indigo*, *turquoise*) into their category (e.g. BLUE) by pressing a computer key. Sometimes the key they have to press is also valid for a second category (e.g. GOOD). It has been shown that implicit associations between two concepts result in speeded responses when the two concepts are combined in a single group for categorization purposes. So, for example, if BLUE is associated to GOOD, it will be easier (faster) to classify a word like *indigo* into an ad hoc category BLUE-or-GOOD than into a category BLUE-or-BAD. Similarly if BLUE and GOOD are perceived to be congruent concepts, people will make fewer errors assigning *indigo* to the constructed category BLUE-or-GOOD than to BLUE-or-BAD. In sum, if GOOD and BLUE are unconsciously related, more speed and accuracy will be expected when classifying a word like *indigo* into a constructed BLUE-or-GOOD category.

Any IAT investigates two categories (e.g. ROJO and AZUL) and an evaluative dimension (e.g. Activity). The test comprises five stages. In the first stage (see Figure 1, stage one), examples of the two investigated categories (e.g. *azul*, *añil*, etc., for AZUL; *rojo*, *escarlata*, etc., for ROJO) are presented in random order in the centre of a computer screen, one by one. On the right and left top corners of the screen the names of the categories are shown, and subjects have to classify the words appearing in the centre as belonging to one or the other category by pressing a key situated on the right- or on the left-hand side of the keyboard. In our experiment, subjects used a Spanish keyboard and pressed ‘m’ for the category on the right and ‘z’ for the category on the left.

In the second stage (Figure 1, stage two), participants see examples of the two poles in the evaluative dimension under study (e.g. words like *excitante*,

Stage One



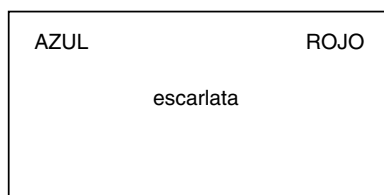
Stage Two



Stage Three



Stage Four



Stage Five



FIGURE 1
IAT design – examples of stages one to five

enérgico, etc., for EXCITADO; and *relajante, sereno*, etc., for RELAJADO) and they have to classify them as belonging to one of the two poles (e.g. EXCITADO and RELAJADO) presented on the right and left top corners of the screen.

In a third stage (Figure 1, stage three) both a category (e.g. ROJO) and a dimensional pole (e.g. EXCITADO) appear together on one side of the screen, and the other category (e.g. AZUL) and the other dimensional pole (e.g. RELAJADO) on the opposite side. Examples of both categories (*azul, añil, rojo, escarlata*, etc.) and both dimension poles (*excitante, enérgico, relajante, sereno*, etc.) are presented in the centre of the screen and subjects have to classify them correctly into their respective categories.

The fourth stage is identical to the first, except for the fact that the order of the categories is reversed (see Figure 1, stage four).

In the fifth and final stage (see Figure 1, stage five), categories and poles are again paired, but in the opposite combination from stage three.

During the experiment, subjects are informed of categorization mistakes by an error message on the screen (for example, if they ascribe the colour term *escarlata* to the category AZUL instead of ROJO). Both reaction time (i.e. how long it takes them to decide that *escarlata* is a member of the category ROJO) and accuracy (i.e. if they assign the term *escarlata* to the correct category, ROJO, or mistakenly press the key for the AZUL category) are recorded throughout the test.

The crucial stages in the design are stages three and five. When a category (e.g. category ROJO) and one of the poles of an evaluative dimension (e.g. pole EXCITADO in the dimension Activity) are strongly associated, their pairing for categorization purposes is supposed to yield shorter reaction times in the task, as well as fewer errors in the subject's categorization responses.

Design

The four colour categories and the three dimensional poles were crossed to generate all possible combinations. First we combined each colour category with the others (6 combinations) and then each colour pair was combined with the three dimensions ($6 \times 3 = 18$ combinations). The order of presentation of the two members in each colour pair and of the two poles in the dimensions was counterbalanced throughout the experiment.

