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Is comfort purple or green? Word-colour associations in the first and second language

Jeannette Littlemore, Paula Pérez-Sobrino, Nina Julich and Danny Leung

1. Introduction and background to the study

Abstract concepts, in particular emotions, are often associated with particular colours, and many of these associations have a bodily basis. For example, for many speakers of English, anger is red, jealousy is green and purity is white. It has been suggested that there is a degree of universal convergence regarding the associations that people form between abstract concepts, emotions and colours because they are, at some level, bodily-based. At the same time, it has also been argued that culture and language play an important role in determining the associations (see Kövecses 2005 for further discussion of this issue). However, we know very little about the extent to which these associations are bodily-based and how their perceived embodiment relates to their universality.

A number of studies have investigated similarities and differences in the associations that people from different cultures and linguistic backgrounds form with colours, and different reasons have been postulated for these findings. For instance, associations between the colour red and anger have been found in English (Waggoner and Palermo 1989), Hungarian (Kövecses 2005), Chinese (Chen et al. 2014), Japanese (Matsuki 1995) and Polish (Mikolajczuk 1998). However, in Chinese, red has additional connotations. The Chinese word for red, 'hóng', has a number of positive meanings, such as 'hóng shì' (red event) (wedding), 'zǒu hóng' (walk red) (become famous), and 'hóng rén' (red) (famous person) (Xing 2008). Other cultures, including English-speaking cultures, have also developed a positive association towards red as it is a symbol of love. Similar sorts of variation have been found for the colour blue (Barchard et al. 2017) and white (Xing, 2008).

In this chapter, we explore why it is that some word-colour associations are more universal than others, and postulate that one explanatory factor might be the extent to which the associations have a physical basis. Some associations have a clear physical basis, such as the association of the colour red with anger, as this reflects a clear physical response to an emotional experience. Other associations are more easily explained in terms of the interactions that we have through our bodies with the physical environment. This explains, for example, the associations that people in Western societies have with the colour yellow and joy (presumably linked to the warmth of the sun). Associations such as these might also include the association of WHITE/BRIGHT with GOOD/MORAL, and BLACK/DARK with BAD/IMMORAL as

these are based on experiences of self-efficacy in light vs darkness conditions, and experiences of cleanliness vs dirt (Sherman and Palermo 1989). Other associations are very difficult to explain either in terms of the body itself or of its interactions with the environment, such as the association that jealousy has with the colour green for many people living in the Western world.

A second question that is of interest is whether these associations carry over to a second language. We do not know whether when people learn a second language they transfer the word-colour associations from their first language or whether they adopt the associations that are common in the second language, or whether they form associations that are a mixture of L1 and L2 associations. Furthermore, we do not know what specific factors drive language learners to adopt L2 word colour associations rather than retaining their L1 associations, even when speaking the L2. Some associations will be acquired through exposure to the target language, but another way in which they may be acquired is through exposure to the visual culture, particularly through online environments in which the language is encountered. As we will see below, one of the findings made in this study was that Cantonese-speaking people associate the word 'comfortable' with the colour green, whereas English-speaking people do not do this. A Google image search for the Cantonese equivalent of comfortable (自在) results in a screen full of green images, most of which are to do with nature, so we can see immediately that the word has very different connotations in Cantonese than it does in English. If people are exposed to L2 colour contexts on a regular basis they are arguably more likely to internalise them when speaking the target language. One question that has not been addressed is which word-colour associations are most likely to be acquired by second language learners. One possibility is that they are more likely to acquire those which have a strong bodily-based motivation as they make more intuitive sense, whereas those that are more culturally-based will take longer to acquire. In this study we test this hypothesis, investigating whether more bodily-based word-colour associations are (a) more universal and (b) more likely to be acquired by second language learners.

2. Research questions and working hypotheses

In order to address these questions, we conducted a study that compared the colours that are associated with a range of emotions and abstract concepts by participants from two very different cultural backgrounds: English and Cantonese. The study was designed to answer the following research questions:

RQ 1. To what extent do the colours that are associated with abstract concepts vary cross-culturally between speakers of English and Cantonese?

Hypothesis 1: We expect some colour-word pairs to be shared across groups, such as “angry” and “red” due to their strong physical basis but we cannot predict the degree of cross-cultural variation across the two languages.

RQ 2. Does performing a word-colour association task in one’s second language engender a move towards second language-type associations?

Hypothesis 2: We expect the speakers to move from typical L1 word-colour associations to those of the L2

RQ 3. To what extent does level of agreement both within and across languages correlate with perceived embodiment?

Hypothesis 3: We expect higher levels of agreement both within and across languages for associations that have a physical basis.

RQ 4. Are physically-based L2 word-colour associations more likely to be adopted by L2 speakers than culturally-based ones?

Hypothesis 4: We expect that physically-based associations will be more likely to be adopted by L2 speakers than culturally-based ones.

3. Methodology

In order to answer the above questions, we conducted a two-part study, which involved the administration of two online Qualtrics questionnaires¹ to native speakers of English and Cantonese and to Cantonese speakers answering in English. In the first part of the study we sought to answer research questions 1 and 2 by identifying the extent to which the colours that are associated with abstract concepts and emotions vary cross-culturally between speakers of English and Cantonese, and the extent to which performing a word-colour association task in one’s second language engenders second language-type associations. We consulted native speakers of English and Cantonese as well as dictionaries and language corpora in an attempt to explain cases of variation. In the second part of the study, we sought to answer research questions 3 and 4 by identifying the extent to which the strength of a particular word-colour association both within and across the two languages correlates with its perceived degree of embodiment and whether bodily-based L2 word-colour associations are more likely to be adopted than culturally-based ones.

3.1. Part 1: Variation in word-colour associations in L1 and L2²

3.1.1. Participants

¹ All materials including the questionnaires, R-scripts and the raw data are available at <https://osf.io/yrbp3/>

² All analyses were performed in R (R Core Team 2012). All the data collected for this study as well as the R scripts are accessible from this public repository: www.github.com/paulapsobrinio

In order to answer research questions 1 and 2, we administered a survey that was designed to identify those colours that are most commonly associated with abstract concepts in English and Cantonese. We distributed the survey to 420 participants divided into three groups. The first group, “English L1”, consisted of 99 English participants reading and responding in English (45 female, 54 male). The second group, “Cantonese L1”, consisted of 195 bilingual Cantonese/English speakers reading and responding in Cantonese (125 female, 70 male). The third group, “Cantonese/English L2”, consisted of 126 bilingual Cantonese/English speakers reading and responding in English (98 female, 28 male). The reason for including this last group was that we were interested in exploring whether the responses provided by bilingual English/Cantonese speakers start to approximate those provided by native speakers of English as an L1. Because the participants were randomly selected we have no reason to expect that their levels of English were different, however we acknowledge that our lack of information about their exact level of English is a potential weakness of the study. All of the Cantonese participants had had at least twelve years of formal English language education and Hong Kong is a bilingual society³. The distributions across age groups were as follows:

