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The Use of Modifying Terms in the Naming and Categorization of Color Appearances in Vietnamese and English

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Accepted for publication by The Journal of Cognition and Culture, Vol. 2.1.

Abstract

Cross-cultural studies of color naming show that basic terms are universally the most frequently used to name colors. However, such basic color terms are always used in the context of larger linguistic systems when specific properties of color experience are described. To investigate naturalistic naming behaviors, we examined the use of modifiers in English and Vietnamese color naming using an unconstrained naming task (Jameson & Alvarado, In Press). Monolingual and bilingual subjects named a representative set of 110 color stimuli sampled from a commonly used color-order stimulus space. Results revealed greater reliance upon polylexemic naming among monolingual Vietnamese speakers and greater use of monolexemic basic hue terms and secondary terms (object glosses) among monolingual English speakers. Systematic differences across these language groups imply that widely used monolexemic naming methods may differentially impact color-naming findings in cross-cultural investigations of color cognition.

The Use of Modifying Terms in the Naming and Categorization of Color Appearances in Vietnamese and English

Since the 1960's, the cross-cultural study of color-naming and color categorization has served as an influential example of a pan-human cognitive universal (see Hardin and Maffi, 1997 for a review). Yet, some theorists question universal models of color categorization and naming, and have warned that it makes little sense to ignore the richness of language in favor of an exclusive focus on a handful of basic color terms thought to arise from color-opponent visual processing mechanisms (Hewes, 1992; Wescott, 1992; Zimmer, 1984). Nevertheless, the search for universals in the semantic structure of the color lexicon has largely focused upon a small number of focal hues or a small number of basic color terms, or both. Even in large-scale surveys such as Berlin & Kay's (1969) early work and the later World Color Survey (WCS), the primary aim was to determine whether color lexicons and color-naming behaviors are represented by 11 focal color categories named by basic terms arising from cognitive universals (Kay & Maffi, 2000).

This investigative emphasis on the construct of universal basic terms for color appearances continues in a number of recent cross-cultural studies of color categorization and naming. For both practical and empirical reasons, such investigations often constrain the naming behavior of informants assessed to monolexemic responses (e.g., Sturges and Whitfield, 1997), or they assess naming for small subsets of color appearance stimuli (e.g., Moore, Romney and Hsia, 2000). Investigations that incorporate such constraints are essential for testing the cross-cultural validity of the theory of eleven basic color terms, but they do not always permit the assessment of systematically occurring cross-cultural differences that might be seen under more naturalistic color naming and categorization. In particular, finding cross-cultural universality of color naming using Berlin and Kay's eleven basic color terms does not automatically imply universality of color-naming behavior when assessing a different set of color naming terms, such as the color labels occurring most frequently in individual discourse.

Thus, while the existence of basic color naming universals has been demonstrated many times (Hardin & Maffi, 1997), the process of boiling a lexicon down to basic terms may obscure important cultural differences in both the use of language to name color samples and the perception of the stimuli themselves, as discussed by Jameson (2001). This "oft-used constraint of forced monolexemic naming" (Guest & Van Laar, 2000, pg 731) using basic color terms, may empirically produce a greater appearance of universality than truly exists. Such a result is entirely possible if in daily communication individuals generally use linguistic features and vocabulary to describe their perceptual experiences that are denied them in empirical studies.

This emphasis on monolexemic basic color labels, and the perceptual categories they describe, arises from the defined construct of universal basic color terms originally formulated by Berlin and Kay

(1969). However, a study of unconstrained color naming by Jameson & Alvarado (In Press), comparing English and Vietnamese language groups, found substantial variation in the use of polylexemic names, modifying terms, compounds, and object glosses to name color stimuli. These findings suggest an alternative perspective, explored here. We begin with the idea that color naming typically incorporates linguistic features beyond monolexemic labels, and that such features can also be examined for cross-cultural similarities that may exist due to specific linguistic constructions shared by some languages. In other words, we suggest that the lexical color labels that best describe the central exemplars of a culture's color category partitions may not always be monolexemic terms. Whether they are is a matter for empirical investigation. To evaluate this, we studied similarities across language groups in the use of modifiers and other linguistic constructions to name color appearances.

It is important to note that the need for a strong test of the monolexemic assumption is not widely discussed in the existing literature, although it is crucial to demonstrating universal basic color term generality. At times the monolexemic assumption is found implicit even in investigations that use unconstrained naming methods. For example, Guest and Van Laar (2000) studied unconstrained naming in English participants using computer-displayed color appearances. In accord with the Kay-Berlin-Maffi theory, Guest and Van Laar found greater use of basic names than non-basic names and greater use of monolexemic terms than polylexemic terms. Upon close examination, however, these results cannot be generalized cross-culturally. This is because the index of naming consistency they define incorporates as parameters characteristics they observed in their English color-naming results. (Specifically, a "modal term" is defined as consisting of a hue term with or without some modifying term or compound. The additional words in a polylexemic name are assigned a lower value and weight the modal name in calculations of naming consistency). As defined, their index privileges both hue stem terms and monolexemic naming in its calculations. We believe that this can only be assumed in cross-cultural research if the relative frequencies of use of monolexemic stem terms and polylexemic, basic and non-basic terms are known to be the same across languages. Thus, by noting their overall high frequency of use of unmodified basic terms (63.7% of English responses) and generally concluding: "This finding suggests that the oft-used constraint of forced monolexemic naming may not be as constrictive as one might fear." (pg 731), they fail to acknowledge the ethnocentric assumption inherent in their analysis which implies that all languages will make use of hue denotata and monolexemes with similar frequencies. Further, although polylexemic naming may indicate difficulty in naming samples at the boundaries of categories for English speakers, we do not know whether polylexemic naming indicates difficulty in naming in other languages, or only in those languages emphasizing hue.

Universal patterns of Modifier Use and Object Glosses in Color Naming.

Several previous investigators have studied the use of modifying terms in color naming. Burgess, Kempton & Maclaury (1983) studied the use of modifiers as support for a theory of evolution

toward a hue-based naming system. They use Maclaury's three-stage mapping process to assign modifiers to regions of the Munsell color space. However, their results are not easily compared to the results of modifier use presented here for English or Vietnamese due to structural differences between the languages tested and differences in the types of distinctions captured by modifiers. Thus their research further illustrates the problems involved in assuming that English color naming patterns are found in other ethnolinguistic cultures.

As described by Burgess et al (1983), the Tarahumara language employs a postposed bound modifier for each color stem term that specifies the relation of the currently named color to the center of the category. For each color name, the modifier KAME is used for colors near the center of the category, the modifier NAME refers to colors further from the center, and the modifier NANTI refers to colors on the fringes of the category. Thus, for red (SITA), these stem term and modifier combinations would translate as "very red" (SITAKAME), "somewhat red" (SITANAME), and "slightly red" (SITANANTI). No color names appear without these postposed modifiers and the modifiers are also used in naming things other than colors. This system of naming is very different than that used in Chinese, Vietnamese, and English where modifiers consist of one or more separate words preceding a color stem term (in English) or following it (in Vietnamese), and relational distinctions are subordinated to other distinctions (although the modifier VERY and its translation were used in both languages). Together with our own previous unconstrained naming results (Jameson & Alvarado, In Press), these findings of Burgess et al. (1993) seem to justify a closer examination of modifier use in color naming across different ethnolinguistic cultures.

