Rosa mexicano: the social optics of a colour neologism

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The phrase '*rosa mexicano*' or what is now called 'Mexican Pink' in English, began to be used in Mexico in the 1950s and has now been adopted as a representative colour for the Mexican nation state. A government agency like the *CPTM* (*Consejo de Promoción Turística de México*), or 'The Council of Promotion of Tourism', and the urban planning and administration unit of Mexico City, called by the acronym *CDMX* (*Ciudad de Mexico*), validates the phrase as a symbolic colour-name of the state and the culture of its peoples. The *CPTM* also endorses the Pantone Matching System colour 'magenta' #E50087 as this specific memorable colour, now called *rosa mexicano* or "Mexican Pink" as the appropriate colour of the 'ancient Mexican peoples'. But despite such institutional and public endorsement, could we safely say that the term has indeed, gradually or otherwise, come to represent a semantic marker for the experience of a very geographically local variant of pink. Here we examine if the phrase *rosa mexicano*, or 'Mexican Pink' can be accepted as a *true* symbol of a long existing, recognisable colour and its visible social preference for people in Central America and Mexico in particular. In cognitive experiments of colour identification, the phrase *rosa mexicano* elicited a response in the spectrum between red and purple corresponding to a Hue value between 310 to 335 in HSB colour space. In contrast normal 'pink' or *rosa* or its JND *fucsia*, or what is called 'fuchsia' in English, are clearly perceived as less intense variations. We finally suggest that the socio-optically constructed neologism *rosa mexicano*, which has been adopted in the common Spanish Castilian variant of most of Mexico's urban and to a large extent a rural population of speakers, indeed represents a statistically significant category close to the specifically stronger or warm pink which appears as a typical colour range used in Mexico since pre-Colombian times. The phrase thus capitalises what sociologists like Bourdieu and Alexander called *habitus* formation. A culturally elite, high energy and high-financial verbal formulation of this compound phrase, with a header '*rosa*' and the adjective qualifier '*mexicano*', originating as it did in art, fashion and a more aesthetics-based commercial culture, gradually binds in with a cognitive-memorial colour of the wider, rural and *mestizo* (mixed) segments of Mexico's stratified social culture.

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Introduction

What is rosa mexicano?

'*Rosa mexicano*', or as it is more globally known, 'Mexican Pink', is the name of a special variation of the colour *rosa* or 'pink'; the phrase appears to have emerged in Mexican culture first within circles of urban art and fashion during the middle of the last century. It has now emerged as a colour name in a variety of globally renowned commercial and aesthetic brands to represent colours on items of fashion, cosmetics, architecture or décor, or for colours associated with paintings on automobiles, or for places and businesses like restaurants, boutiques *etcetera*.

Now, the official page of Mexico's 'Council of Promotion of Tourism', or *CPTM* (*Consejo de Promoción Turística de México* in Spanish), says that the colour *rosa mexicano* may be signified by 'Magenta' # E50087 on the Pantone Matching System index of colours (henceforth PMS). The *CPTM* information page consists of an alphabetical logo printed with the colour *rosa mexicano*. This brochure further states that the PMS # E50087 colour shade was created by 'the ancestors of Mexico' and is a symbol of 'charisma' [1]. Then, *rosa mexicano* is also categorised as '786 Satinado-Mate' by the Mexican paint manufacturing company COMEX [2]. But COMEX '786 Satinado-Mate' unlike the PMS #E 50087 denotes a slightly different shade of pink in the HSB (and *Lab*) code classification system. Versions of *rosa mexicano* that are endorsed by various government institutions or companies do not have a recognised or specific Hue value.

Lack of specific referent for rosa mexicano

This presents us with a problem of branding standard for Mexican pink in the consumer domain. The colour name *rosa mexicano*, or 'Mexican Pink' (in English translation) in different organisations represent differing shades of pink. *Rosa mexicano* lacks a brand standard of the kind issued by the Norma Oficial Mexicana (the brand authorisation wing of the Secretariat of Economics), for such colours as those used on the Mexican national flag for example.

So, our first significant question is whether this neologism *rosa mexicano*, that developed in a course of only less than hundred years, indeed represents a unique colour frequency? Does this very popular urban phrase catch the essence of the deep pink that has existed for several centuries in pre-Hispanic (as also 'mixed' colonial) culture, as the CPTM brochure indicates? In fact, an undecidedness about the exact shade to which *rosa mexicano* refers is also symptomatic of the lack of agreement in common people's perception for very close variants of the colour in the populations studied for this project. We tried to examine if this new Spanish-Nahuatl compound phrase succeeds by far better in denoting the colour that has long been anonymously embedded in indigenous traditions and its later Mestizo manifests, and one that artists of the fifties tried precisely to retrieve.

The Philology of 'rosa mexicano'

In Mexico the colour name *rosa mexicano* has become more popular since the nineteen sixties, after its adoption in the works of Frida Kahlo, Diego Rivera, and later reportedly and more specifically by Ramon Valdiosera [3]. The combination of words '*rosa*' and '*mexicano*' seems to have been only frequently used or adopted first in circles pertaining to art and aesthetics, especially painting and fashion, and gradually in mainstream cultural expressions like architecture and urban planning.

Usage of this pink has subsequently given rise, consciously and otherwise, to a steadfast visual-semiotic category called the *rosa mexicano*. Henceforth this *rosa mexicano* (or Mexican Pink, as it is called in English) has been referred to as the colour 'intrinsic to culture' [4], an example of 'critical or authentic regionalism' [5], a tonal expression of a 'conciliated vernacular style' and a 'pathway of light' [6]. On the visual level it is thought to be an inalienable expressive symbol in works like the serene walls of architects like Luis Barragan and Ricardo Legorreta, just as much as in the paintings of Frida Kahlo and Rufino Tamayo [7].

More purportedly, we might consider the deliberate use of pink among contemporary painters and artisans like Elena Climent (painter), and numerous indigenous inspired sculptors or artists like Santiago Matamoros (handicrafts, Guanajuato), Juan Dominguez Garcia (handicraft and painting, Morelos), or Angelico Jimenez (painter, Oaxaca) all of whose works have been exhibited in locations

like the *Museo de Artes Populares*, Mexico D.F., or centres of art works or galleries like that of the *Casa de Venados* in Valladolid, Yucatan, and the *Museo de Textiles*, Oaxaca.