Table 1

Age groups and language backgrounds of the participants in Part 1 of the study

Group/questionnaire language	18-24	25-34	35-44	45-54	55-64	65-74
English L1	7	24	37	17	9	5
Cantonese L1	55	79	40	16	4	1
Cantonese/English L2	42	25	31	20	8	0

3.1.2. Materials and Stimuli

Prior to the study, we compiled a list of 41 words that people associate with a particular colour in English. In order to generate this list of words, four informants, all of whom were native speakers of English, were asked to list as many words for non-concrete phenomena that they could think of that were associated with the colours yellow, orange, red, blue, green, purple, brown, black, white and grey. The group then discussed these associations and those that made sense to at least three people were retained for the study. Some of the informants included flavours in their list of associations. After some discussion, we decided to retain these items as they involve cross-sensory metaphor, are relatively abstract and may be susceptible to cross-cultural variation. For the sake of completeness, we decided to include four basic flavours (sweet, sour, salty and bitter) but decided to exclude ‘umami’ as this would be unfamiliar to

³ All of the participants in the study were adults which means that they had all received twelve years of compulsory English Language education in accordance with the country’s educational regulations.

many of the English-speaking participants. The resulting list of 41 words consisted of words for abstract concepts (e.g. intelligence), emotions (e.g. anger) and flavours (e.g. sweet). The full list is available at <https://osf.io/yrbp3/>.

In the study, participants were asked to complete an online questionnaire prepared in Qualtrics. This questionnaire contained the aforementioned 41 words gathered for emotions and abstract concepts in their own language (for the English and Cantonese L1 groups) and in their L2 (English) for the Cantonese/English L2 group. These words were translated by a bilingual speaker of English and Cantonese. Back translations were conducted to confirm that the translations were appropriate. For each word, participants were asked to select from ten different colours (yellow, orange, red, blue, green, purple, brown, black, white, grey), which they felt it was most strongly associated with. The exact wording was:

You will be shown a number of words, each followed by a list of colours. Please select which colour you associate most strongly with each word you see.”

They were given the option to say “I do not associate this word with a colour” if they so wished, as well as “I associate this word with a colour that is not listed here” and “I don’t know”. The sequence of words was randomised for each participant. The questionnaire was administered via a Snowball sampling technique via social media and email.

3.1.3. Statistical procedures

In order to test whether the differences in word-colour associations across the three language groups were significant, we performed a Cochran-Mantel-Haenszel Test for three-dimensional contingency tables, the three dimensions being abstract concept / emotion, colour, and the three language groups. The distribution was significant ($M^2(480)=33,385$, $p<.001$), indicating that the language groups preferred different word-colour associations. This analysis was complemented by a within-group analysis as well as an across-group analysis for each of the 41 words.

Within-group analysis: We performed a chi-squared test and Fisher Exact Test⁴ for each language group and analysed the residuals to establish which associations were most prominent in each language group⁵.

⁴ In the data set, some cells have expected frequencies below 5. For this reason, the p-value was obtained by performing a Fisher Exact Test. Residuals, however, are based on the results of the chi-squared test (see footnote 4).

⁵ The residuals of a chi-squared test indicate how much an observed value in a cell differs from what would be expected given the overall distribution. The residuals obtained here are Pearson residuals which are calculated by the following formula: observed frequency minus expected frequency divided by the square root of the expected frequency. Residuals above 2 and below -2 are usually interpreted as significant. High positive residuals indicate that a colour is more frequently associated with a particular

Across-group analysis: To test whether prominent colour associations differed across the groups, we performed Fisher Exact Tests comparing the distribution of colours selected for each word across the three language groups. For this analysis, we were particularly interested in the behaviour of the Cantonese/English L2 group. We wanted to find out whether this group was more likely to respond in a similar way to the Cantonese L1 group, thus retaining their native culture’s association, or converge with the English L1 group, thereby revealing a move towards the L2 associations in their responses.

3.2. Part 2: The physical basis of word-colour associations

3.2.1. Participants

In order to answer research questions 3 and 4 (i.e. to ascertain how ‘bodily-based’ the most prominent word/colour relations for each of the three groups were perceived to be), we compiled and administered a survey to two new groups of participants. They were contacted via the same social media and email networks as in Part 1 of the study and steps were taken to ensure that the people who had participated in Part 1 of the study did not participate in Part 2. This was done so as to avoid a familiarity effect. The first group, “English L1”, consisted of 51 English participants reading and responding in English (29 female, 19 male, 3 unspecified). The second group, “Cantonese L1”, consisted of 41 Cantonese speakers reading and responding in Cantonese (28 female, 12 male, 1 unspecified). With this survey we aimed to establish whether or not the degree of perceived embodiment supporting a word-colour association related to the strength of that association within a particular language as well as the tendency of the L2 speakers to adopt the association in their L2. The distributions across age groups were as follows:

Table 2

Age groups and language backgrounds of participants in Part 2 of the study

Group	18-29	30-39	40-49	50-59	60-69
English L1	20	5	10	11	2
Cantonese L1	9	17	9	5	0

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3.2.2. Materials

We selected the most frequently associated colour for each of the concepts from Part 1 in both languages and asked English and Cantonese participants to rate the associations according to their perceived degree of embodiment. For concepts where no colour was strongly associated (e.g. for dishonest in English, see *Table 1* below), we still used the most frequent emotion than expected given the overall distribution. High positive residuals thus indicate strong word-colour associations.

colour. We excluded 'Angry is Red' because it was used as an introductory item. This yielded 40 items for English and Cantonese participants each, which were presented to participants in a randomised order. Participants were asked to rate on a sliding scale ranging from 0 ("very weak") to 100 ("very strong") the extent to which they perceived the colour-word pair to have a physical origin. There was also a possibility to rate the pair as "not having a physical origin".

3.2.3. Statistical procedures

We then correlated the perceived embodiment ratings for word-colour associations with their relative frequency of selection in the first study to see whether degree of perceived embodiment was related to the popularity of the responses. Furthermore, for those items where the association in Cantonese and English were different, we were interested in establishing whether Cantonese speakers of English as an L2 would be more likely to adopt bodily-based associations than non-bodily-based ones. In order to do this, we inspected the perceived embodiment ratings in all cases where speakers of the two cultures differed in their associations (which we termed 'culture-specific associations') to establish whether the associations used by Cantonese/English L2 speakers converged to the more bodily-based association.

4. Findings

Our findings are discussed in relation to each of the four research questions listed in Section 2.

4.1. RQ 1. To what extent do the colours that are associated with abstract concepts vary cross-culturally between speakers of English and Cantonese?

In order to answer this research question, we identified four types of word-colour association: (1) those words for which the two languages exhibited the same word-colour association; (2) those where the two languages had the same main association, but differed in the rest of choices; (3) those where there was some variation in the order but where the overall choices were broadly similar; and (4) those words where completely different word-colour associations were reported. Here we discuss each of these groups in turn.