One hundred and fifteen native speakers of Spanish (most of them students at the University of Murcia), ranging in age from 20 to 46 (mean

age 24.2), participated in the study as volunteers or in exchange for course credit. Each condition was observed by at least eight subjects.

Results

Our results can be analysed in terms of dimensions and colours. We start by describing the profile of each dimension. Then we analyse the specific colour results and their connection with the literature on colour–emotion associations.

The overall results of the study can be found in Tables 3 and 4. Table 3 reports the mean reaction times (RT) in milliseconds and their statistical significance. The results for the Evaluation dimension have not been included because they did not reach significance. Table 4 presents the accuracy rates in the categorization task and their statistical significance.

Evaluation

In the analysis of errors, no statistically significant effects were found for colour or dimension only, but an analysis of variance showed that their interaction was significant ($F(3,123) = 4.729, p = .004$). A look at the results shows that AMARILLO, ROJO and VERDE are perceived as positive by our participants ($p < .005$), while AZUL is evaluated as negative ($p < .05$).⁵

No statistically significant differences were found in the analysis of the RT, but the effects showed the same direction as the error analysis, which allows us to discard a trade-off effect.

The greatest effects in terms of accuracy were found for AMARILLO (the most positive colour) and AZUL (the most negative). These results partially disconfirm our expectation that VERDE and AZUL would be the two colour categories most closely associated to the Evaluation dimension, since VERDE is not. In fact, the RTs in the positive and negative pairings for VERDE are technically the same (a difference of 6 ms). AZUL, on the other hand, is significantly related to Evaluation in our error analysis, but it shows effects in the opposite direction from that expected.

Also disconfirmed was our expectation that the semantics of VERDE and AZUL would be more positively marked than those of ROJO and AMARILLO, since AZUL was negatively marked and there were no statistically significant differences between VERDE, ROJO and AMARILLO in our analysis of errors. In a colour-by-colour comparison of RTs, a paired t-test revealed statistically significant oppositions between ROJO–AZUL ($p = .05$) and AMARILLO–VERDE ($p < .05$).

TABLE 3
Mean Reaction Times (RT) ANOVA in the categorization task

	ms		<i>F</i>	d.f.	<i>p</i>
Potency:	Pw	W			
<i>rojo</i>	777	889	17.875	1, 113	0,000*
<i>amarillo</i>	890	815	7.778	1, 113	0,006*
<i>verde</i>	809	807			n.s.
<i>azul</i>					n.s.
Activity:	E	R			
<i>rojo</i>	747	911	38.09	1, 103	0,000*
<i>amarillo</i>	831	759	12.741	1, 103	0,000*
<i>verde</i>	844	815	12.741	1, 103	0,000*
<i>azul</i>	840	766	12.741	1, 103	0,000*

Note. RTs ANOVA: Pw = powerful, W = weak, E = excited, R = relaxed

TABLE 4
Accuracy rates in the categorization task

	%		<i>F</i>	d.f.	<i>p</i>
Evaluation:	P	N			
<i>Rojo</i>	0.94	0.91	10.504	1, 123	0,002*
<i>Amarillo</i>	0.94	0.90	10.504	1, 123	0,002*
<i>Verde</i>	0.93	0.91	10.504	1, 123	0,002*
<i>Azul</i>	0.91	0.95	5.897	1, 123	0,017*
Potency:	Pw	W			
<i>Rojo</i>	0.94	0.89	8.985	1, 113	0,003*
<i>Amarillo</i>	0.90	0.93	4.509	1, 113	0,036*
<i>Verde</i>	0.90	0.93	4.509	1, 113	0,036*
<i>Azul</i>	0.91	0.91			n.s.
Activity:	E	R			
<i>Rojo</i>	0.94	0.87	19.628	1, 103	0,000*
<i>Amarillo</i>	0.92	0.94	5.085	1, 103	0,026*
<i>Verde</i>	0.91	0.93	5.085	1, 103	0,026*
<i>Azul</i>	0.91	0.93	5.085	1, 103	0,026*

Note. Error rates ANOVA: P = positive, N = negative, Pw = powerful, W = weak, E = excited, R = relaxed

Potency

No independent effect of colour or Potency was found, but their interaction was statistically significant both in the analysis of errors ($F(3,113) = 4.506$, $p < .005$) and in the RTs ($F(3,113) = 8.363$, $p < .0005$).