Among the identification criteria originally proposed by Berlin and Kay (1969) to define basic color terms is the requirement that candidate basic terms are words which have acquired a meaning independent of both: (a) the object whose color is being named and (b) the context in which naming occurs. Even in cultures with few abstract color names (Berlin & Kay's early stages), an abundance of color names bound to objects or contexts are used (Schirillo, 2001). In the present study, we refer to color names derived from these contextualized color terms as "object glosses." In English, which has a full complement of 11 basic color terms, unmodified object glosses (e.g., BRICK, OLIVE) are widely used to capture fine distinctions in naming (Jameson & Alvarado, In Press). Critics of the concept of "basic terms" point out that many English basic color names began as object glosses. For example, Hewes (1992) states that PURPLE began as the name of an "exotic commodity derived from a mollusk" (p. 163). Compounding of object glosses with basic stem terms is frequent in English and Vietnamese, constituting a form of modifier (e.g. TURQUOISE BLUE, SKY BLUE, XANH LA CAY translated as "leaf green").

Lin, Luo, MacDonald, and Tarrant (2001a, 2001b) compare color modifier use for Mandarin Chinese speakers with British speakers of English. In addition to constructing a database of Mandarin

color terms (Lin et al., 2001a), they use subject judgments to map specific modifiers to regions of the Swedish Natural Color System space for both languages (Lin et al., 2001b). Moreover, as noted by Lin et al. (2001a), features of the Chinese language may encourage this compounding of object glosses as modifiers or as modified contextualized color names. First, Chinese characters are frequently constructed by compounding several characters into a single character with a new meaning. All three of the "secondary terms" listed by Lin et al. (2001a, Table II) contain the character for "sky" as a constituent element.[1] The terms DAI, BE and ZAN (translated as JADE or DYE by Lin et al., 2001a) could also be more poetically translated as references to a dark sky before a rain, a clear sky, and a blue sky near sunset, respectively. Second, in Chinese, all color terms consist of two-character pairs. The first character denotes the color category and the second character specifies that it is a noun referring to the color appearance itself. These pairs might be more strictly translated as "the red color" rather than simply "red." Thus each of these names qualifies as an abstract color name not bound to any object or situation and each meets Berlin & Kay's (1969) abstractness criterion for basicness (if not the other criteria). In Chinese, when the color name is used as an adjective, the second character is the name of the object taking that color. This practice also occurs in Japanese, where a different second character is used to differentiate chromatic and achromatic color names, as discussed by Lin et al. (2001a). Vietnamese does not affix a second word meaning "color" to color names in its phonetic writing system, but like Japanese, Vietnamese employs both a phonetic and a Chinese character-based writing system. Thus, when using characters, both languages may habitually denote even basic colors using multiple-word phrases.

Lin et al. (2001a) also list several alternative basic names that are more metaphorical, figurative, or poetic, expanding the 11 basic color terms. They argue on the basis of frequency of use that these deserve consideration as basic terms. For example, HONG is red in standard Chinese but JU refers to the color red of royal clothing. It brings with it associations of majesty and privilege, and is thus a special red. However, these alternative terms are arguably more culture specific and more likely to be used differently in different dialects. For example, Moore et al. (2000) include as their name for basic brown the character for "coffee" accompanied by a second character denoting that this is a color name. It is an object gloss characteristic of Taiwanese Mandarin Chinese, not used to name brown in standard Chinese. Lin et al. (2001a), who also studied Taiwanese Mandarin, do not list this as a high frequency alternative term for brown, though it was used by some of their subjects (as was "tea"). By Berlin and Kay's criteria, this complicates evaluation of the basicness of the Taiwanese Mandarin term for brown used by Moore et al. (2000), and underscores the difficulty in untangling whether findings of cross-cultural universality originate from the few basic terms they assessed, coupled with large differences among color appearance stimuli, or from consistencies in basic color naming and perception. The impact of culture is more obvious in use of these alternative, object-derived color names, richer in connotation

(Schirillo, 2001; Hewes, 1992), but that impact may become evident only when comparisons are made that reveal finer distinctions.

To systematically describe the frequency and use of non-monolexemic linguistic constructions in color naming, different researchers have applied different taxonomies for classifying the color naming behaviors from different linguistic cultures. These differing classification strategies, typically dictated by different assumptions, make comparisons difficult across studies, much less languages. Lin et al. (2001a) applied one version of Simpson and Tarrant's (1991) seven-category taxonomy: (1) basic color terms; (2) modified basic terms (e.g., DARK RED); (3) compound terms (e.g., BLUISH-RED); (4) qualified basic terms (e.g., DARK BLUISH RED; (5) secondary terms (e.g., CARDINAL RED); (6) idiosyncratic (no obvious pattern); (7) unnamed (no name given). This scheme classifies object glosses as "secondary terms." They then boiled these seven categories down to four, for further comparisons: (1) basic; (2) modifier; (3) compound; (4) secondary. Guest and Van Laar (2000) used a different version of Simpson and Tarrant's seven-category system, one that differentiates hue-modified terms from lightness-modified terms, but classifies secondary terms as "other monolexemic" and similarly divides them by modifier type. This latter scheme is more similar to the one used in the present study, though lightness and "other" modifiers (e.g., BRIGHT, VERY) are combined in our study and only hue-based modifiers are counted separately (as compounds or object glosses). Because we were interested in directly examining use of object glosses (secondary terms), we classified them both with and without modifiers, separately from compound names and modified basic terms. Former object glosses now used to name basic color categories in English (e.g., ORANGE, PURPLE) were not considered object glosses in either language.

Universal Mapping of Modifiers and Object Glosses to Color Appearances.

Another method used to compare color naming across linguistic cultures involves examining the spatial mappings of color terms from different languages as they correspond to color appearances in a common color ordered space (e.g., Moore et al, 2000). While such mappings have been used liberally in studies of universal basic color categories and basic terms, the application of such analyses to study cross-cultural similarities of modifier use has been infrequent. In their discussion, Lin et al. (2001a, 2001b) relate their results to Kelly's Universal Color Language (UCL) for describing surface color appearances (Kelly & Judd, 1976). Kelly's classification system spatially organizes color descriptions by their correspondence to color space regions and by levels of precision. The lexical classification specifies that the first and least precise level consists of the generic hue names or basic color terms studied in most cross-cultural research on color naming. Kelly's second level consists of the entire range of names in the lexicon, including compound names such as "yellowish-brown" and object glosses such as "coffee" or "chocolate." Kelly's level three consists of all of the level two hue names together with modifiers.

In Kelly's taxonomy, modifiers include any word used as an adjective to modify a hue term. Such modifiers typically refer to saturation or lightness (e.g., "light," "bright," "pastel") but might also describe other dimensions of the stimulus (e.g., "fluorescent," "peaceful," "dirty"). These latter forms of modifiers were not studied by Lin et al. (2001b) though they note their importance (2001a). Guest and Van Laar (2000) classified them as "Other, complex". Kelly's proposed naming system assumes that the use of modifiers permits increased fineness of description using the lexicon and thus greater precision in naming. Levels four through six consist of color notation systems (e.g., Munsell) measured at increasing levels of precision. (For a review of models of color space, see Kuehni, 2001). Using this naming system, Kelly (Kelly & Judd, 1976) assigned modifier names to regions of Munsell space (the same space sampled by Berlin and Kay), as shown in Figure 1. While Kelly did not intend them to apply to languages other than English, these maps were used as predictions for naming behavior observed in our study.