Table 3 shows the words where the two languages converged in response patterns (group 1)⁶:

Table 3

Cases where Cantonese and English associations were similar

⁶ Numbers in brackets indicate residuals and percentages. We only report associations with residuals above a value of 2. The higher the residuals, the stronger the association. Percentages indicate which proportion of the group chose the colour for the given emotion.

Word	Cantonese	English	Significance of difference ⁷
Angry	red (24.5, 93%)	red (20.1, 91%)	similar (p=.12)
Dangerous	red (24.2, 92%)	red (17.2, 80%)	different(p<.001)
	brown (13.3, 25%)	no colour (5.0, 56%)	similar (p=.09)
Disgusted	no colour (7.1, 37%)	brown (2.6, 11%)	
	colour not listed (5.0, 9%)	colour not listed (2.2, 5%)	
	no colour (9.8, 45%)	no colour (5.9, 61%)	similar (p=.05)
Dishonest	don't know (2.2, 4%)		
	grey (2.1, 11%)		
Formal			similar(p=.14)
	white (4.4, 12%)	white (2.0, 8%)	
Furious	red (21.5, 84%)	red (18.5, 85%)	similar(p=.86)
Old	grey (23.7, 53%)	grey (16.2, 44%)	different(p<.05)
	brown (13.3, 25%)	brown (11.4, 31%)	
	green (13.8, 32%)	green (8.2, 34%)	similar(p=.12)
Safe	white (4.1, 12%)		
	blue (3.8, 17%)		

The associations between the words ‘angry’ and ‘furious’ and the colour red might be related to the physical reactions that people have to these emotions or experiences, in that they cause blood to rush to the surface of the skin. The motivation for the association between danger and red relate to the natural world where (for example) red-coloured insects and mushrooms being particularly poisonous or it may derive from the fact that in many cultures the colour red is often used in signs warning of danger because this colour stands out more than other colours. The motivation of the relationship between the word ‘disgust’ and the colour brown may relate to mud and dirt. With respect to the choice of black for ‘formal’, it can be argued that it may originate in the wearing of black suits at formal occasions (which is accepted practice in both Hong Kong and in the UK). The association of ‘old’ with grey may have been due to the fact that colours fade when things grow old, and people’s hair turns grey with ageing. In Cantonese people are more likely to talk about hair becoming ‘white’ (rather than grey), which may explain the difference in English and Cantonese association patterns. Finally, the association of the word ‘safe’ with the colour green is more difficult to explain. It could be

⁷ The last column indicates whether the distributions of selected colours for the emotion were significantly different or not (i.e. similar) across the different language groups, based on a Fisher Exact Test for each emotion.

related to nature or to the cultural convention of green lights meaning that it is safe to go ahead when driving. It should be noted however that these explanations are highly speculative, and we address the issue of causal factors in a more systematic way below.

Table 4 displays the cases where the overall distribution was different but the first word-colour association was the same (group 2):

Table 4

Cases where the overall distribution was different but the first word-colour association was the same

Word	Cantonese	English	Significance of difference
Bored	grey (24.7, 55%)	grey (17.9, 48%) brown (4.3, 15%)	different (p<.05)
Calm	blue (20.9, 53%) white (7.3, 17%)	blue (14.8, 47%) green (6.6, 29%)	different(p<.001) different(p<.001)
Corrupt	brown (7.6, 16%) grey (2.9, 13%) grey (15.4, 37%)	grey (9.4, 28%)	different(p<.001)
Depressed	blue (9.1, 28%)	blue (5.5, 22%)	different(p<.001)
Dirty	colour not listed (2.4, 6%) orange (15.6, 37%)	orange (9.0, 22%)	different(p<.001)
Energetic	yellow (4.3, 15%) green (3.7, 13%)	yellow (4.4, 21%)	
Evil		red (4.7, 32%)	different(p<.001)
Extrovert	orange (9.2, 25%) yellow (2.4, 12%) don't know (2.2, 4%) green (2.0, 10%)	orange (5.5, 15%) don't know (2.4, 5%)	different(p<.05)
Fresh	green (22.5, 48%)	green (19.5, 69%) white (2.0, 8%)	different(p<.001) different(p<.001)

Mysterious	grey (2.9, 13%)		
New	white (24.4, 45%)	white (12.4, 28%) green (3.9, 21%)	different(p<.001)
Passionate	red (20.4, 81%)	red (17.2, 80%)	different(p<.01)
Sour	yellow (21.6, 49%) orange (5.1, 17%) no colour (14.4, 58%)	yellow (8.3, 32%) no colour (4.4, 52%)	different(p<.001) different(p<.001)
Spontaneous	don't know (6.3, 8%)	orange (2.5, 9%)	
Sweet	colour not listed (11.9, 17%) orange (10.5, 27%) white (8.9, 19%)	colour not listed (7.9, 13%) orange (7.5, 18%) white (10.5, 25%)	different(p<.05) different(p<.05)
Truthful	no colour (5.0, 31%) blue (3.8, 17%) don't know (3.2, 5%)	blue (3.3, 16%) no colour (2.3, 41%)	

It is not easy to find reasons for all of these cases of variation but it is possible to identify possible sources in some cases. For example, the fact that 'depressed' is linked to blue in English but to black in Cantonese could be explained by the idiomatic association between sadness and blue in English (e.g. 'feeling blue'). However, the motivation for this association is unknown. A similar hesitation holds for 'evil': the fact that it is more likely to be associated with red in English than in Cantonese perhaps reflects the fact that this is how the Devil is sometimes portrayed; but, again, we do not know what factors lie behind this association.

Table 5 shows the words for which the same associations were offered, but in a different order of preference (group 3):

Table 5

Cases where the same associations were offered but in a different order of preference

Word	Cantonese	English	Significance of difference
Cheerful	orange (13.7, 33%) yellow (10.7, 28%)	yellow (16.6, 57%) orange (6.0, 16%) colour not listed (2.2,	different(p<.001)

		5%)	
Excited	red (13.6, 60%)	orange (8.5, 21%)	different(p<.001)
	orange (6.8, 20%)	red (2.3, 23%)	
	orange (9.2, 25%)	yellow (16.6, 57%)	different(p<.001)
Happy	yellow (7.2, 21%)	orange (2.0, 8%)	
	red (3.4, 29%)		
	green (9.9, 25%)	blue (4.8, 20%)	different(p<.001)
Harmonious	white (9.5, 21%)	green (4.6, 23%)	
	blue (6.9, 24%)	white (2.5, 9%)	
	colour not listed (2.4, 6%)		
	orange (9.7, 26%)	yellow (9.3, 35%)	different(p<.001)
Joyful	red (5.9, 36%)	orange (7.0, 18%)	
	yellow (4.5, 16%)		
	blue (10.8, 32%)	brown (3.9, 13%)	different(p<.001)
Reliable	no colour (3.6, 27%)	no colour (3.6, 48%)	
	brown (2.6, 9%)	blue (2.5, 14%)	
Sad	grey (19.4, 45%)	blue (13.3, 43%)	different(p<.001)
	blue (6.2, 22%)	grey (7.3, 23%)	

Again, whilst we cannot comment on all the patterns in this table, it is interesting to note that both languages associate orange and yellow with the concepts “happy” and “joyful”, but it is only in Cantonese where both concepts are also associated with red. This is in line with the culture-specific association of red with positive things in Chinese culture (Xing 2008). *Table 3* also shows a shared connection between “calm” and green and blue (yet with different degrees of saliency in each language), perhaps hinting at the common understanding of nature and the sea as peaceful locations. Finally, it is interesting to note that both languages refer to blue and grey when asked about “sad”. We have already mentioned that the choice of blue can be accounted for by the English idiom, but it can also be argued that this connection now has international reach as it refers to a well-known musical style. The choice of grey, in turn, might have a greater physical basis, due to the paleness of the skin in depressed emotional states.