In terms of Potency, ROJO stands out as the most powerful colour and AMARILLO as the weakest one. The pattern is statistically significant in terms of errors and RTs. These results confirm our hypotheses and coincide with Adams & Osgood's (1973) cross-cultural study. Additionally, in a colour-by-colour comparison of RTs, a paired t-test revealed statistically significant (or almost significant) oppositions between ROJO and all the other colours: AMARILLO ($p < .01$) – the clearest case – VERDE ($p < .05$) and AZUL ($p = .051$).

Our additional expectation that VERDE and AZUL would not be clearly defined in terms of Potency seems to find (at least partial) support too: in the analysis of errors, VERDE stands as significantly associated to WEAKNESS, but no effect is found in the analysis of the RTs. As for AZUL, as expected, none of the analyses revealed any effects.

Activity

As before, an analysis of variance showed that the interaction of colour and Activity was significant in terms of accuracy ($F(3,103) = 8.216, p < .001$) and RTs ($F(3,103) = 17.74, p < .001$).

The differences in terms of colour were also clear. AMARILLO, VERDE and AZUL are significantly related to low Activity (RELAXATION), while ROJO is significantly associated to EXCITEMENT. Both error analysis and RTs reveal this pattern. The results confirm our hypothesis as well as Adams & Osgood's (1973) observations for RED. They also support our expectation that AZUL and VERDE would be low-activity colour categories.

In a colour-by-colour comparison of RTs, a paired t-test revealed statistically significant oppositions between ROJO and the rest of the colours (AMARILLO: $p < .001$), VERDE: $p < .05$, and AZUL: $p < .005$), and between AMARILLO and VERDE ($p < .05$).

ROJO (+E, +P, +A)

According to our results, ROJO is implicitly construed as a positive, high-potency, high-activity colour. This is mostly consistent with the literature (except for the valence, where there is no agreement). Our expectation that ROJO would be positive was confirmed, but the strength of the association does not match the results observed in Adams & Osgood's semantic work. This markedness may be the result of cultural preference (see 'Summary and discussion').

The term *rojo* is associated to *ira* (anger) in Peninsular Spanish in the expression *rojo de ira* ('red with anger'), and the colour is symbolically

used to represent the emotion as well (Soriano, 2005). We currently lack information about the unconscious connotative structure of the emotion word *ira*,⁶ but we have some information about the conscious dimensional structure of its English counterpart *anger*. Fontaine and his colleagues (Fontaine et al., 2007) have shown that *anger* is characterized by negative Evaluation, high Potency and high Arousal (i.e. Activity). Except for Evaluation, the connotative structure of the colour and the emotion word *anger* coincides.

High arousal is also a feature of the word *fear* in English, Dutch and French (e.g. Fontaine et al., 2007), another emotion word cross-linguistically associated to the general colour category RED (Hupka et al., 1997).

AMARILLO (+E, -P, -A)

Our results show AMARILLO as characterized by positive evaluation, low activity and low potency. These results confirm our hypothesis on the Potency dimension. The positive evaluation, located near the neutral point by Adams & Osgood, is in our case significantly stronger, which may be a case of cultural preference (see 'Summary and discussion').

The word *amarillo* is not conventionally associated to any particular emotion word in Spanish. We also lack semantic information about the dimensional structure of Spanish emotion words. Nevertheless, the English noun *contentment* has been found to be characterized by positive valence, low arousal and medium potency (Fontaine et al., 2007). Therefore, a possibly compatible term for *amarillo* in Spanish might be *contento* ('content').