Following sociologist Zerubavel's theory of visual semiotics we may say that a socio-optical appropriation of pink based colour usage has led to sociologically significant changes in the categorical perception of pink in recent years [8]. Pink symbolism gradually appeared radically in discussions on popular art and fashion of contemporary international designers and fashionistas like Ramón Valdiosera.

Early colonial phraseology of pink

Before the invention of this compound phrase however the one Spanish colonial word '*rosa*' must have acted as the preferred qualifier for all pink and near-pink shades in Mexico. '*Rosa*' reportedly denoted the brilliant pink on the dresses of bullfighters. On the other hand, Spanish colour names like *magenta* and *fucsia* represented the deeper indigenous pinks, as they still appear to be used by contemporary rural and *mestizo* (i.e. racially mixed) populations today.

As for indigenous names of a deeper pink, likely contestants exist, but such word or words like other indigenous words have not been adopted in Mexican Castilian Spanish. To some extent Nahuatl *tlataleualtik* refers to 'magenta' as well as fuchsia. The other word which signifies a pale shade close to the '*rosa*' of the Spaniards is *xochipaltik* – the rather light pink, similar to contemporary Spanish (Mexican) *rosa pastel* i.e. 'pale pink'. The word survives very largely in Mixteca and Mayan codices, and refers more to a pink that was also applied over European fabrics and artifacts brought over from Spain after the conquest. *Xochisuatl* refers to an even lighter pink.

There are perhaps even more plausible historical reasons for the assumption of the Spanish word *rosa* for the compound expression '*rosa mexicano*'. The word *rosa* was carried over to Mexico and got to be used like a focal term for a much broader perception of pink [9-10]. Anticipatedly, *rosa* must have profoundly affected perceptions of the entire range of red to pink shades of the indigenously available colour because of what is known as discursive dominance [11]. *Rosa* was a high valency, territorialising signifier prevalent in the colonial and more elite Spanish art and culture: this is evident from the history of eighteenth century paintings, like those of Goya, and the contumely of fashionable royal and aristocratic Bourbon families where pink shades are ubiquitous.

If we consider the evolution of *rosa* from its origins in Old World Spain we get to see how the imported word for pink could be more effortlessly used by Spaniards to refer also to non-Spanish New World, indigenous pink-like shades. This Spanish *rosa* is lighter, and identified with a HSB Hue median of 303. The *rosa* of '*toreros*' or the bright stockings worn by bullfighters, is a case in point. The old Spanish *rosa* may have also been closer to the *rosa galliciae*, a northern European colour extract [12-13]. These pinks of Spanish enlightenment culture, like those found in Goya's *Reclining Woman Wearing a 'Maja'* (1800) and the interiors, have been instrumental colours in the cultural history of Spain but would have been less used or seen in pre-Colombian contexts, simply because the material sources of the colour in Europe were different, and derived mostly from kemp or rose which were typical to northern European habitats [14-15].

Pre-Colombian pragmatics of indigenous words denoting pink

As we move towards the East of Mexico, there appears no word for 'pink' *per se* among Mayan dialect groups like the Tzotzil and Tzetzal. Again, our table shows (Table 1) deeper pinks may have been represented by indigenous compound words. The Mayan word *ik* for 'dark', and *kan* meaning 'red' and finally chak for a 'light pink' may be combined together to give rise to a Yucatec dialect colour-term like

the *ik-kan-chak* which means 'dark-reddish-pink'. Perhaps another Yucatec word *nikte* comes closer to the strong pink flower having a shade similar to the stronger *rosa mexicano*. But as our survey shows pre-Colombian words from some of the major language groups of Mesoamerica (like *ik*, or *kah*) were never adopted in Spanish to denote the darker pinks of indigenous material culture.

There were older ethnic words from which a possibly more focal colour term may have emerged for a darker pink, as Kay and Regier argues is usually the case for zonally distributed intra-language speakers who respond to a given colour range in their common material culture [10]. But the truth in case of the indigenous deep purple pink is that none of any such indigenous words were not adopted (Table 1). There is no answer to this phenomenon except for the fact that Spanish *rosa* continued to be used as a result of discursive (political and economic) dominance in a region of competing language identities [11].

Language	Language family	Red	Pink / Rosa	Objects of extraction	Hue of pink (HSB colour space)
Yucatec Maya	MAYAN	Kan	Chak or Ik/Chak/Kan or Nikte	Campeche wood, Cochinilla	330 to 345
Tzoztil	MAYAN	---	---	---	330 to 345
Tzeltal	MAYAN	---	---	---	330 to 345
Chontal (Tabasco)	MAYAN	Chik	---	Cochinilla	335 to 345
Aguatec	MAYAN	Kvak	---	---	340 to 350
Nahuatl	NAHUATL	Chichiltic	Tlataleualtik	Rose (flower)	335 to 340
Otomi	OTO-PAME/ OTOMANGUEAN	Theni	Donzha	Flower of Zha	320 to 330

Table 1: List of indigenous words showing pink JNDs and corresponding cultural object-identifiers [16].

Experiment

Statistical analysis of colour and determination of a median pink

Our objective for the experiment was to consider if this compound phrase '*rosa mexicano*' could represent a basic and historical cultural experience, and was colorimetrically suited to capture an embedded perception of the colour. To understand this, we first tried to derive a range for the indigenous colour from well-known artifacts of Mexican and central American material culture, including perishable objects like textiles, basketry, and *papier maché*. We derived the statistical mean of pink-based colours from spectrometric analysis of (a) garments and wearables (textiles) (Table 2); (b) handicrafts (Table 3); (c) naturally available colours like that of flowers and fruits native to the region (Figure 1); (d) paintings (Table 4); and finally (e) fashion (Tables 5 and 6).

Tables below provide good examples of cultural artifacts that have traditionally been rendered with indigenously developed pink pigments, or mostly pink shades. HSBs were derived from spectrographic measurement of 1×1 cm surfaces (against a reflectance coefficient of 1) from each object in the category – like textile, handicrafts etc. Colour areas which were generally agreed by colour experts to be either reflecting *rosa mexicano* or shades 'close' to it were ones solely retained for measurements.