The questions explored in our research include the following. First, are there differences in the naming strategies of English and Vietnamese languages and if so, how do they relate to the use of monolexemic color terms? Second, are modifiers applied to samples according to the maps proposed by Kelly and Judd (1976), Guest and Van Laar (2000) and Lin et al. (2001b)? Third, what is the effect of bilingualism on modifier use? After considering these questions we return to discussing what our findings imply for studies of color naming universality.

The data reported here was collected under precisely controlled viewing conditions in a study of unconstrained naming behaviors for a set of standardized color papers sampled to represent a wide range of color appearances. In Jameson & Alvarado (In Press) we hoped to discover whether the previously noted perceptual salience of certain category focal colors would in general contribute to greater agreement in naming under the less constrained naming conditions used. To examine this issue across language groups, we compared color-naming behaviors in Vietnamese and English, two languages with different linguistic categories for green/blue and yellow/orange. We also investigated the impact of the level of access to terms on naming behavior by including bilingual Vietnamese living in the U.S.A. as a comparison group. We found that when subjects were unconstrained by empirical demands, their naming behavior (1) did not differentiate the salience of focal colors from that of non-focal colors, and (2) showed group differences in the use of polylexemic names, modifying terms, compounds, and object glosses. Here we present new analyses of the color-naming behaviors listed in (2), and present an explanation of the important implications of such differences for theories of color cognition.

Method

The results presented here are based on data from experiments described by Jameson and Alvarado (In Press) that empirically addressed the salience of focal colors. Details about the colorimetry

of the stimuli and psychophysical data collection procedures are provided in that article and are only elaborated here when relevant to the central question of the cross-cultural use of modifiers in color naming.

Participants

Color naming behavior was assessed in three samples: (1) 31 monolingual English speakers, (2) 29 bilingual English and Vietnamese speakers tested in Vietnamese, (3) 32 monolingual Vietnamese speakers. All monolingual English and some bilingual Vietnamese speakers volunteered through the University of California, San Diego, human subjects pool. Monolingual Vietnamese participants were recruited from immigrant Vietnamese communities in the San Diego area. Monolingual and bilingual Vietnamese speakers unable to read and write Vietnamese were excluded. All subjects were screened for normal (corrected) vision and for normal color vision using Ishihara's (1987) Pseudoisochromatic Test Plates.

Procedure

Participants in each of the three language groups were provided with a series of 110 different 1 in. color squares on a 2 in. neutral gray surround in a test booklet, one per page. For each color sample, participants were asked to provide the appropriate name, with no constraints imposed on their choice of semantic label. Confidence judgments were also made but are not discussed here. Within each language group, stimuli were presented to subjects in different random orders. The task was self-paced. For all three groups, the task was conducted under controlled viewing circumstances and ambient lighting environment.

Stimuli

The 110 stimuli consist of a representative sample drawn from the Optical Society of America (OSA) Uniform Color Scale stimulus space (MacAdam, 1974, 1978). The stimuli include focal and centroid exemplars from the eleven basic color categories as identified by previous investigators (i.e., Berlin and Kay, 1969; Boynton & Olson, 1987, 1990), as well as 99 additional stimuli randomly chosen from the OSA set under the constraint that they proportionally represent the 424 colors comprising the OSA color space. The OSA stimuli were accurately reproduced using an Apple Color StyleWriter 2400 inkjet printer. See Jameson & Alvarado (In Press) for a description of the sampling method and the properties of these stimuli, rendered within the most acceptable visual match of their OSA counterparts, as confirmed by both colorimetry measures and empirical verification.

Results

The results presented below examine the patterns of responses arising from unconstrained color naming, as well as the similarities and differences in such responses as found across language groups. In addition to the taxonomic levels specified by Kelly's naming system (described earlier), frequencies of use for the following modifiers were compiled: VERY, PALE, LIGHT, BRIGHT or BRILLIANT,

FRESH, GRAYISH, OFF, MODERATE or MEDIUM, STRONG, DARK, DEEP, VIVID, PASTEL, DULL, and OPAQUE. These are the terms proposed by Kelly to describe regions of the color space. Mean frequencies of use for each type of term or modifier are then compared across languages. The focus of these analyses is comparing patterns of modifier use in different regions of color space, as opposed to finding the best or consensual name for each sample (as was done by Lin et al., 2001a, 2001b and Burgess et al., 1983). Under this analysis some important differences emerge in the use of modifiers, single-word color names, and object glosses, as described below.

Compared to monolingual Vietnamese, the English ethnolinguistic group showed significantly higher mean frequencies of use of single-word color terms, especially object glosses (e.g., BRICK, LILAC, OLIVE), as shown in Figure 2a (use of basic and non-basic hue terms) and Figure 3a (use of object glosses). The monolingual Vietnamese group tended to combine object glosses with hue terms and hue terms with modifiers instead of using them alone, as shown in both Figures 2b and 3b. Monolingual Vietnamese speakers were also more likely to use compound names (YELLOW GREEN), as shown in Figure 4. For all categories except monolexemic object gloss use (see Figure 3a), the bilingual Vietnamese group (responding in Vietnamese) showed naming patterns more similar to English than to monolingual Vietnamese. The object gloss exception is discussed in the next section.

The following patterns emerged with respect to use of individual modifiers. The modifier VERY (or its translation) was used with the same low frequency across all three language groups. PALE was only used by English speakers and appeared to be a synonym for LIGHT (as described below). LIGHT (NHAT, LOT) was used with greatest frequency by monolingual Vietnamese speakers, as shown in Figure 5. BRIGHT was used most frequently by English speakers. FRESH (TUOI) was used primarily by monolingual Vietnamese speakers and never by English speakers. GRAY or GRAYISH (XAM) was used primarily by monolingual Vietnamese speakers whereas OFF was used only by English speakers. MEDIUM or MODERATE was used by both English and monolingual Vietnamese speakers, and least by bilingual Vietnamese speakers (apparently suggesting a diminished vocabulary). STRONG was used only by English speakers, and even then, infrequently. DARK (DAM) was used most frequently by monolingual Vietnamese (see Figure 5). DEEP was used only by English speakers. No one used the terms VIVID, PASTEL, DULL, or OPAQUE, despite the presentation of samples drawn from the regions of Munsell space named using those terms in Kelly's system (see Figure 1).

Where the same modifiers were used in all three groups, frequency of use for bilingual Vietnamese speakers generally fell midway between frequencies for English and monolingual Vietnamese, as might be expected if they possessed shifting fluency between one language and another. As can be seen in Figures 2 through 5, differences between English and monolingual Vietnamese were all statistically significant (based upon 95% confidence intervals), while means for bilingual Vietnamese speakers fell within the confidence intervals of the other two groups. Variability was generally similar for

the English and monolingual Vietnamese groups, except with respect to use of object glosses and modified object glosses. Within each language group, variability among subjects was greater for the more frequently used modifiers (e.g., greater for LIGHT or DARK than for VERY which was less frequently used by subjects within each language).