Table 6 shows the words that were associated with completely different colours (group 4):

Table 6

Cases where the words were associated with completely different colours

Word	Cantonese	English	Significance of difference
Bitter	brown (8.6, 18%) no colour (2.5, 24%) don't know (2.2, 4%)	yellow (3.0, 17%) brown (2.1, 10%)	different (p<.001)
Comfortable	green (16.0, 36%) blue (6.4, 23%) white (5.7, 14%)	green (2.9, 18%) blue (2.2, 13%) brown (2.1, 10%)	different(p<.001)
Erotic	yellow (25.9, 57%)	red (11.6, 59%) colour not listed (2.2, 5%)	different(p<.001)
Fearful	no colour (11.7, 50%)	no colour (3.6, 48%) green (8.2, 34%)	different(p<.001) different(p<.001)
Grown		no colour (2.9, 44%) don't know (2.4, 5%)	
Intelligent	blue (5.7, 21%) white (5.7, 14%)	no colour (6.3, 63%)	different(p<.001)
Jealous	no colour (4.6, 30%) red (8.1, 43%)	green (15.2, 56%) red (2.6, 24%)	different(p<.001)
Salty	no colour (8.2, 40%) brown (7.6, 2%) don't know (3.7, 3%) white (2.9, 4%)	white (13.6, 31%) no colour (2.5, 42%)	different(p<.001)
Shy	colour not listed (8.0, 12%) red (3.3, 28%) no colour (2.3, 23%)	no colour (5.3, 58%) don't know (2.4, 5%)	different(p<.001)
Stable	blue (12.7, 36%)	brown (3.9, 14%) blue (3.7, 17%)	different(p<.001)

Cases of clear divergence are somewhat easier to account for. Some can be explained in very practical terms. For example, for speakers of English, the concept of 'salty' is associated with salt but for speakers of Cantonese it is associated with soy sauce or fish sauce, which are both brown. The same association may also explain why 'bitter' is brown for speakers of Cantonese and yellow for speakers of English; whereas soy sauce is bitter as well as salty, lemons are the most prototypical bitter fruit for English speakers. An interesting case is "comfortable", which is associated with the colour green in Cantonese but purple in English. This might be explained by the fact that the word for 'comfortable' in Cantonese connotes nature, countryside and wellbeing, due to the small size of apartments in Hong Kong. In turn, in English, 'comfortable' is perhaps more likely to be associated with soft furnishing inside the house. The word therefore appears to have a slightly different meaning in the two languages in that in English it implies physical contact with an object (such as an armchair or a bed) whereas in Cantonese it refers to the environment more generally.

We now turn to culture to provide possible explanations for the different colour associations for two of the items: 'jealous' and 'erotic'. The fact that the word 'jealous' is associated with the colour green in English can be explained by the idiom 'green with envy', which does not exist in Cantonese; this might explain why Cantonese rely on a more physical word-colour connection (our faces turn red when we experience a strong emotion such as jealousy). Similarly, the fact that 'erotic' is associated with the word 'yellow' in Cantonese probably relates to the fact that pornographic magazines are referred to as 'yellow magazines', though the origin of this term is unclear. English speakers, on their part, rely on red and thus prime the physical basis of this word colour association. This leaves us with the following items: 'fearful', 'grown', 'intelligent', 'shy' and 'stable'. These items are difficult to explain but will be returned to below.

The similarities and differences observed in *Tables 1-4* lead us to retain *Hypothesis 1* insofar as some colour-word pairs appeared to be universal across groups, but there was also a degree of cross-cultural variation across the two languages that will be explored in more detail in the following sections.

4.2. RQ 2. Does performing a word-colour association task in one's second language engender a move towards second language-type associations?

In order to answer this research question, we looked only at cases where the English and Cantonese native speakers' responses differed significantly from each other (group 4). When this was the case, we were interested to see whether the L2 speakers stuck to the most common L1 associations, according to study 1, or whether they converged towards the L2-type associations. Cases of convergence are highlighted in Table 7 in bold.

Table 7

Word associations provided by L2 speakers shown in comparison with native speaker associations in the two languages

Word	Bilingual Cantonese/English speakers answering					
	Cantonese native speakers	in English (referred to here as 'L2')	English speakers	native 'L2' Cantonese	vs. 'L2' English	vs.
Bitter	yellow (3.0, 17%)	yellow (3.0, 17%)	yellow (3.0, 17%)	(3.0, 17%)	similar	different (p<.001)
	brown (8.6, 18%)	brown (12.0, 28%)	17%		(p=.32)	
	black (6.0, 25%)	black (6.0, 25%)	brown (2.1, 10%)			
	no colour (2.5, 24%)					
Comfortable	don't know (2.2, 4%)					
	green (16.0, 36%)	green (13.6, 44%)			similar	different (p<.001)
	blue (6.4, 23%)	white (5.1, 14%)	green (2.9, 18%)		(p=.24)	
	white (5.7, 14%)	blue (2.2, 13%)	blue (2.2, 13%)			
Erotic	brown (2.1, 10%)		brown (2.1, 10%)			
	yellow (25.9, 57%)	purple (5.4, 13%)	red (11.6, 59%)		different (p<.001)	different (p<.001)
	don't know (3.6, 9%)					
	colour not listed (2.2, 5%)		colour not listed (2.2, 5%)			
Fearful	red (3.5, 26%)	colour not listed (3.2, 10%)				
	yellow (3.2, 17%)					
	black (17.5, 47%)	black (2.7, 17%)	no colour (3.6, 48%)		different (p<.001)	different (p<.05)
Grown	purple (2.3, 8%)	no colour (2.1, 25%)				
	no colour (11.7, 50%)	green (10.0, 35%)	green (8.2, 34%)		different (p<.001)	different (p<.05)