Garment type	City origin	State	Ethnic group	Pigment type	Material	Range of hue for pink (HSB colour space)
Huipil	San Antonio and San Pedro Amusgos	Aguascalientes and Oaxaca	Amuzgos	Cochinilla, from insect *Dactylopius coccus**	Interwoven threaded cotton textiles and Cotton thread textile	340 to 350
Huipil Ceremonial (Overcoat or wrap)	San Andrés Larráinzar and Quetzaltenango, Guatemala	Chiapas Guatemala	Tzotziles	*Palo de Tinte*** or *Palo de Brasil*	Cotton textile or taffeta woven on loom	335 to 350
Huipil de tapar (Overcoat or wrap)	San Bartolo Yautepec	Oaxaca	Mazateca (Mixteca)	Cochinilla,* from insect *Dactylopius coccus*	Industrial cotton textiles and silk	340 to 350
Huipil con enagua (Overcoat or wrap)	Xochistlahuaca	Guerrero	Mixtecas	*Palo de Tinte*** or *Palo de Brasil*	Cotton textile or taffeta woven on loom	335 to 350
Traje de tehuana (Full women's dress)	Tehuantepec	Oaxaca	Zapoteca	Cochinilla,* from insect *Dactylopius coccus*	Hand embroidered velvet	340 to 350
Blusa (Blouse or shirt)	Oaxaca	Oaxaca	Huichol and Otomí	Cochinilla,* from insect *Dactylopius coccus*	Coloured thread embroidered with beads	340 to 350
Gabán (Loose jacket)	Contla de San Juan	Tlaxcala	Otomí	*Tuna cardona* (fruit) [Sc. Name *Opuntia Ficus*]	Wool tapestry woven with loom and pedal	330 to 345
Sarape de Saltillo (Shawl)	Teotitlán del valle	Oaxaca	Huichol and Otomí	Cochinilla, * from insect *Dactylopius coccus*	Woven wool and treadle	340 to 350
Paño de carranza (Cloth cover)	Venustiano Carranza	Chiapas	Tzotziles	*Palo de Tinte*** or *Palo de Brasil*	Cotton and linen embroidered waist loom	335 to 350
Tablas (Garment**)**	Santiago iscuintla	Nayarit	Nahuas	Purple snail, called *Caracol púrpura* in Castilian Spanish [Sc. name *Plicopurpura patula pansa*]	Worsted yarns glued with Campeche wax	290 to 320
Mantel (Garment, skirt)	Tenango de Doria	Hidalgo	Mazahuas and Nahuas	*Tuna cardona* in Sp. (a fruit) [Sc. Name *Opuntia Ficus*]	Cotton embroidered with coloured threads	330 to 345
Manta Lliklla (Full Garment)	Niño Corin, Charazani, La Paz.	Bolivia	Lecos	*Palo morado*^ [Sc. Name *Peltogyne mexicana*]	Fabric yarn woven with double wool	297 to 325
Corte (Long garment)	San Cristobal, Totonicapán	Guatemala	Kekchí	*Palo de Tinte*** or *Palo de Brasil*	Cotton Yarn Fabric	335 to 350
Cinta para la cabeza (Belt)	Totonicapán, Totonicapán	Guatemala	Kekchí	*Palo de Tinte*** or *Palo de Brasil*	Cotton yarn and acrylic	335 to 350
Paño de cabeza (Headdress)	Chichicastenango, El Quiché	Guatemala	Quiché	*Palo de Tinte*** or *Palo de Brasil*	Interwoven cotton thread fabric	335 to 350
Poncho (Jacket variation)	Niño corín, Charazani, La Paz	Bolivia	Lecos	*Palo morado*^ [Sc. Name *Peltogyne mexicana*]	Interwoven cotton	297 to 325
Poncho (Jacket variation)	Chahuaytire, Cuzco, Ayacucho, Huamanga and Pitumarca, Cuzco	Perú	Quechuas	Cochinilla,* from insect *Dactylopius coccus*	Cotton	340 to 350

*Table 2: Traditional regional Pre-Colombian garments in Mexico and additional countries. *Cochinilla are dried scale insects that act as natural dyes. **Palo de Tinte or Palo de Brasil refers to colour-containing bark extract from wood. ^Palo morado [Sc. Name Peltogyne Mexicana] refers to purple-coloured wood.*

Name of handcrafted objects	Name of places where found	Pigment type	Description	Range of hue for pink (HSB colour space)
Cesta (Basket)	Darién, Panama	Palma Teñida	Foil strips ' dodgy ' palm woven round	320 to 335
Aislantes y joyeros (Artifact, Boxes)	La Aranda, Santa Bárbara, Honduras	Colour natural teñidas	Strips woven reed round	311 to 330
Frutero (Fruit basket)	Guacamayas, Boyaca, Colombia	Agave teñido	Agave fiber strips 'fique' and woven into a circular tejñidas	315
Doña Marina la Catrina (Decorative skeleton)	Mexico City	Acrylic Synthetic pigment	Wire and molded polychromotic paper	334
Pintura Teotihuacana (Painting)	Piramide de la Luna	Natural Pigments	Mural	330
Coyote (Animal figures)	San Martín, Tilcajete, Oaxaca	Acrylic Synthetic pigment	Carved and polychromatic wood	334
Bolsa Yo-yo (Bags)	Halacho, Yucatan	Natural Pigments	Huana' style painted fabric	332 to 336
Cruz de encaje (Cross)	Cuernavaca Morelos	Acrylic Synthetic pigment	Sculpture or piece of adornment	335
Árbol de la vida ('Tree of Life', a decorative artifact)	Metepec, Estado de México	Acrylic synthetic pigment	Modeling and polychromatic clay	315 to 335
La Sirena del universo (Figurines)	Acatlán, Puebla	Acrylic synthetic pigment	Burnished and polychromatic clay	320 to 324
Nacimiento (Nativity figures)	Estado de México	Acrylic synthetic pigment	Modeling and polychromatic clay	335 to 340

Table 3: Examples of handicrafts or artesania, and contemporary motifs in popular art preserved in popular art museums, including types observed in markets. The recurrent use of red and dark saturated pinks create a cognitively unique colour experience for Mexican pink in Mexico.

Figure 1: Hue range of pink samples collected from objects in contemporary Mexican material culture: traditional handicraft (top left), textile (top right), flower 'stenocereus' (middle left), cross-section of fruit pitahaya (middle right), sample from painting by Rufino Tamayo (bottom left) fashion sample from contemporary designer (bottom right).