A variety of additional terms were suggested by participants and these differed by language group. English speakers used the following additional modifiers (not used by Vietnamese speakers): FLUORESCENT/NEON, DILUTE, CLEAR, SOFT, FADED, DIRTY, VIBRANT, GRAINY, STUNNING, SHARP, SHINY/REFLECTING, BASIC/SIMPLE, BARELY, HEAVY, SUPER, REALLY. Monolingual Vietnamese speakers used additional modifier glosses not used by English speakers: OLD, METALLIC, STRIPED, SPARKLE, LITTLE/SLIGHTLY, CLOSE TO, REAL, FULLY, SWEET, EVEN, BITTER. In addition, they also repeated a name to give it emphasis, e.g., YELLOW YELLOW. No monolingual English speaker did that, but several bilingual Vietnamese speakers also used word repetitions for emphasis. Bilingual Vietnamese speakers used the following additional modifiers not used by the other two groups: PEACEFUL, LONELY, NOT.

Correlations among the frequencies of use for each of the classifications in our taxonomy (described above) reveal additional usage patterns. For all three languages, monolexemic naming was positively correlated with the number of people giving the same name to an item, suggesting that greater agreement or consensus in naming occurs for those items that are named using a single color name (English: .r=.754, p=.000; bilingual Vietnamese: r=.858, p=.000; monolingual Vietnamese: r=.490, p=.000). As discussed below, this is an important result for existing color naming theory. Consensus or agreement in naming is negatively correlated with use of modifiers and compound names for all three languages. For compound names, English r=-.408, p=.000, bilingual Vietnamese r=-.538, p=.000, monolingual Vietnamese r=-.364, p=.000. For modifier use, English r=-.373, p=.000, bilingual Vietnamese r=-.540, p=.000, monolingual Vietnamese r=-.260, p=.006. Bilinguals also showed the highest negative correlation between use of monolexemic terms and use of modified terms, perhaps indicating that they have forgotten their vocabulary of Vietnamese modifiers. Interestingly, use of object glosses is negatively correlated with agreement about naming for English and bilingual Vietnamese but is uncorrelated with naming agreement for monolingual Vietnamese. This suggests the previously unexplored possibility that object glosses may have a different status in Vietnamese than in English.

The modifier LIGHT showed the strongest negative correlation with use of a single-word color term (English: r=-.420, p=.000; bilingual Vietnamese: r=-.416, p=.000; monolingual Vietnamese: r=-.299, p=.001). Where people tended to use generic hue terms (as opposed to object glosses), they tended not to use the modifier LIGHT and they tended to use modifiers denoting saturation, including STRONG, FRESH, and MODERATE or MEDIUM. The preferred modifier denoting saturation varies with language. It is interesting that use of compound names (e.g., YELLOWISH BROWN) is negatively

correlated with the modifier DARK in English (r=-.224, p=.019) but positively correlated with DARK in both Vietnamese groups. Thus DARK is used as an alternative way to modify hue in Vietnamese, which contains fewer monolexemic hue terms. An example is the naming of samples labeled YELLOW-ORANGE in English. They were called VANG DAM (dark yellow) by monolingual Vietnamese.

Our findings for Vietnamese are problematic for Kelly's Universal Color Language mapping of modifiers to the color space because certain modifiers were never used in Vietnamese, including VIVID, PALE, and STRONG. Certainly other terms can be offered as synonyms, but these tended to be terms already mapped to other regions of color space. To examine the application of modifiers to regions of OSA stimulus space, color appearances within a category (as identified by the modal name applied to that sample) were plotted in OSA space. Then the frequency with which a given modifier was applied to that term was superimposed onto its position in space.

The resulting plot is similar to Guest and Van Laar's (2000) frequency density plots, without the assumption of continuity between samples. This mapping permitted inspection of the relative positions of modifiers with respect to color appearance names within each color category. A comparison of English and Vietnamese use of the modifier LIGHT as applied to all samples named using the stem term YELLOW (VANG) is shown in Figure 6. (Mappings were originally performed in three dimensions but are shown here in two-dimensions because they are easier to interpret.) Figures 6a and 6b show a commonality across languages in the use of the modifier glossing LIGHT. In both groups it is most frequently used to describe stimuli located in roughly the upper left quadrant of each figure. (Ambiguous points in Figure 6b are distinguished by their OSA g coordinates in a three-dimensional plot. Only the highest frequency is shown. The same modifier relation is observed in three dimensions.) Note that in Figures 6a and 6b the selection of samples varies because, although all subjects judged the same stimulus set, subjects speaking different languages applied the name yellow to different samples. Monolingual Vietnamese subjects also applied the term yellow to samples generally classified as orange in English, as shown in Figure 7.

For each color category, within each language group, for each modifier, this procedure was used to determine whether the relative positions corresponded to those predicted by Kelly and found by Lin et al. (2001b). As for yellow, different samples were identified in English and Vietnamese for those categories named differently in the two languages, especially those labeled BLUE or GREEN in English and the modified stem term XANH (grue) in Vietnamese. In all cases, the modifiers LIGHT, DARK, and BRIGHT, FRESH or MODERATE appeared in the same relation to the highest frequency single-word named color appearance for that color category. This suggests that these modifiers may be universally used to name roughly similar areas of color space surrounding the best exemplars of a color category. As one might expect, the modifiers LIGHT and DARK are applied with movement along the brightness axis, while the modifiers BRIGHT, FRESH, and MODERATE are applied with movement

along the saturation axis (or horizontal meridian) of the OSA stimulus space. The particular samples emerging as the highest frequency or best exemplars varied and the constituent items of the color category also varied across language groups tested, as described by Jameson & Alvarado (In Press).

Discussion

Vietnamese and English speakers clearly use different naming strategies, with English speakers employing a greater variety of terms and with monolingual Vietnamese speakers much more likely to use modifiers and less likely to use single-word basic or non-basic hue terms. Monolingual Vietnamese speakers were also less likely to use monolexemic object glosses and more likely to use modified object glosses and object glosses as modifiers. Monolingual Vietnamese speakers were also more likely to use compound terms (e.g., YELLOW BROWN) and were the only ones to use repeated hue terms (e.g., YELLOW YELLOW). Thus there is a clear preference for use of multiple-word color terms among monolingual Vietnamese speakers, rather than the highly specific single-word object glosses used in English. This is similar to the patterns of modifier and secondary term use found for Mandarin Chinese speakers by Lin et al. (2001b). Results for our English speakers were consistent with those of Guest and Van Laar (2000). However, results for our monolingual Vietnamese speakers were considerably different from results for English speakers.