			no colour (2.9, 44%)		
			no colour (2.5, 26%)		
		don't know (2.1, 6%)	don't know (2.4, 5%)		
			no colour (6.3, 63%)	similar (p=.15)	different (p<.001)
	blue (5.7, 21%)	blue (6.7, 25%)			
	white (5.7, 14%)	no colour (3.4, 29%)			
Intelligent					
	no colour (4.6, 30%)				
			green (15.2, 56%)	similar (p=.07)	different (p<.001)
Jealous	red (8.1, 43%)	purple (7.7, 17%)	red (5.3, 33%)		
			red (2.6, 24%)		
	no colour (8.2, 40%)	no colour (6.4, 41%)	white (13.6, 31%)	different (p<.01)	similar (p=.11)
			no colour (2.5, 42%)		
	brown (7.6, 2%)	white (5.9, 16%)			
	don't know (3.7, 3%)	blue (3.2, 16%)			
Salty	white (2.9, 4%)				
	colour not listed (8.0, 12%)	no colour (5.1, 36%)	no colour (5.3, 58%)	different (p<.01)	different (p<.05)
		colour not listed (2.8, 9%)	don't know (2.4, 5%)		
Shy	red (3.3, 28%)				
	no colour (2.3, 23%)				
				similar	different
	blue (12.7, 36%)	blue (7.0, 25%)	brown (3.9, 14%)	(p=.33)	(p<.01)
Stable		white (3.9, 12%)	blue (3.7, 17%)		
		black (2.5, 16%)			
		no colour (2.1, 25%)			

These results show that in most cases, the responses given in the second language resemble those that are given in the L1. There was only one case where the L2 association converged towards English: 'salty', where the Cantonese/English group chose white over brown (which was the most prominent choice of the English group). The findings for 'salty' could be

explained by the fact that the word contains the word ‘salt’ itself, thus leading the speakers to think of salt itself in their responses. For this reason, this word might therefore be eliminated from the analysis, allowing us to conclude that the strongest tendency was to retain the L1 association.

There were however some cases where the associations produced in the L2 clearly diverged from Cantonese. These were: ‘erotic’, ‘fearful’, ‘shy’ and ‘grown’. In the case of ‘shy’, there was no strong association with any particular colour. In the case of ‘grown’, the main association is green as was the case in English. Yet, there was still a significant difference between the overall distribution of colours associated with ‘grown’ in the L2 and English. This might be interpreted as a weak form of conversion. ‘Fearful’ behaved in a similar way in that the L2 diverged from Cantonese (black was less strongly associated) and moved towards the English association (where black was not associated at all with fearful). Interestingly, for the word ‘erotic’, the L2 associations differed significantly from Cantonese but they did not converge towards the English pattern (red) in any significant way. In these cases, the L2 speakers appear to have developed a kind of ‘interlanguage’ in terms of their associations. Consequently, *Hypothesis 2* is only partly confirmed: speakers move from typical L1 word-colour associations to those of the L2, but they also continue to make use of associations that are used in their L1, as one would expect.

Above we saw that for ‘happy’ and ‘joyful’, associations in English and Cantonese are fairly similar. However, Cantonese (in contrast to English) also associates red with these positive concepts. Interestingly, red does not emerge as a significant association for ‘happy’ and ‘joyful’ in the Cantonese/English L2 group (see *Table 8*). This may reflect the cultural rather than bodily-based origin of the association between red and happy / joyful.

Table 8

L2 behaviour for happy and joyful

Word	Cantonese	Cantonese L2	English	L2 vs. Cantonese	L2 vs. English
happy	orange (9.2, 25%)	yellow (9.6, 33%)	yellow (16.6, 57%)	different (p<.05)	different (p<.001)
	yellow (7.2, 21%)	orange (7.9, 27%)	orange (2.0, 8%)		
	red (3.4, 29%)				
joyful	orange (9.7, 26%)	orange (10.4, 33%)	yellow (9.3, 35%)	different (p<.001)	different (p<.001)
	red (5.9, 36%)	yellow (9.6, 33%)	orange (7.0, 18%)		

yellow	(4.5,
	16%)

So far in our study, we have managed to explain some of the associations in terms of practical considerations (e.g. the colour of soy sauce) or idioms whose etymology is unclear (e.g. ‘green with envy’). However, we saw above that it may be the case that some word-colour associations both in the L1 and the L2 can be explained by their levels of perceived embodiment. It is to this issue that we now turn by looking first at the role of perceived embodiment in shaping L1 associations (RQ3) and second at its role in shaping L2 behaviour (RQ4).

4.3. RQ 3. To what extent does level of agreement both within and across languages correlate with perceived embodiment?

Perceived embodiment ratings and strength of association (operationalised by how frequently a colour was selected for a given word in the first study) were highly correlated for both English and Cantonese (for English: $t = 10.483$, $df = 38$, $r = .86$, $p < .001$; for Cantonese: $t = 5.3159$, $df = 38$, $r = .65$, $p < .001$). This finding suggests that, indeed, strongly associated word-colour pairs are more bodily-based. We thus accept *Hypothesis 3* of the study: the overall trend shows a tight correlation between the most prominent word colour choices and their perceived degree of embodiment. *Figure 1* (English) and *Figure 2* (Cantonese) plot the correlation between the mean perceived embodiment rating for each association and the strength of the association operationalised by the relative frequency of selection, i.e. percentage of how often the colour was chosen for the given concept (please note that for reasons of display the figures do not present the full range of the rating scale, which was 1 to 100).

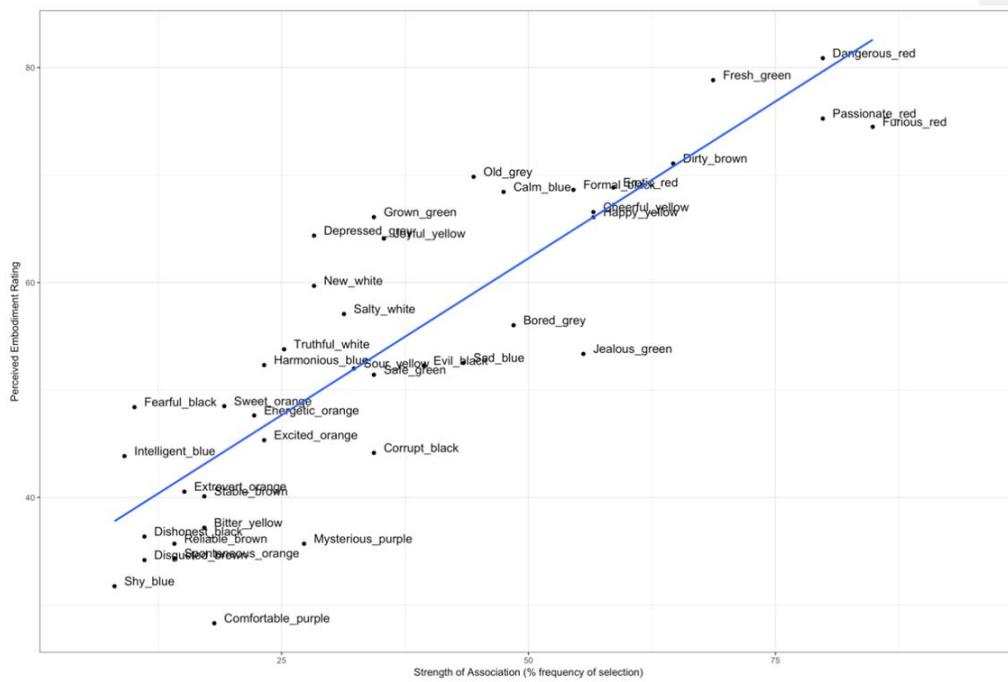


Figure 1. Perceived degree of embodiment for Frequently Associated Word-Colour Pairs (English)