Artist	Title	Pigment type	Medium and dimensions	HSB
José Guadalupe Posadas (1852 - 1913)	La Catrina or *The Skeleton* (1910)		Illustration	[328 73 51]
Diego Rivera (1886 - 1957)	*The Flower Carrier* (1935)	Acrylic Synthetic pigment	Oil and Tempera on Masonite 121.9 × 121.3 cm	[331 49 69]
Diego Rivera (1886 - 1957)	*The Watermelons* (1957)	Acrylic Synthetic pigment	Oil on Canvas	[353 56 77]
Diego Rivera (1886 - 1957)	*Dream of a Sunday Afternoon in Alameda Park* (1947)	Acrylic Synthetic pigment	Painting on Fresco 4.7 × 15.6 m	[339 53 78]
Rufino Tamayo (1899 - 1991)	*Watermelons* (1968)	Acrylic Synthetic pigment	Oil on Canvas 130.3 × 196.5 cm	[353 64 87]
Frida Kahlo (1907 - 1954)	Self-portrait with velvet suit (1926)	Acrylic Synthetic pigment	Oil on Canvas 79.7 × 60 cm	[331 70 81]
Frida Kahlo (1907 - 1954)	Viva la Vida, or *Watermelons* (1954)	*Acrylic Synthetic pigment*	Oil on Masonite 52 × 72 cm	[355 68 68]
Frida Kahlo (1907 - 1954)	Pitahaya (1938)	Acrylic Synthetic pigment	Painting on Metallic Surface 35.6 × 25.4 cm	[331 80 73]
Alejandro Colunga (1948 -)	La tejedora or *Moon Weaver* (1994)	Acrylic Synthetic pigment	Oil on Canvas	[336 52 76]

Table 4: Well-known 20th century paintings reflecting prominent use of pink shades. The reds, pinks, purples have a common subtractive quality derived from a long-standing tradition of natural and organic pigment bases developed in Mesoamerica and Central South America; the pigments used are all indicative of a saturation characteristic of 'warm' pink [17-18].

Name of Designer	Artist, Fashionista Category	Description or Event of Magnitude	Birth and dead
Dolores del Rio	Fashion Icon	Actress of Cinema, Theater and Television in Mexico	1905 – 1983
Frida Kahlo	Painter, poet and Fashion Icon	Her unique style of painting has been one of the greatest sources of inspiration for designers and fashion firms all over the world, but especially Mexico	1907 – 1954
María Felix	Fashion Icon	Actor and Figure of Importance in Golden Age of Mexican Cinema	1914 – 2002
Ramón Valdiosera	Fashion Designer	Introduced the pink bougainvillea in New York, later came to be known as 'Mexican rose', or Mexican Pink in Anglophone fashion	1918 -
Julio Chavez	Fashion Designer	Clothes designs were used in the Golden Age of Mexican Cinema (1933-1964)	1920 – 2013
Pedro Loredo	Fashion Designer	First to create coordinated or matching sets. Details of such sets were innovations in their era: later became great fashion trends in the whole world.	1923 – 2010
Manuel Méndez	Fashion Designer	Master of Mexican Haute Couture and designer at the Palacio de Hierro, Mexico	1930 – 2014
Enrique Martinez	Fashion Designer	First Mexican Fashion Boutique in New York	1951 – 1998
Armando Valdés Peza	Fashion Designer	Head-dress designer of María Felix, Dolores del Rio and Miroslava, renowned actresses of Mexican cinema	1970 -

Table 5: Pink based fabric design prototypes in the drawings and material representations of fashion designers in Mexico.

Name of Designer	Entry Category	Traditional prototype
Lydia Lavin	*Mujer de la tierra,* or 'Women of the Land', Contemporary Mexican Fashion, Spring-Summer 2015	Pantaloon and blouse, embroidered and textured
Lydia Lavin	*Semilla de viento,* or 'Windmills' Contemporary Mexican Fashion, Spring-Summer 2015	Cotton Dress, Vintage Gowns
Armando Mafud	Mexican Culture 2013	Traditional Velvet and Cotton Dress based on traditional Fiesta style
Armando Mafud	Mexican Culture 2013	Quechquémitl
Benito Santos	Fall-winter 2014	Satin Dresses in Spanish Long Garments styles
Meche correa	*Flores de mi tierra,* or 'Flowers of the Land', Spring-Summer, 2014	Skirt and shirt with embroideries
Pineda Covalin	*Life and Nature*, Mexican Textiles, 2014	Fashionable Dress in *poncho* style
Macario Jimenez	Mercedez Benz Fashion Show, Fall-Winter 2015	Fashionable Dress, flowing garment style
Lorena Saravia	Mexican High Fashion, Contemporary Mexican Fashion, Spring-Summer 2016	Traditional Skirt and Dress, woven and embroidered textiles
Ricardo Seco	Mercedez Benz Fashion Show, Fall-Winter 2016	Cardigan, *sarape* style

Table 6: Contemporary Mexican designers with garment prototype reflecting prominent application of rosa mexicano.

Textile samples were studied from a historical perspective [19-20]. From a survey at least 18 distinctive textile types and corresponding styles were chosen from different states of Mexico. Table 2 is considered crucial to our research findings as it provides a sampling of some of the most important dress styles and colour usage codes prevalent since pre-Colombian times.

Determination of people's understanding of a referent for rosa mexicano

We exposed Mexican people from various economic and cultural strata to respond to a MATLAB generated template of pink shades to understand if there was a common and collective agreement in their perception of the colour represented by the phrase '*rosa mexicano*'. Colour recognition abilities were measured based on data collected from respondents' survey (n=56). Subjects were asked to respond to a questionnaire indicating their age, gender, educational background, location, and their level of awareness of the term *rosa mexicano*. Respondents could choose a scale for each individually filtered dimension of pink extracted from a 3D HSB scale. Each dimension of the colour could be reported on an HTML 5 submit program. This cognitive HSB colourmaker (Figure 2) was offered to respondents so they could indicate their personal variant of *rosa mexicano* and related pinks, namely *fucsia* and *rosa*.