Across all three language groups, the modifiers LIGHT and DARK for lightness and BRIGHT, FRESH, MEDIUM for saturation were applied similarly to regions of the color space, but this mapping occurred in terms of the relationship of modified category names to culturally specific central exemplars of categories, not the exact samples labeled, which differed by language group. The color space maps proposed by Kelly (1976) were thus only partially confirmed, even for English, suggesting perhaps a change in English modifier use over time. Cross-cultural similarities were noted in the relationship among color names, but differences were noted in which samples were labeled using which terms. This evidence from our analysis of modifiers supports our earlier suggestion (Jameson and Alvarado, In Press) that color category focals and boundaries may not arise from pan-human shared visual processing but rather from other regularities of language, categorization and color cognition. This variation is also consistent with findings of Lin et al. for Chinese (2001b). Despite using more monolexemic terms, English speakers showed a larger vocabulary of modifiers as well as different choices of modifiers than monolingual Vietnamese. Based on our findings, stem terms (both basic terms and object glosses) in both languages appear to be used to capture differences in hue while modifiers are used to describe differences in lightness and saturation. Monolingual Vietnamese were more likely to use object glosses as modifiers in phrases (e.g., baby banana leaf tip green)

MacLaury (1992) suggests that Berlin and Kay's evolutionary stages actually reflect a transition from a lightness-based naming system to a hue-based system. According to Schirillo (2001) Berlin and Kay's evolutionary stages may also reflect a transition from use of contextualized names to use of more

abstract names. Berlin and Kay (1969) and subsequent universality theorists further suggest that the sequence of emergence and choice of terms in an abstract naming system arises from underlying color neural physiology. Van Brakel (1992), who generally espouses an anti-empiricist perspective on the topic, suggests that evolutionary stages reflect the influence of Western culture on indigenous naming behaviors and are thus a transition to the Western color system from a variety of viable alternatives. Our findings have several implications for these competing theories.

Monolingual Vietnamese speakers in our study used more modified object glosses, suggesting less reliance on abstract basic hue terms. When speakers draw upon fewer monolexemic color names, yet the color appearance space to be named remains broad, modifiers and compounds may be required to fully differentiate items in that space. Both Schirillo (2001) and Lin et al. (2001b) suggest that this may account for greater use of modifiers to name more extensive color categories such as green/blue or grue (XANH). Thus, the fewer the monolexemic terms available, the greater the number of modifiers will be used. This tradeoff between highly specific monolexemic terms and modified terms may exist among individuals as well as cultures. However, bilingual Vietnamese speakers did not show such a tradeoff in our study, exhibiting reduced variety of both monolexemic terms and modifiers. That is most likely attributable to shifting fluency in the native language while acquiring English, and suggests the difficulty of conducting cross-cultural language studies using bilingual immigrant populations, as was done in many color naming studies including the Berlin and Kay (1969) original survey. Our bilingual subjects' naming patterns appear to indicate that highly specific object glosses and modifiers fall into disuse before basic color terms. As evidence of this, bilingual speakers show naming patterns more similar to English than monolingual Vietnamese except for the use of monolexemic object glosses (see Figure 3a). This suggests that bilingual speakers are unable to rely upon a large vocabulary of object glosses in Vietnamese and thus cannot fully emulate the pattern of naming used by English speakers while speaking Vietnamese. Note that bilingual speakers apply basic terms more frequently than either monolingual language group and show a convergence on the type of universality noted in previous studies.

MacLaury (1992) suggests that linguistic cultures evolve from lightness to hue-based naming systems due to a shifting emphasis on difference and similarity. It is possible that use of modifiers of all types represents one strategy for differentiating among color appearances, while use of a large array of highly specific object glosses represents another. If so, then modifier use should not vary with the availability of basic terms, but should instead be limited in those cultures emphasizing similarity and more extensive in those cultures emphasizing difference. While our study did not test widely disparate cultures in terms of evolutionary stages, frequency of modifier use appeared to vary inversely with basic term use, rather than directly with it, supporting the idea that extensive vocabulary and extensive modifier use are alternative strategies rather than different evolutionary stages. If the purpose of modifiers is to

provide greater attention to difference, then languages using more basic terms (encoding finer hue differences) should also use more modifiers. This was the case for English, which produced a larger array of both. Thus, specificity or differential attention to difference does not readily explain the preference for using modified terms compared to monolexemic or basic terms during naming found in both Vietnamese and Chinese (as reported by Lin et al., 2001b).

It may also be that cultures evolve not from lightness to hue, per se, but from a single-dimensional to a multi-dimensional naming system. The interaction of any of three commonly posited dimensions (i.e., hue, lightness and saturation) with another may produce more sharply defined category boundaries than a single dimension alone. Such distinctions captured by language may result in the observed increase in naming using basic terms. In that case, modifier use increases as cultures attend to additional dimensions. Similarly, because the Tarahumara modifiers are used relationally to name other categories besides color appearances, they may have been evolving from use of generic relational modifiers to a system of modifier use more specific to the category of color (e.g., evolving from VERY and SOMEWHAT to LIGHT and BRIGHT) as required to name separately attended aspects of additional dimensions.

Conclusions

The existence of basic color terms applied to focal colors is well established. However, focusing solely upon basic terms ignores that in everyday discourse such terms are used in combination with modifiers and object glosses to differentiate finer aspects of stimuli. Thus color-naming should be studied cross-culturally and in the context of these broader naming strategies. Because cultures differ in their patterns of modifier use, our findings suggest the importance of using research paradigms that do not restrict subjects to monolexemic naming when making cross-cultural comparisons. Further, if subjects are constrained to using monolexemic terms in a language that relies heavily upon modifiers, researchers must consider the impact on access to memory and consequent response times, attention to relevant aspects of stimuli habitually named by the denied modifiers, and so on. Otherwise, differences and similarities in performance may result from language structure, not the characteristics of the stimuli to be named.

This study of modifiers reveals cross-cultural similarities and differences which studies limited to basic color terms are unable to pick up. While the widely observed cross-cultural use of monolexemic basic color terms is impressive, it doesn't account for enough of the variance in naming behavior to justify ignoring the rest. Lin et al. (2001a) state: "Both groups preferred to describe colours using secondary names [object glosses], comprising 42% of all colour names given." (p. 53). Later they state: "The frequency of the 12 colours in the modifier-basic (C7-2) category was also generally larger than in the basic (C7-1) category for Chinese subjects. This tendency was similar to the British results, suggesting that *all subjects preferred to use modified basic names, rather than using basic names*

alone." (p. 55, emphasis added). Monolingual English and Vietnamese speakers in our study also supplied more non-basic and modified terms than basic terms. Thus the tendency to use modified and non-basic terms such as object glosses constitutes the larger portion of observed naming behavior.

Our finding of consistencies between Chinese and Vietnamese and differences between both languages and English, suggest that important aspects of naming are being overlooked because of pragmatic and theoretical impositions on the empirical study of color naming. We consider it hasty to conclude that basic color terms describe naming so completely that the cultural contribution to language can be assessed from basic terms alone (Moore et al., 2000). We believe our findings demonstrate that cultural differences reside in the details not the broad strokes of color naming, but so might additional universalities. Given that universal tendencies exist in the subset of color-naming behaviors assessed under monolexemic response constraints, it seems reasonable to search for universal tendencies arising in conditions that more closely approximate naturalistic language use. Although further empirical study is required, the present findings provide an initial indication of what those universalities might be.

In our data, subjects also used modifiers to describe properties of stimuli not captured by the first three dimensions of color perception. Terms are used to describe texture, reflectance, luminosity, and affective response to the perceived sample. These are valid dimensions of subjective color experience that go beyond mapping to existing three-dimensional color spaces. The extent to which these experiences are important within a culture may influence use of modifiers to name them (Schirillo, 2001). Contextualized object glosses may arise not as part of an inevitable cultural evolutionary sequence, but because these additional qualities of color appearances are important to the context in which objects appear. Object glosses may reflect the poverty of context-independent language available for describing such additional properties of color appearances.