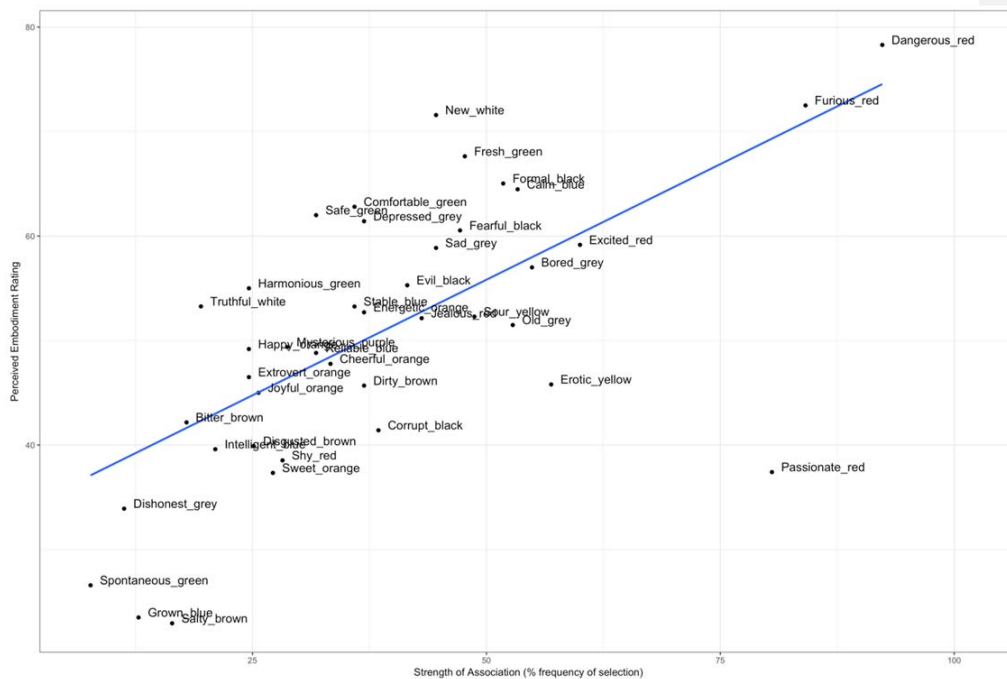


Figure 2. Perceived degree of embodiment for Frequently Associated Word-Colour Pairs (Cantonese).

It should be noted that the standard deviation for the mean ratings is rather high. The standard deviation indicates how strongly individual ratings for an association differ from the mean rating for the association. If the standard deviation is small, the mean is a good summary for the distribution of ratings for a particular association. The higher the standard deviation, however, the more the data points vary within the distribution. For the English perceived embodiment ratings, the standard deviation on average was 27.8. The smallest standard deviation was found for ‘fresh is green’ (SD = 21, variation coefficient 0.27)⁸. Thus, this pair exhibited the least amount of variation among participants. The largest standard deviation was found for ‘shy is blue’ (SD = 29, variation coefficient = 0.91). Thus, this pair exhibited the highest amount of variation, or divergence, among raters.

For the Cantonese perceived embodiment ratings, the standard deviation was equally high. On average, the standard deviation was 27.3, indicating that the individual ratings varied strongly from the mean for a particular association. ‘Bitter is brown’ showed least variation (variation coefficient = 0.32) and ‘salty is white’ showed most variation (variation coefficient = 1.54).

⁸ In order to compare standard deviations, they were normalised by calculating the variation coefficient (Gries 2013: 125).

Furthermore, it should be noted that when rating the degree of bodily-based motivation for a given word-colour pair, participants also had the option to select “don’t associate”. It turns out that for some word-colour pairs participants selected this option quite often (e.g. “don’t associate” was selected 61% of the times for Jealous is Green in the Cantonese data and even 66.7% for Comfortable is Purple in the English data).⁹ The frequency with which this option was selected for a given pair is negatively correlated both with strength of association ($t = -6.3435$, $df = 55$, $p < .001$, $r = -.65$ for the Cantonese data; $t = -8.6991$, $df = 38$, $p < .001$, $r = -.82$ for the English data) as well as perceived degree of bodily-based motivation ($t = -13.045$, $df = 55$, $p < .001$, $r = -.87$ for the Cantonese data; $t = -13.464$, $df = 38$, $p < .001$, $r = -.91$ for the English data). This means that participants selected “don’t associate” for pairs that were not perceived as being bodily-based and which were not among the most frequent pairings identified in the first study. This finding provides further support for the hypothesis that bodily-based word-colour associations are more universal. We can give two potential explanations for the frequent selection of the “don’t associate” option: First, the association might be more cultural than bodily-based, thus “don’t associate” was selected; and, second, in the first study, participants may have been pushed to select a colour because there was no “don’t associate” option which led to the higher number of “don’t associate” answers in the second study for these word-colour pairs.

We also analysed whether perceived embodiment ratings differed significantly between English and Cantonese (*Figure 3*). Overall, perceived embodiment ratings for shared associations between Cantonese and English ($N = 23$) were correlated ($t = 3.1079$, $df = 21$, $p < .01$, $r = .56$). There were only three cases where the mean ratings differed significantly (circled in *Figure 3*): (1) ‘dirty is brown’ ($t = -4.0264$, $df = 76.89$, $p < .001$, two-sided, independent samples), (2) ‘old is grey’ ($t = -3.3371$, $df = 76.994$, $p < .01$, two-sided, independent samples), and (3) ‘passionate is red’ ($t = -5.8091$, $df = 38.72$, $p < .001$, two-sided, independent samples). Our first study showed that in Cantonese, both brown as well as black are almost equally strongly associated with dirty (cf. *Table 2*). It might be because Cantonese has these two competing colours that dirty and brown were perceived as less bodily-based. With respect to the association between ‘old’ and ‘grey’, this was significantly less likely to be perceived as bodily-based in Cantonese than in English. The mean degree of perceived embodiment for ‘old is grey’ was 51 in Cantonese, and 70 in English. However, the perceived embodiment rating for ‘old’ and ‘grey’ in Cantonese was still relatively high. Finally, although ‘passionate’ and ‘red’ were strongly associated in Cantonese (actually more so than in English, see *Table 2*), they were perceived as less bodily-based compared to English. The exceptional character of this word

⁹ Figures regarding the frequency of the selection of the “don’t associate” option can be accessed via the raw data in the online repository.

pairing is also clearly noticeable in *Figure 3*. The reason why the association between ‘passionate’ and ‘red’ received such a low degree of perceived embodiment in Cantonese in contrast to its high strength of association requires further research.