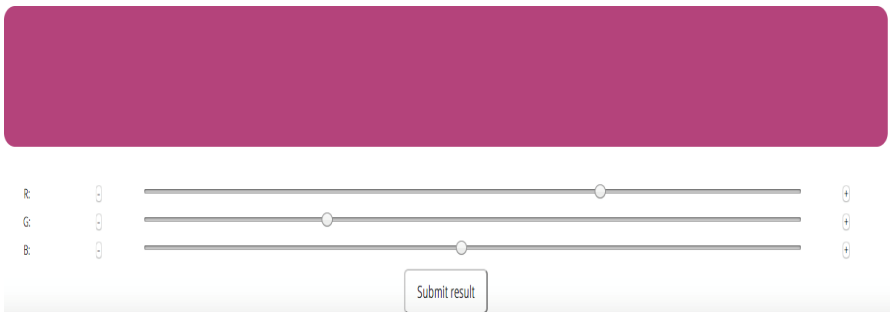

Figure 2: HTML Colour determination chart for rosa mexicano. *The respondents were asked: 'Adjust RGB colour parameters according to your visual experience of the colour* rosa mexicano. *RGB metrics were converted to HSB colour space using the standard generic C-code for converting RGB colour to HSB colour space (see Figures 3-6).*

Our cognitive experiment was designed to measure if people's perception of *rosa mexicano* on this chart were indeed intrinsic to their memory of colours in material culture, or if it were guided by arbitrary linguistic conventions for pinkish hues.

Results

Statistical analysis on colour recognition of rosa mexicano, *fuchsia and* rosa

Statistical analysis on colour recognition of *rosa mexicano*, fuchsia and *rosa* or pink can be divided into two parts: (i) comparison of the colours of categories garments, handicrafts, natural pigments and paintings and (ii) colour recognition based on data from respondents' reconstruction of pink-like shades.

i. Comparison of colours associated with sampling of garments, handicrafts, natural pigments and painting or fashion

ii. One way ANOVA (Analysis of Variance) was conducted among groups named Garments, Handicrafts, Natural Pigments, Paintings, Fuchsia, Rosa mexicano, and Rosa for all three components of Hue, Saturation and Brightness. The null hypothesis adopted was 'Means for all categories are equal' against the alternate hypothesis that 'at least one Mean is different from the others'. The results demonstrated that there was no difference among the Mean value of all the groups (P-Value is equal to 0.655) with respect to the Hue value; but there were differences among the Mean of all group with respect to Saturation and Value (P-Value < 0.00001). Level of significance α was chosen as 0.05. Figures 3 to 5 shows the box plot of Hue, Saturation and Brightness for all the groups. It supports the findings of ANOVA. Other significant findings are (a) paintings differ from other groups, (b) garments, handicrafts and natural pigments belong to the same group and are closer to fuchsia than to *rosa mexicano* and *rosa* or pink (c) Fuchsia and *rosa mexicano* are closer to each other than *rosa*, based on their values of Hue, Saturation and Brightness.

iii. Colour recognition based on data from respondents' survey

Data description: Cognitive reconstruction chart was created on HSB (Hue, Saturation, Brightness) colour space and we received responses from 56 respondents. Out of these 56 respondents, 22, 14 and 20 of them are capable of being categorised into three socio-economic groups, namely educated urban, rural and colour expert respectively. Among these respondents, 31 were men (*male*) and the remaining 25 were women (*female*). Further, respondents were categorised into three age groups as *young* (age below 30), *adult* (ages are between 30 and 50) and *old* (age greater than 50). The numbers of *young*, *adult* and *old* respondents are 24, 25 and 7 respectively (Figure 6).