When the interaction between modifiers and basic terms is better understood for a variety of languages, structural universalities may emerge that clarify the debates about the evolution of color naming in various cultures. We must approach naming as a system that is applied to a perceptual space to encode meaningful aspects of appearance in order to optimize communication. This understanding seems essential to recognizing the relationships between basic terms and other words used to convey fine differences in meaning. Kelly's mapping of modifiers to the Munsell space was never intended to describe color naming in all languages. However, the implication of our failure to confirm Kelly's broad-to-precise taxonomy is that a simplistic view of modified terms as nested coextensive names encompassed by broader basic color terms doesn't adequately describe the patterns of use observed in English or Vietnamese.

Author Notes

Send correspondence to: Nancy Alvarado, IBM, T. J. Watson Research Center, P.O. Box 704, Yorktown, NY 10598 or nanalv@us.ibm.com. Kimberly A. Jameson, Department of Psychology, University of California, San Diego. This research was supported by NIMH grant RO3-MH53126-01 (Jameson) and Hellman Faculty Fellowship Award (Jameson). Additional support was provided by IBM, T.J. Watson Research Center (Alvarado). The authors gratefully acknowledge the assistance of undergraduates A. Lewis, A. Nguyen, A. Garcia, I. Moy, and H. Ngo. The authors would like to thank Margaret Chan, IBM, T.J. Watson Research Center, for her assistance in the translation of Mandarin Chinese, and for general assistance on features of Asian languages.

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Footnotes

1. Translation of Chinese color terms was performed by professional translator, Margaret Chan, IBM, T.J. Watson Research Center.

Figure Captions

Figure 1. Universal Color Language map of modifier use by Munsell value and chroma within hue. Note: From "Color: Universal language and dictionary of names," by K. Kelly and D. Judd, 1976, U.S. Department of Commerce, NBS Special Publication 440.

Figure 2. Comparison of the frequency of use of monolexemic basic and non-basic color terms and modified basic and non-basic color terms by language group.

Figure 3. Comparison of the frequency of use of monolexemic secondary terms (object glosses) and modified secondary terms by language group.

Figure 4. Frequency of use of compound hue terms by language group.

Figure 5. Frequency of use of the modifiers "light" and "dark" by language group.

Figure 6. Frequency of use of the modifier "light" for yellow, superimposed on sample location in OSA space, by language group.

Figure 7. Modal English names applied to samples labeled yellow (VANG) in Vietnamese.

Figure 1.

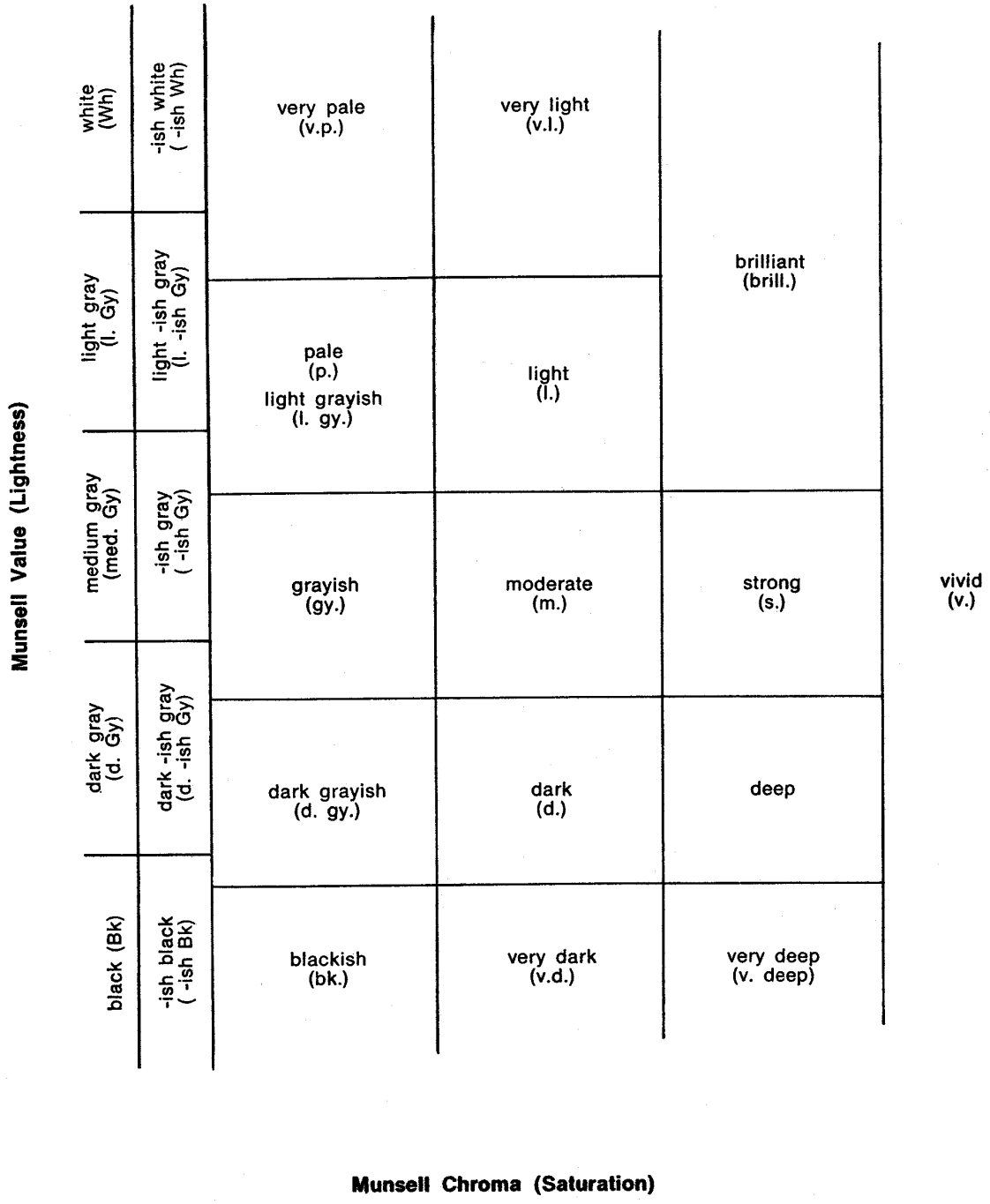
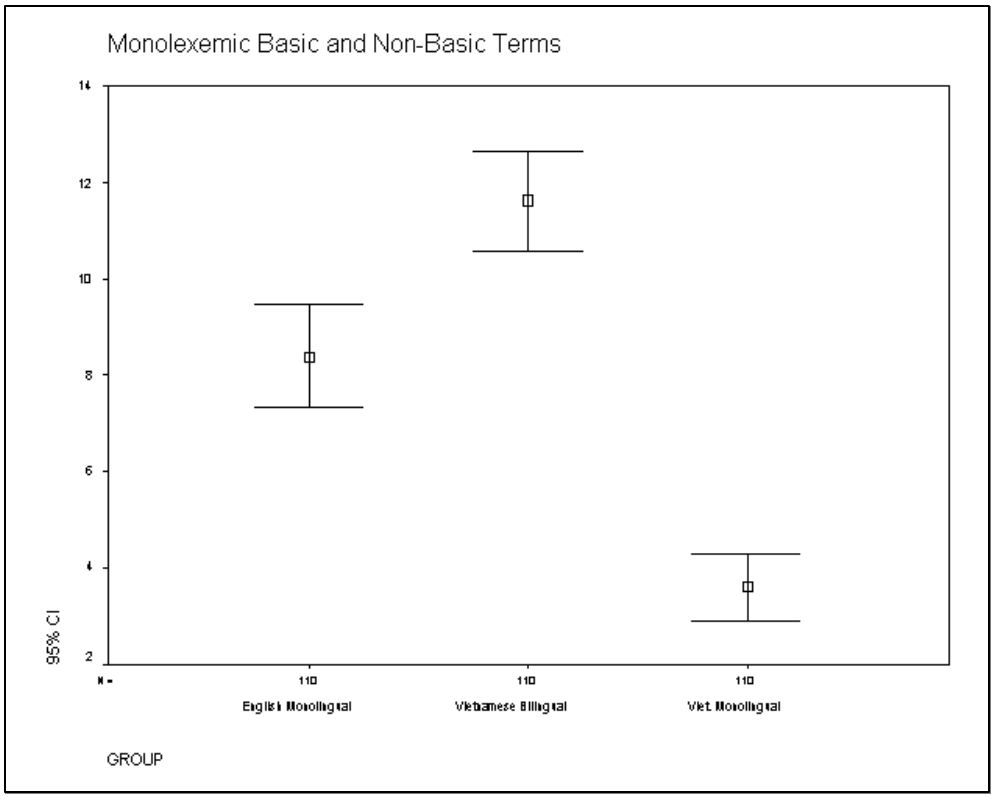