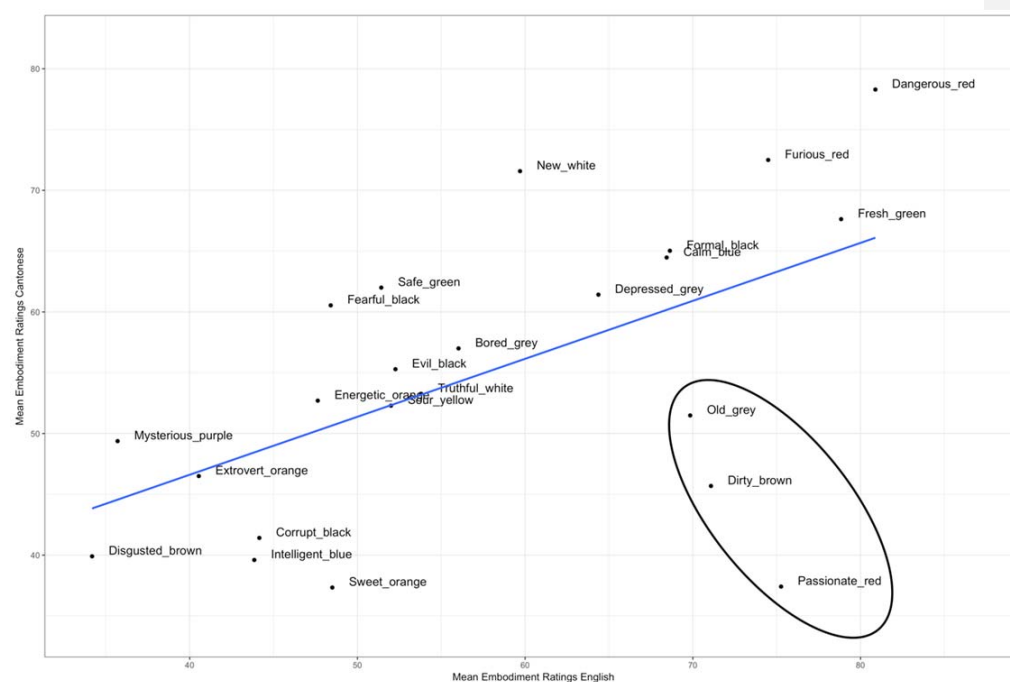


Figure 3. Comparison of perceived embodiment ratings for associations that are shared between English and Cantonese.

In general, this second finding supports the hypothesis that universally shared associations also tend to be more bodily-based, thus confirming *Hypothesis 3*.

4.4. RQ4. Are bodily-based L2 word-colour associations more likely to be acquired than culturally-based ones?

In order to find out whether L2 behaviour was driven by degree of perceived embodiment, we considered cases where English and Cantonese differed in their associations (*Table 5*) and compared these to the perceived embodiment ratings in English and Cantonese. The respective cases were colour associations for ‘bitter’, ‘comfortable’, ‘erotic’, ‘fearful’, ‘grown’, ‘intelligent’, ‘jealous’, ‘salty’, ‘shy’, and ‘stable’. See below *Figure 4* for exclusive culture-specific associations in English.

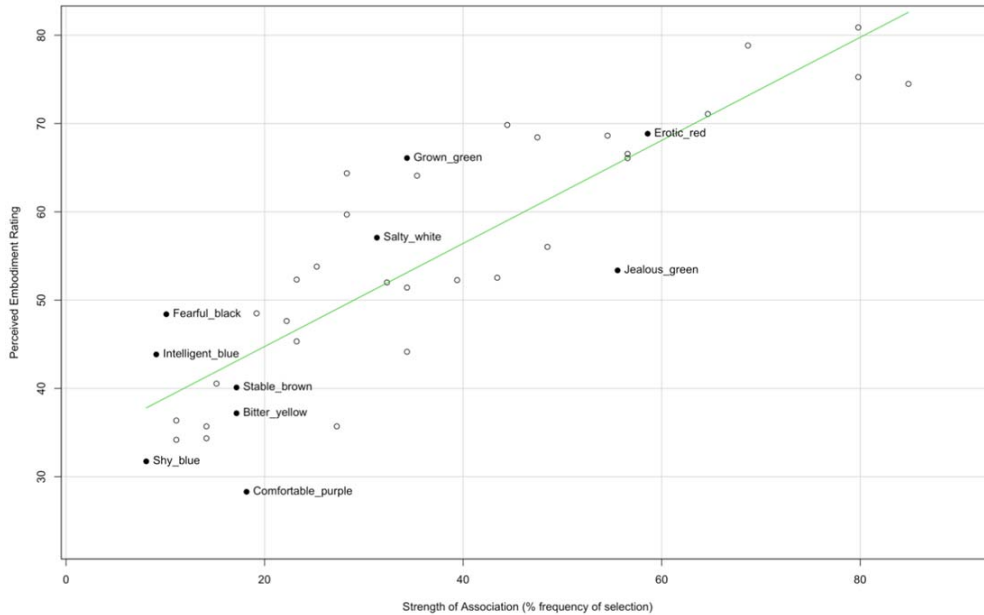


Figure 4. Degree of perceived embodiment for culture-specific associations (English)

We can see that ‘grown is green’ and ‘salty is white’ were actually more bodily-based than expected given their frequency of selection. It was for these two pairs that the Cantonese / English L2 group converged towards English. However, even though ‘fearful’ and ‘black’ were not significantly associated in English in the first study (cf. Table 5), the association was still perceived as having a relatively high physical basis, as can be seen in Figure 4. The reason why ‘fearful’ and ‘black’ were not significantly associated with one another even though there was a great degree of perceived embodiment supporting that connection requires further research. The same applies to ‘intelligent is blue’, an association which was reported as having a fairly strong physical basis, but which was not found to occur with a high frequency in the first questionnaire.

The perceived embodiment ratings for associations for ‘jealous’, ‘stable’, ‘bitter’, ‘shy’ and ‘comfortable’ were lower than expected given their relatively high frequency of selection. This may explain why we found that the Cantonese / English L2 group did not converge to these specific associations (cf. Table 5).

We now turn our attention to the culture-specific associations for Cantonese (see Figure 5 below). Interestingly, these findings mirror the trends observed for English above. ‘Grown is blue’ and ‘salty is brown’ received very low perceived embodiment ratings, and it was for these associations where the Cantonese / English L2 group converged to English. In turn, ‘bitter’, ‘comfortable’, ‘fearful’, ‘jealous’, and ‘stable’ received bodily-basis ratings in line with the

ratings for the strength of the association (or were even higher), and thus it was in these cases where the Cantonese / English L2 group retained the Cantonese associations.