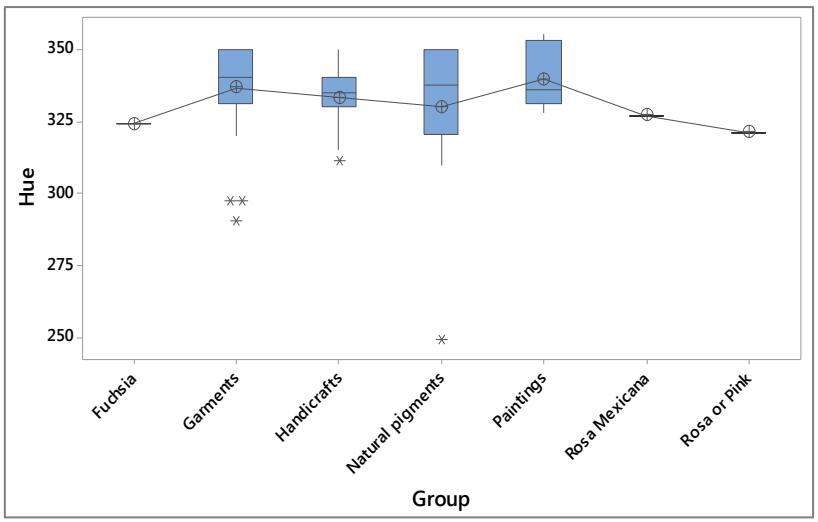

Figure 3: Boxplot of hue

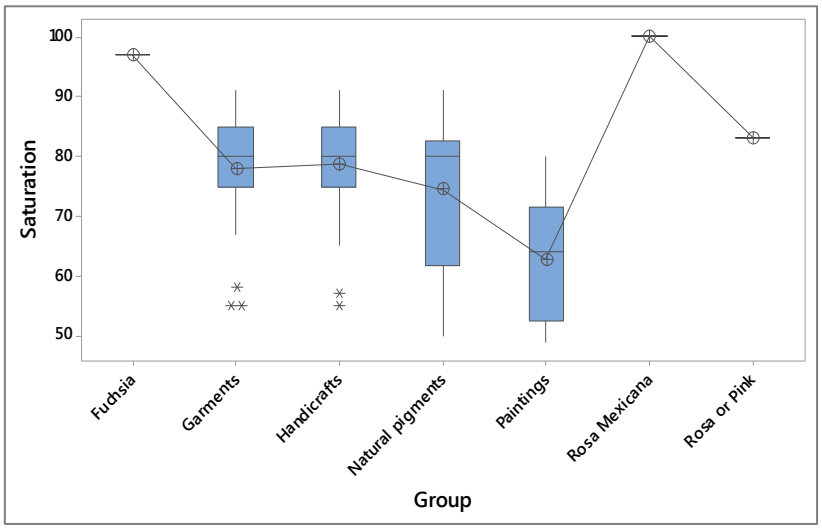

Figure 4: Boxplot of saturation

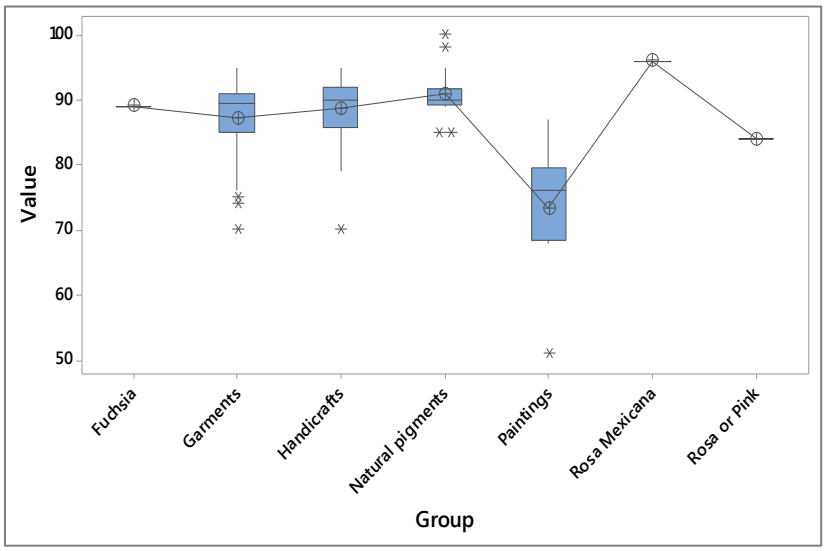

Figure 5: Boxplot of brightness

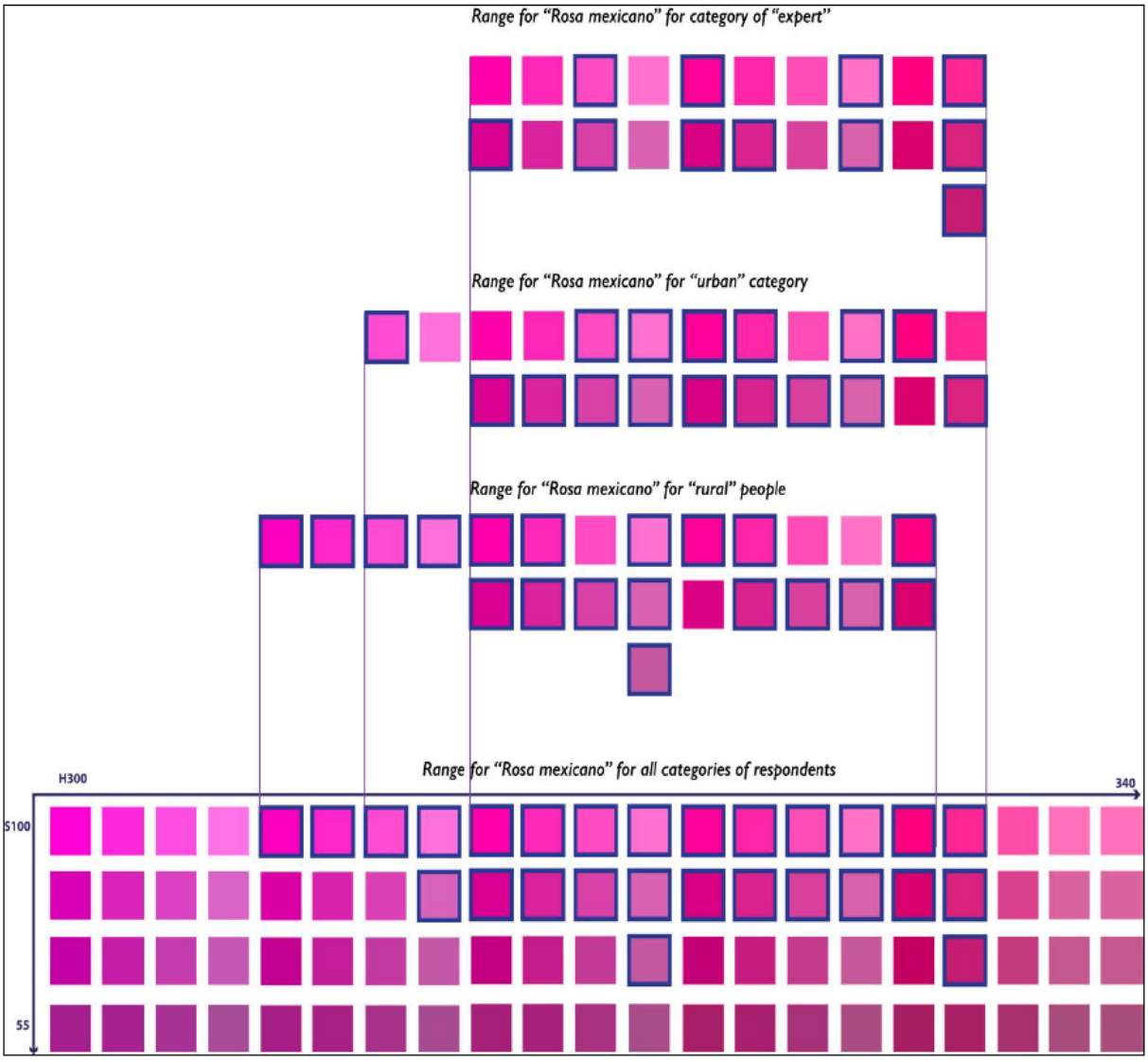

Figure 6: Range of responses to Hue based colour chips by at least three categories of respondents. We reduce the structure of responses by combining all responses on a single two-dimensional scale. The range of responses are shown by pink shades marked within framed blue borders.