Munsell Value (Lightness)
white (Wh)
-ish white (-ish Wh)
light gray (l. Gy)
light -ish gray (l. -ish Gy)
medium gray (med. Gy)
-ish gray (-ish Gy)
dark gray (d. Gy)
dark -ish gray (d. -ish Gy)
black (Bk)
-ish black (-ish Bk)
very pale (v.p.)
very light (v.l.)
pale (p.)
light grayish (l. gy.)
light (l.)
grayish (gy.)
moderate (m.)
dark grayish (d. gy.)
dark (d.)
blackish (bk.)
very dark (v.d.)
brilliant (brill.)
strong (s.)
deep
very deep (v. deep)
vivid (v.)
Munsell Chroma (Saturation)

Figure 2.


Monolexemic Basic and Non-Basic Terms
95% CI
14
12
10
8
6
4
2
N =
110
110
110
English Monolingual
Vietnamese Bilingual
Viet. Monolingual
GROUP

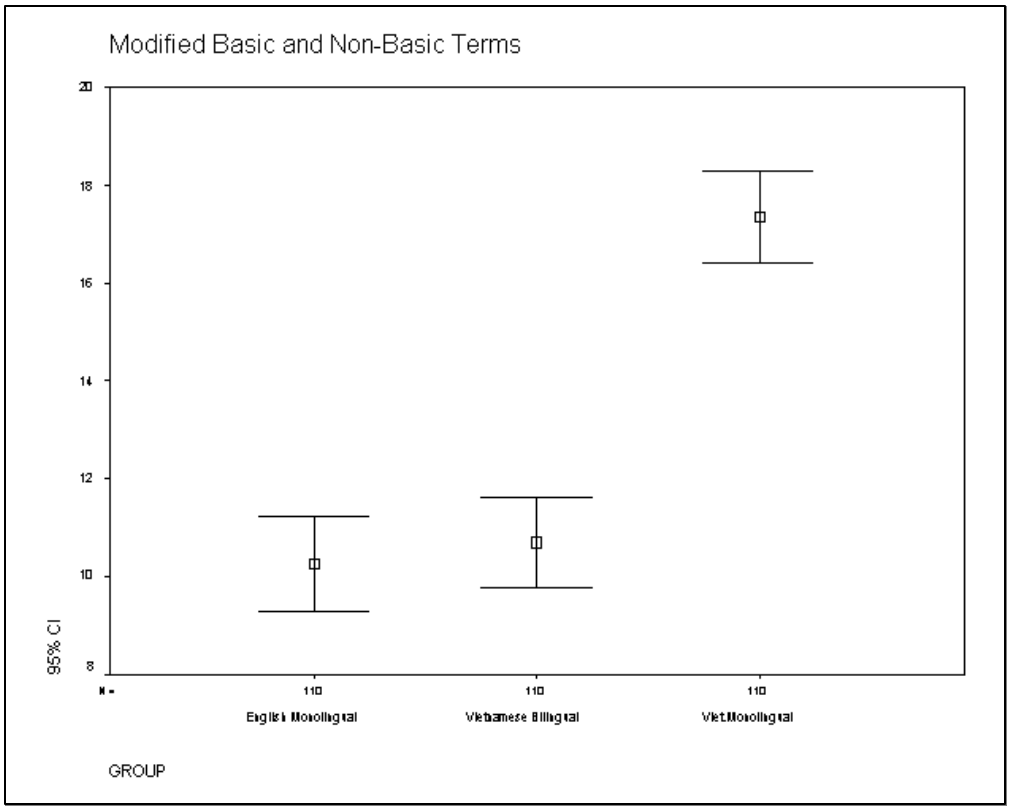
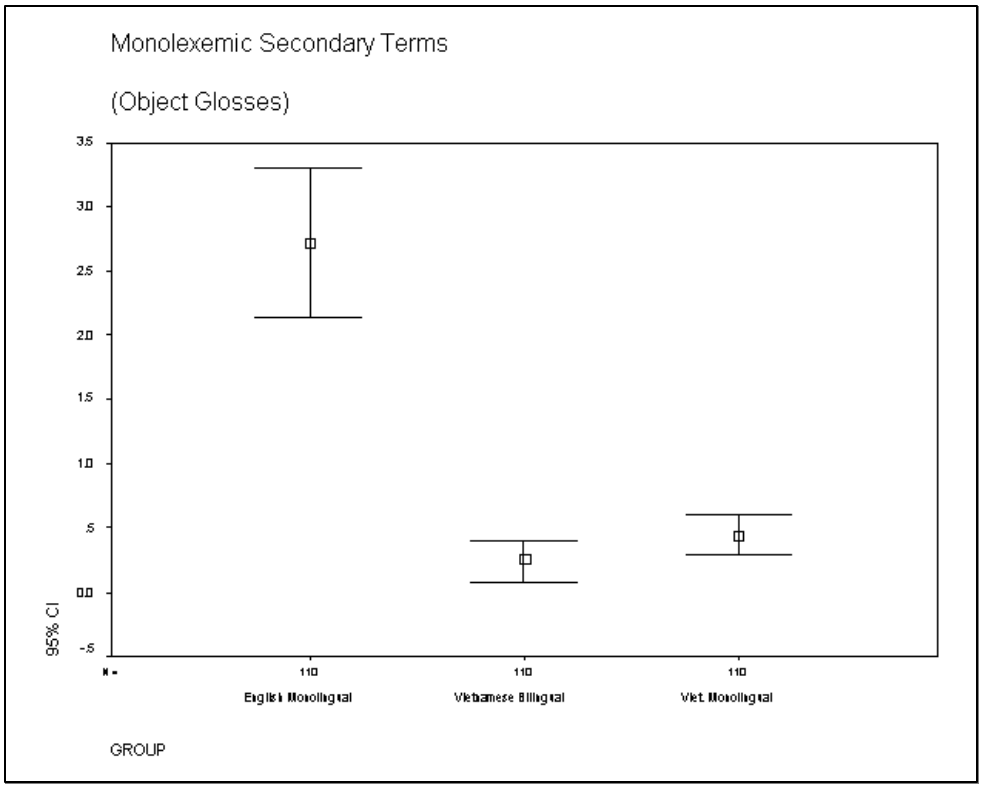

Modified Basic and Non-Basic Terms
95% CI
20
18
16
14
12
10
8
N =
110
110
110
English Monolingual
Vietnamese Bilingual
Viet.Monolingual
GROUP

Figure 3.