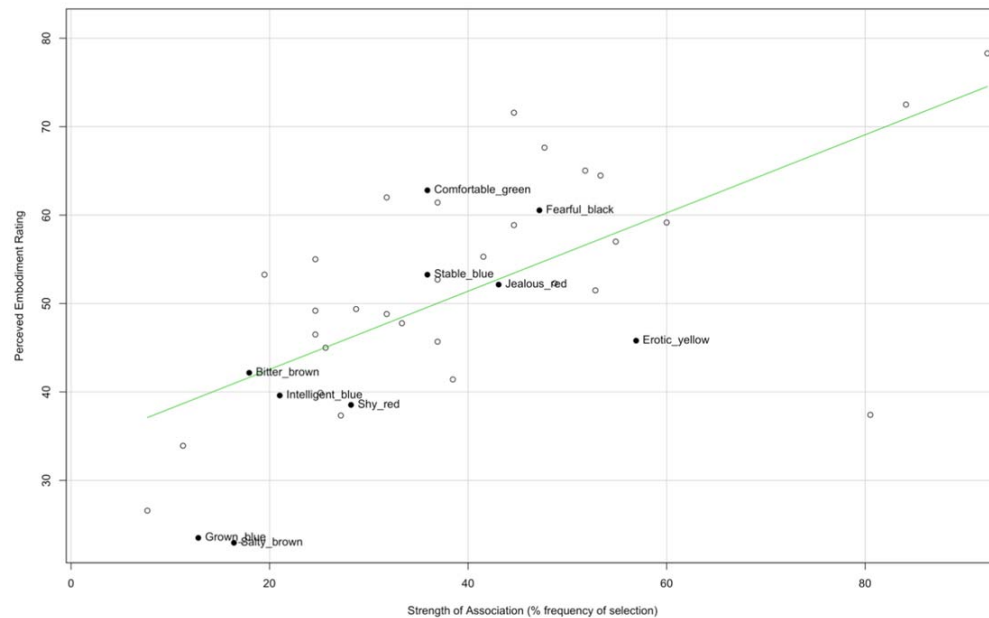


Figure 5. Perceived degree of bodily-basis for culture-specific associations (Cantonese). Two interesting cases that deserve further consideration are ‘erotic’ and ‘shy’. Recall that, for ‘erotic’, we saw in *Table 5* that the Cantonese / English L2 group diverged from the Cantonese associations. This is supported by the fact that ‘erotic is yellow’ received a comparably low bodily-basis rating. Interestingly, the L2 group still did not converge to the English association, and remained somewhere in between the native and the target language. For ‘shy’, we can see that in terms of bodily-basis the respective associations received relatively low bodily-basis ratings in both English and Cantonese. This may explain why the L2 did not exhibit any strong preference for shy with any colour.

Overall, these findings suggest that associations that are formed in the L2 tend to converge to the more bodily-based associations that are present either in the L1 or the L2, much in line with our expectations in *Hypothesis 4*. They also suggest that the less bodily-based an association is in the L1, the less likely it is that a person will remain ‘loyal’ to that association when they are using their L2.

5. Conclusion

In this chapter we have provided an overview of the most prominent word-colour choices in English and Cantonese. Our data reveals that there is a great degree of convergence between the languages, but more interestingly, a myriad of diverging choices, the study of which has helped to further our knowledge of these two cultures. Whereas some of the diverging choices can be accounted for in terms of cultural differences, the findings from our study suggest that the level of perceived embodiment in the motivation for a particular word-colour association plays a crucial role in determining the level of agreement both within and across languages, as well as the extent to which the association is likely to be adopted by an L2 speaker of the language. These findings provide empirical evidence for the role of perceived embodiment in motivating linguistic and conceptual associations in both the first and second language.

More importantly, our findings have implications for cross-cultural communication, and by extension, the ways in which language teachers deal with implicit meaning, as they suggest that bodily-based associations that have been established in the L1 are more likely to be entrenched than culturally-based associations, and are therefore likely to be difficult to modify when speaking the L2. It would be interesting to investigate whether this pattern also extends to other forms of bodily-based language, such as collocations that are motivated by bodily-based metaphor. For example, Akpınar and Berger (2015) explored the development of collocations over the course of 200 years in a corpus of 5 million books and found that metaphoric collocations that reflect an underlying sensory relationship are significantly more likely to remain in the language than their non-sensory counterparts. Their study revealed that sensory metaphoric collocations were thus ‘more culturally successful’ than their non-sensory counterparts. For example, the term ‘sharp increase’ was more likely to remain in the language once it had entered it than the ‘severe increase’ and the term ‘bright future’ was more likely to remain than the term ‘promising future’. Akpınar and Berger also tested 365 participants on their ability to recall the different terms and found that they were significantly better at recalling the bodily-based metaphorical collocations than their literal equivalents. If these collocations behave in the same way as the bodily-based word-colour associations in our study, then one would expect them to be more entrenched and therefore less resistant to change in cases where the L2 uses a different collocation.

However, a note of caution needs to be sounded as our study was based on correlational analyses and we cannot therefore be sure about the role of causality. Although we have assumed that degree of perceived embodiment explains the frequency of association, it could be that the relationship works in the opposite direction (i.e. where frequent associations lead one to assume that the relationship is bodily-based) or it could be that both frequency of association and perceived embodiment are influenced by a third, as yet unidentified variable.

Other aspects of our data which merit further investigation are those cases where perceived embodiment and strength of association diverge. In other words, it would be useful to conduct an investigation (possibly making use of qualitative methods) into all the cases that appear far from the correlation line in *Figures 1* and *2*. For example, it would be interesting to explore the idea that ‘passionate is red’ in Cantonese. This word pair exhibited a strong association in study 1 but received low perceived embodiment scores in study 2. Similarly, the idea that ‘fearful is black’ was rated as being relatively bodily-based in English and Cantonese but in English it was not at all associated, and in the L2 it was less strongly associated than in Cantonese. Findings such as these are difficult to explain without recourse to interview data.

Finally, other questions that could usefully be explored relate to the range of associations that people make in their first and second language, the reasons that they provide for making these associations, and the role of the participants’ idiom knowledge in the first or second language in shaping their responses. In our study, we did not allow for the fact that participants may associate more than one colour with each of the prompts. This is particularly relevant for bilinguals (all of the participants in our study were bilingual speakers of English and Cantonese), who may produce more associations than monolinguals, due to their increased cognitive flexibility and associative networks (Bialystok 2001a, 2001b; Bialystok et al. 2014). Furthermore, we did not ask the participants to provide explanations for their answers. We therefore do not know what motivated their choices. Another consideration is the fact that some L2-type (English) associations may have appeared when participants were performing the task in their first language (Cantonese). More pronounced differences might be found if the study were replicated with inclusion of respondents who were monolingual speakers of a language distant from English. And finally, although we hypothesised that knowledge of idioms may have affected responses to some of the items, we did not explore this systematically. The role played by their explicit knowledge of idioms could be explored through a qualitative examination of the reasons given for their choices and the role played by their implicit knowledge of idioms could be examined through corpus-based frequency studies of the colour-based idioms in each of the two languages. We now intend to conduct a follow-up study in which participants are permitted to provide multiple associations and to motivate their responses. This will be accompanied by a corpus-based analysis of colours and their associated idioms in English and Cantonese, whose findings we will use to help explain some of the variation.

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