Summary of the results

We conducted here an extensive statistical analysis to analyse the effects of gender, age and socio-economic group on their colour perception among fuchsia, *rosa mexicano* and *rosa* or pink. We analyse the colour reconstruction on three different colour spaces namely HSB, RGB and *Lab*. The objectives of this statistical analysis are twofold: (1) investigate the effects of age, gender and socio-economic status of the respondents on their colour recognition about fuchsia, *rosa mexicano* and *rosa* or pink on three different widely used colour spaces such as Hue-Saturation-Brightness (HSB), Red-Green-Blue (RGB), and *Lab* (Lightness and a and b are the colour-opponent dimensions); (2) derive a distance metric which maximises the difference between inter and intra–class difference and thus allows or supports better colour cognition. Distance metric plays a crucial role for colour cognition and better distance metric demonstrates better colour difference by employing Euclidean distance in a device independent colour space. Key findings of our statistical analysis are thus given below:

(a) The distance between the average *rosa mexicano*, i.e RM, and F, and R were calculated. The distance with the standard adopted by Consejo de Tourismo was also calculated and taken into account

for the socio-cognitive viability of this colour name. Statistical analysis demonstrates that the difference of the Mean responses of Fuchsia, *rosa mexicano* and rosa on all three colour spaces (HSB, RGB and *Lab*) are statistically significant. This result demonstrates that the colour cognition of rosa mexicano is sustainable.

We could thus say that the phrase *rosa mexicano* does not fail to capture an important characteristic of a historical, indigenous colour for a more contemporary discourse. But at the same time the terminology that captures the essence of the colour is, as our survey shows, a functional neologism that is yet to spread rapidly over segments of population less exposed to the new language of the urban, elite and educated groups (or of experts) who deal more directly with the world of fashion and material colour productions. It would appear that there is growing awareness of *rosa mexicano*, and also the fact that the naming of the category augments a historical memory of that colour.

(b) Gender plays a prominent role in colour cognition. Females achieve slightly better colour cognition ability. We did not find the difference of their colour cognition ability from each other to be statistically significant. The reasons for this cannot be discussed for lack of adequate references. Perhaps there is better female engagement with pink (*rosa*, *rosa mexicano* and fuchsia denominations) for social or cultural reasons. To some extent the observation may be corroborated by the fact that young people (both male and especially female) within the urban brackets are more sensitised to pink shades by a supermarket culture.

(c) Young and adult categories can recognise (or finely distinguish) colours slightly better than older people. Similarly, 'educated' and 'colour experts' have better colour recognition ability for *rosa mexicano* than 'rural' people. The memory of pink in acts of colour recognition in ethnic garment and handicraft, and above all cosmetics, seemed to strongly determine colour codes and discourse for Mexican urban-elite culture.

(d) All the distance metrics used in this experiment can help discriminate the colours fuchsia, *rosa mexicano*, and *rosa* from each other. However, the distance metrics dedicated for *Lab* colour space demonstrates relatively better cognitive ability since these distance metrics incorporate additional correction factors and scalability into the Euclidean distance metric and is apt for device independent colour space. CIELAB brings perceptual uniformity into the measurements (Tables 7 to 9).

Kruskal Walllis Test	Chi-square value	p-value
Euclidean	2353	0
Seuclidean	971	<0.0001
Cityblock	2129	0
Minkowski	2353	0
Chebyshev	2360	0
Mahalanobis	1244	<0.0001
Cosine	2262	0
Correlation	1846	0
Spearman	74	<0.0001
Hamming	791	<0.0001
Jaccard	791	<0.0001

Table 7: Kruskal Wallis Test between interclass and intraclass distance for different distance metric on HSB colour space.

Kruskal Walllis Test	Chi-square value	p-value
Euclidean	2126	0
Seuclidean	858	0
Cityblock	1680	0
Minkowski	2126	0
Chebyshev	2198	0
Mahalanobis	1239	<0.0001
Cosine	2064	0
Correlation	651	<0.0001
Spearman	>9000	0
Hamming	553	<0.0001
Jaccard	507	<0.0001

Table 8: Kruskal Wallis Test between interclass and intraclass distance for different distance metric on RGB colour space.

Kruskal Walllis Test	Chi-square value	p-value
CIE00ΔE	7530	0
CIELABΔE	7655	0
CMCΔE	7628	0
CIE94ΔE	6782	0

Table 9: Kruskal Wallis Test between interclass and intraclass distance for different distance metric on LAB colour space.

Discussion

Social optics of colour in the twentieth century

Following Maclaury's description of a 'vantage' category from which cultural agents or individuals view specific colour categories: we could show that the head phrase *rosa* determines the way pink JNDs are viewed and absorbed in a context of more extensive red and pink pigment sets in post-colonial central America and Mexico. This increasing range for Hue for 'pink' from 300 through 340 (as demonstrated in Tables 2-6) may be described as a significantly large *coextension* towards deeper (*intense*) shades [10].

The evidentiary weight for a 'warm' *rosa mexicano* is overwhelming. In Figures 7-9 there is a preference of high Hue and Saturation, and a dipping Brightness among both urban, educated and rural segments. Even in extreme ends of the social spectrum (as our survey questionnaire shows) people retained the sense of *fuerte* or '*strong*'. This warm category of pink is retained not only for a wide geographical distribution in the south central and far southern regions within Mexico.

But more importantly the emergence of *rosa mexicano* as a neologism to describe the higher-value *intense* or *strong*, that is, 'fuerte' shades of pink (closer to fuchsia) and its JNDs shows, how colour naming or verbalisation becomes an important means of cultural homogenisation in the twentieth century, especially in case of Mexico [21]. Social perception of colour depends, in differences of perception in the Hue value from 310 or less to more than 320. This is exactly similarly to the high Average 320 of *urban* and *expert* populations, which reflects a socialisation process of colour names from hierarchically predisposed young, educated and urban elite groups (like fashion and art) to less

exposed peripheral segments of a population set (like rural or older, i.e., aged people). This phenomenon is evident very clearly in the cultural formations of a colour terminology in Mexico's predominantly *mestizo* social layer (a late learner layer).