In other languages, like German, Italian, Dutch or Turkish, *yellow* is associated to *envy* (Osgood et al., 1975; Hupka et al., 1997). However, this association is not motivated by a shared connotative structure, but rather by metonymic reference to the colour of bile, believed to accompany the experience of envy/jealousy and to give the complexion a greenish-yellowish taint (Ogarkova, 2007).

VERDE (+E, ±P, -A)

For our participants, in comparison to the rest of the colour categories VERDE is a positively tainted colour, although not so much as AMARILLO or ROJO. On the contrary, the association with relaxation is strong. Both the positive Evaluation and the Activity values confirmed our expectations and match Adams & Osgood's (1973) observations with the Semantic Differential Technique.

The difference between VERDE and AMARILLO in our data seems to be one of degree (cf. Philip, 2006, for a similar analysis in her study of Italian colour terms.) Both colour concepts share positive Evaluation and low Activity, but in terms of Potency, AMARILLO is always significantly weak, while VERDE is significantly weak only when we look at error rates, but not at RTs. Therefore VERDE seems slightly more powerful than AMARILLO.

The Spanish term *verde* is conventionally related to *envidia* ('envy') in the language through the expression *verde de envidia* ('green with envy'). However, the motivation for this expression, as we saw for *yellow* above, stems from the assumed participation of bile (a yellow-greenish fluid) in the experience of envy.

AZUL (–E, ±P, –A)

The hypothesized positive valence of AZUL was disconfirmed by our data, since it shows a significant association with the negative pole in comparison to the other three colour categories under study ($p < .05$). AZUL is also implicitly associated to relaxation.

While the relaxation was expected, the negative evaluation was not. Very few scholars have observed a negative valence for BLUE. Soldat, Sinclair & Mark (1997) hypothesized a relationship between BLUE and sadness, a negative emotion, perhaps influenced by the fact that English has a lexicalized association between the two (*to have the blues*, *to feel blue*). Philip suggests that the negative overtones of Italian *blu* (dark blue) may be motivated by the proximity of dark blue to black on the colour scale, and the historical grouping of *blu* with dark colours (2006: 84–5).

Unlike the English *blue*, *azul* is not conventionally related to any emotion term in Peninsular Spanish. However, if *tristeza* ('sadness') has the same dimensional features as *sadness* – i.e. negative Evaluation (–E), low Potency (–P) and low Arousal (–A) (Fontaine et al., 2007) – one might expect Spanish speakers to find the association between *tristeza* and *azul* (–E, ±P, –A) to be more natural than between *tristeza* and *rojo* (+E, +P, +A) or *tristeza* and *verde* (+E, ±P, –A).

Summary and discussion

Table 5 presents a summary of the dimensional profile of the four Spanish colour categories. What our results reveal is that ROJO, AMARILLO, VERDE and AZUL can be successfully differentiated in terms of Evaluation

TABLE 5
Summary of the dimensional profile for the four
Spanish colour categories

Colours	Evaluation	Potency	Activity
ROJO	+	+	+
AMARILLO	+	–	–
VERDE	+		–
AZUL	–		–

(good–bad), Potency (powerful–weak) and Activity (excited–relaxed), Evaluation and Activity being the two most descriptive dimensions in Spanish.