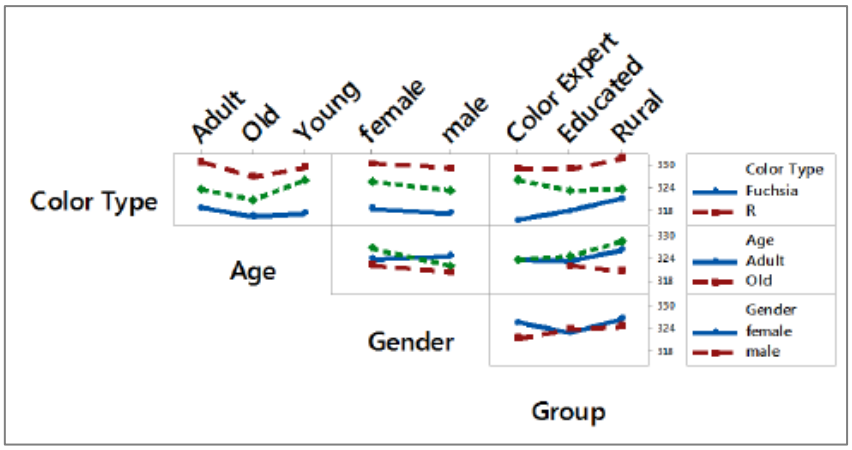

Figure 7: Interaction plot for Hue for colour type, age, gender, socio-economic group.

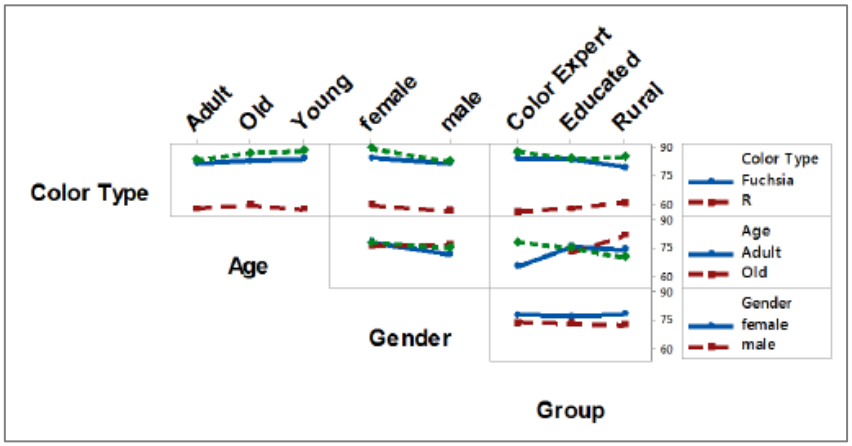

Figure 8: Interaction plot for Saturation for colour type, age, gender, socio-economic group.

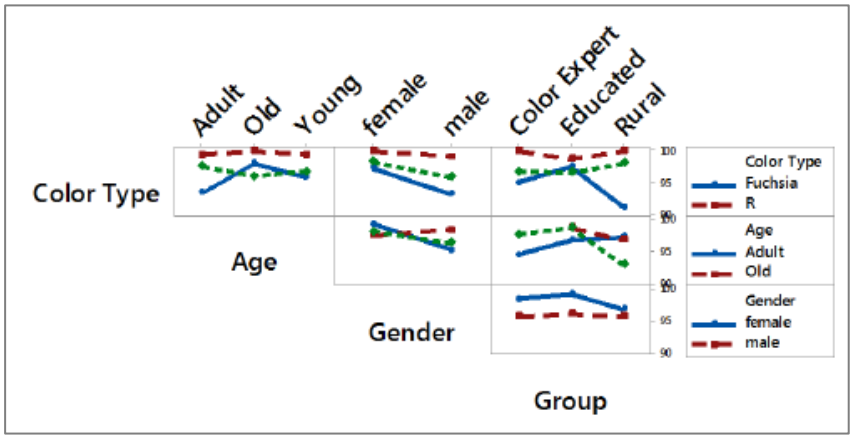

Figure 9: Interaction plot for Brightness for colour type, age, gender, socio-economic group.

The transition of the phrase is from the more socially and economically dominant urban Spanish to the lower economic classification of the more rural, ethnic mestizo subculture [22-23]. This is a classic example of a sociological *bridge* for an evolving class based habitus [24-25].

Thus, what our research shows conclusively is that the semantic reference of *rosa mexicano* is made possible less by how the phrasal head 'rosa' behaves in this context. The adjectival phrase *rosa mexicano* implies not merely rosa as Spanish speaking colonial users of the word understood it but also in a co-extensive manner a colour which is '*mexicano*', and likely to be inclusive of indigenous pinks. What this proves is the fact that on the social scale, there is one layer of language in which the word *rosa mexicano* is functioning within a visual-semantic culture of colours. On another level, the colour spectrometry indicates that the term *rosa mexicano*, if it is considered as a colour category, has a cognitively universal *warm* orientation in which several respondents incline towards a 329 or above for a *high* red chromaticity.

As every case study in the category shows, on assuming that the fields of investigation comprise a kind of social organisation on a universal level, it would seem that the cultural expression of colour in Mexico's predominantly urbanised, or globally oriented social life are only continuing to harness on pre-existing (memorable) cognitive templates. The environmentally originated colour categories deriving from the long history of the campeche, cochineal or the *purpura pansa* act like a memory signal - as is evident in the preponderance of the use of *rosa mexicano* in such fields as traditional and historically evolving cuisine, artifacts and fabric colour such as are studied in Tables 2-6.

Hence even in the consumer discourse on fashion initiated in a way by Frida Kahlo (with her designs as they reflected in the self-portraits and photographs in *Vogue* magazine) and later in Ramon Valdiosera's notebook diagrams that incorporate traditional ethnic colour preferences, there are anticipations of the same warm *rosa mexicano* pink shades that come close to the later CPTM endorsed Pantone Magenta and Lakme's lipstick variant called the Mexican Pink

Conclusions

There is no evidence of the phrase *rosa mexicano* in any linguistic context from any earlier period in the colonial history of Mexico [26-27]. The adjectival phrase *rosa mexicano* implies not merely *rosa* as Spanish speaking colonial users of the word understood it but also in a co-extensive manner as a colour which is '*mexicano*', and likely to be inclusive of indigenous pinks.

The term demonstrates how microcultural groups could generate a novel compound word. The cultural sociology of *rosa mexicano* demonstrates very amply how colour names may be created out of a process of salient priming of feature/s (in this case the header *rosa*) which helps agents confronting competing language systems to not only focalise but to engender a more extensive range of experience in an interdependent structure [28-29]. In this case the Spanish colonial *rosa* acts like a rudder of values and perceptions for what Bourdieu calls the *habitus* of a transitional contemporary society such as Mexico's. We could conclude by saying that *rosa mexicano* appears to promote a socially and cognitively binding discourse of homogenisation for an evolving, hierarchical and stratified social structure, such as is also typical of Mexico.

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