The results also reveal a general match between implicit associations and explicit associations (of the sort captured by Adams & Osgood) for colour terms and connotation. Potency and Activity exhibit the same structure, but Evaluation – the most irregular dimension in the literature – does not coincide. A possible reason might be that the construals of Potency and Activity, unlike that of Evaluation, are mostly dependent on physiology. Perceptions of Potency (weak–powerful) in colour are strongly linked to brightness (light–dark) (Valdez & Mehrabian, 1994; Gao et al., 2007). Perceptions of Activity (excited–relaxed) are strongly linked to saturation (saturated–unsaturated) (D’Andrade & Egan, 1974; Valdez & Mehrabian, 1994). Therefore, saturated dark colours (red, black) should be perceived as excited and strong, and more naturally match emotions with the same features, like anger, lust or hate. This is reflected in language: the terms *red* and *black* seem to be widely associated to anger cross-culturally (Hupka et al., 1997). Also, in our own data, ROJO was implicitly perceived as excited and powerful. Conversely, light colours like yellow should be perceived as weak. In our data, too, AMARILLO was implicitly perceived this way, and the main difference between VERDE and AMARILLO was that VERDE (a slightly darker colour) was perceived as slightly stronger than AMARILLO.

People are in fact sensitive to the meaning changes conveyed by these differences in colour shade. In an experiment on Italian colour terms used metaphorically, Cacciari, Massironi & Corradini (2004) showed that subjects agreed on the most congruent shades of colour for the emotional tone of a text. Clarke & Costall (2008) also recorded spontaneous accounts of these meaning nuances in colour during their interviews.

What about Evaluation? Brightness (dark–light) seems to have an impact on it, too. As we saw with conceptual metaphors, brightness biases towards positive judgements, while darkness biases towards negative ones (cf. also

Valdez & Mehrabian, 1994). Therefore darker colours are typically associated to negatively valenced emotions, like anger, hatred or depression/despair.

The difference observed between our results and Adams & Osgood's (1973) as regards Evaluation may mean that evaluative associations are different at an implicit and explicit level, a possibility that requires further investigation. But it seems to us that Evaluation may be a qualitatively different dimension from the other two as well. Determining when something is 'good' or 'bad' is much more general than estimating 'the amount of energy involved in it' (Activity), or 'the amount of power and control it can exert' (Potency). The latter are specific semantic features; 'goodness'/'badness', on the contrary, is more vague. Positive or negative connotations seem to be crucially mediated by context and, in the case of colour, by the association to another experiential domain with which the colour co-occurs (and/or which is culturally sanctioned as relevant). This allows for a greater degree of interpersonal and intercultural variability than the other two dimensions. As Elliot and colleagues (2007: 156) explain, colour meaning may be a matter of context. We hypothesize that, in the case of valence, this may be *especially* so. For example Spaniards may regard ROJO and AMARILLO very positively because they are the two colours of the Spanish flag and because red and yellow outfits are typically used to represent the country in international competitions. It is an interesting possibility that the two colours may have lately become particularly positive in people's minds as a result of Spain winning the UEFA European Football Championship after 44 years, as well as the Davis Cup in tennis.

Conclusions

The literature on the relationship between colour and emotion is vast and varied. Different disciplines, orientations and methodologies combine to produce a truly heterogeneous field that tries to provide an answer to the question of which colours are associated to which emotions in a given culture, in a language or, possibly, all over the world. An answer to this question requires more than linguistic analysis. But linguistic analysis is necessary as well, because general conceptual pairings of emotions and colours in a culture are likely to be influenced by the specific linguistic associations of colour words and emotional words in it.

It is this association we aimed to address. We have provided several reasons why colour and emotion terms are associated in the languages of the world, and have given examples of cross-linguistic variability in this respect. In addition we have suggested a new methodology for analysing connotative

overlap, one of the possible motivations for some of those associations. We believe implicit measurements are necessary to capture the connotative structure of colour and emotion terms, since implicit and explicit representations (of the sort reflected by Osgood's Semantic Differential Technique) need not coincide, and it is the implicit unconscious representations that can give us a better lead into the reasons for colour–emotion association. One could further explore the unconsciousness of the associations between colour terms and the affective dimensions testing for the existence of Stroop interference effects between a colour term and a contradicting dimensional pole (e.g. the recognition of the word *energetic* written in red vs in blue/green/yellow).

The results of our study parallel earlier findings on Potency and Activity in colour semantics and colour–emotion association, but they diverge as regards the evaluative sign of the Spanish colour terms. We have suggested that colour Potency and Activity semantic ratings are likely to be more stable across languages because of their important relation to physical properties of colour, like brightness or saturation. Evaluation, on the other hand, is influenced by saturation, but seems nevertheless more sensitive to context, more dependent on external associations and a framework of reference, and therefore more prone to cross-linguistic variability.

Further research is now necessary to establish the implicit connotative structure of emotion terms in Peninsular Spanish, and to compare it with that of the colour terms. This opens the field to new interesting possibilities. For example Peninsular Spanish lacks any phraseology directly linking *azul* or *amarillo* to specific emotion terms.⁷ The same is true for other colour terms, like *naranja* (orange). This makes Spanish a very interesting case study for potential facilitating effects between those colours and emotion terms with compatible dimensional structures, as well as interference effects with incompatible ones.

All in all, the present study has suggested new ways to investigate the connections between colour and emotion, and to render a more vivid picture of their cross-linguistic connotative landscape.

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European journal of English studies 8(3): 295–308; (with J. Valenzuela, 2009) 'Are conceptual metaphors accessible on-line? A psycholinguistic exploration of the CONTROL IS UP metaphor', in J. Valenzuela, A. Rojo & C. Soriano (eds) *Trends in cognitive linguistics: theoretical and applied models*, pp. 31–50 (Frankfurt: Peter Lang); with A. Ogarkova, in press) 'Linguistics and emotion', in D. Sander & K. R. Scherer (eds) *Oxford companion to emotion and the affective sciences* (Oxford: Oxford University Press). *Author's address*: Swiss Centre for the Affective Sciences, 7 rue des Battoirs, CH-1207 Geneva, Switzerland. [email: Cristina.Soriano@unige.ch.]

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Notes

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1. Italics are used for linguistic examples and specific colour or emotion terms. A translation of their meaning (when necessary) appears in single quotation marks. Conceptual metaphors, conceptual metonymies, as well as colour and emotion concepts are capitalized (following the convention in cognitive linguistics).

2. For an inventory of 25 studies from various disciplines reporting on the association white–good and black–bad, see Adams & Osgood (1973).

3. Red. (n.d.) *The American Heritage® Dictionary of the English Language, Fourth Edition*. Retrieved 15 March 2009 from Dictionary.com website: <http://dictionary.reference.com/browse/red>.

4. For an inventory of studies reporting additional converging evidence see Adams & Osgood (1973).

5. We have collapsed the results for AMARILLO, ROJO and VERDE, since the differences among them were non-significant.

6. The explicit meaning structure of *ira* and 23 other emotion terms is currently being analysed in the GRID study. The GRID Project (<http://www.iccra.net/grid-project>) is an international research initiative to investigate the semantic structure of 24 emotion terms in over 30 world languages. Dimensional analyses are also included. The Spanish words investigated are *tristeza* (sadness), *desprecio* (contempt), *asco* (disgust), *ira* (anger), *irritación* (irritation), *odio* (hate), *celos* (jealousy), *miedo* (fear), *ansiedad* (anxiety), *estrés* (stress), *desesperación* (despair), *interés* (interest), *sorpresa* (surprise), *gozo* (joy), *placer* (pleasure), *orgullo* (pride), *felicidad* (happiness), *satisfacción* (contentment), *amor* (love), *decepción* (disappointment), *estar herido* (being hurt), *compasión* (compassion), *culpa* (guilt) and *vergüenza* (shame). The scholars responsible for the Peninsular Spanish studies are Cristina Soriano (for the Southern Spanish sample) and Itziar Alonso-Arbiol (for the Northern Spanish sample).

7. *Rojo* and *verde* are conventionally related to *anger* and *envy*, respectively, by virtue of the expressions *rojo de ira* ('red with anger') and *verde de envidia* ('green with envy'). As we saw earlier, these expressions are motivated by metonymic thinking, not connotative overlap.

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