Monolexemic Secondary Terms
(Object Glosses)
95% CI
N =
110
110
110
English Monolingual
Vietnamese Bilingual
Viet. Monolingual
GROUP

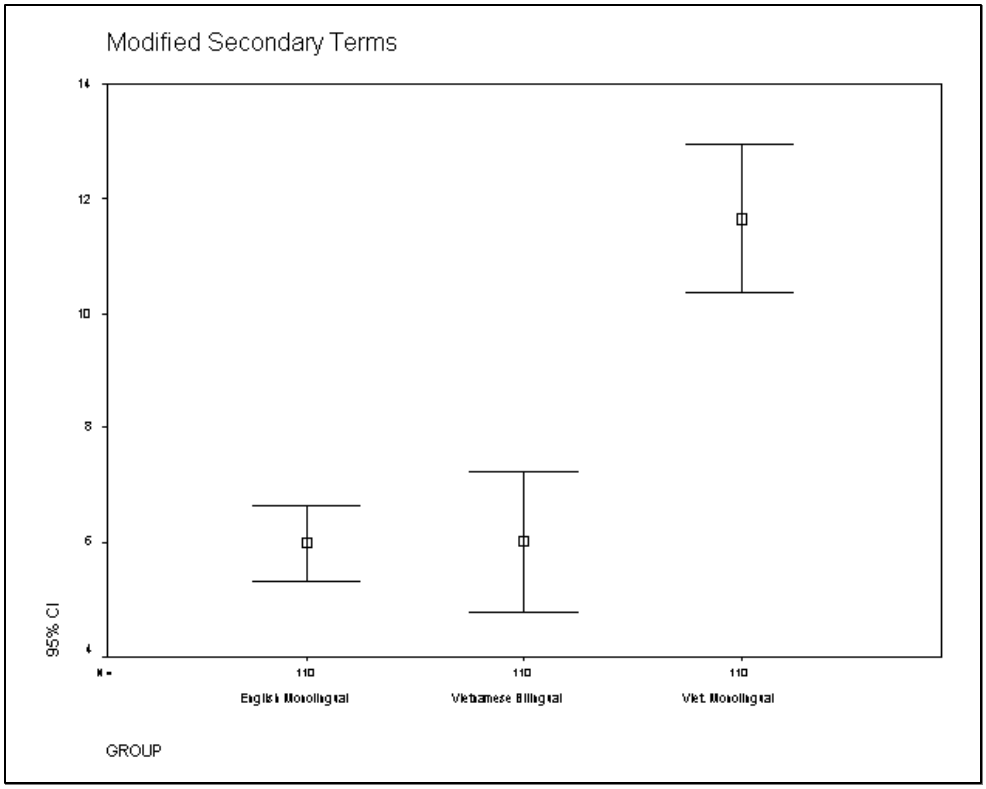

Modified Secondary Terms
95% CI
N =
110
110
110
English Monolingual
Vietnamese Bilingual
Viet. Monolingual
GROUP

Figure 4.

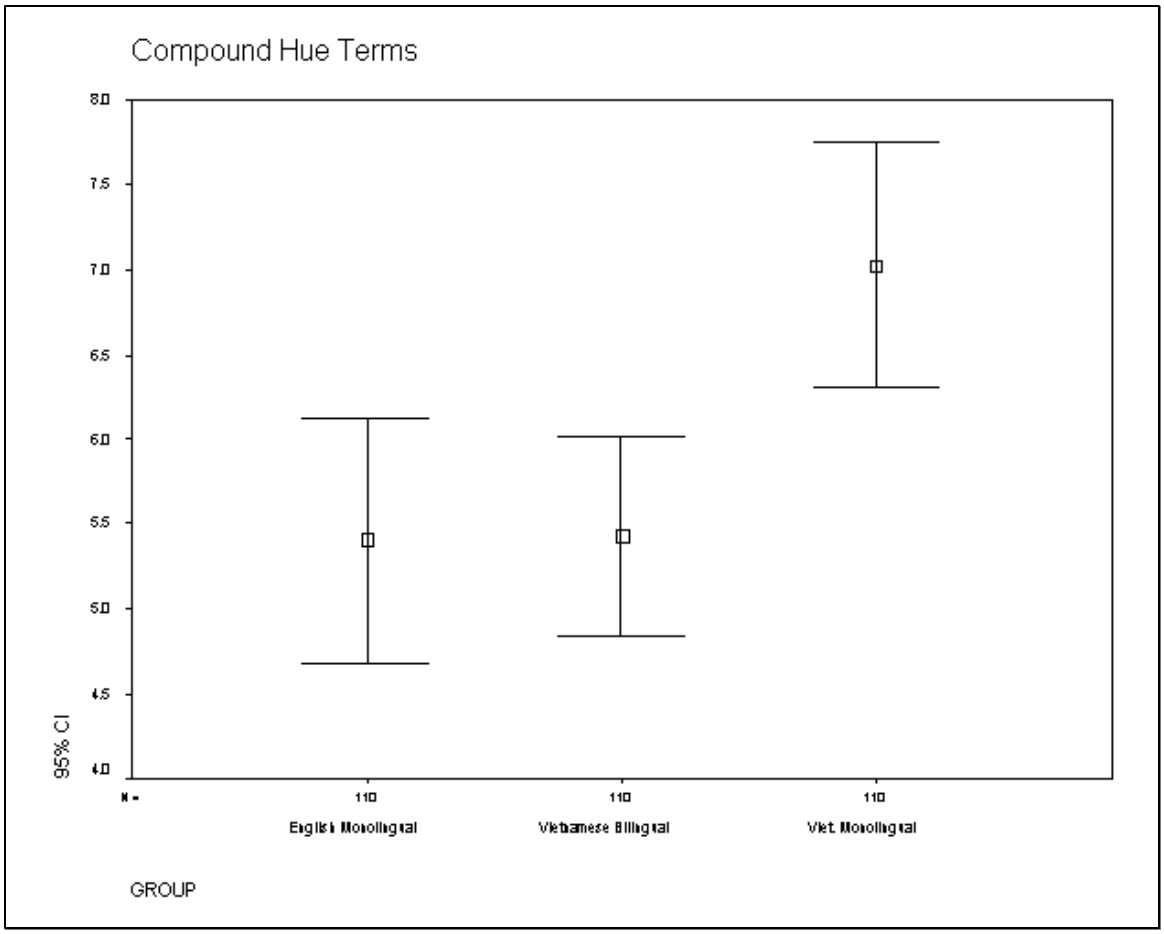
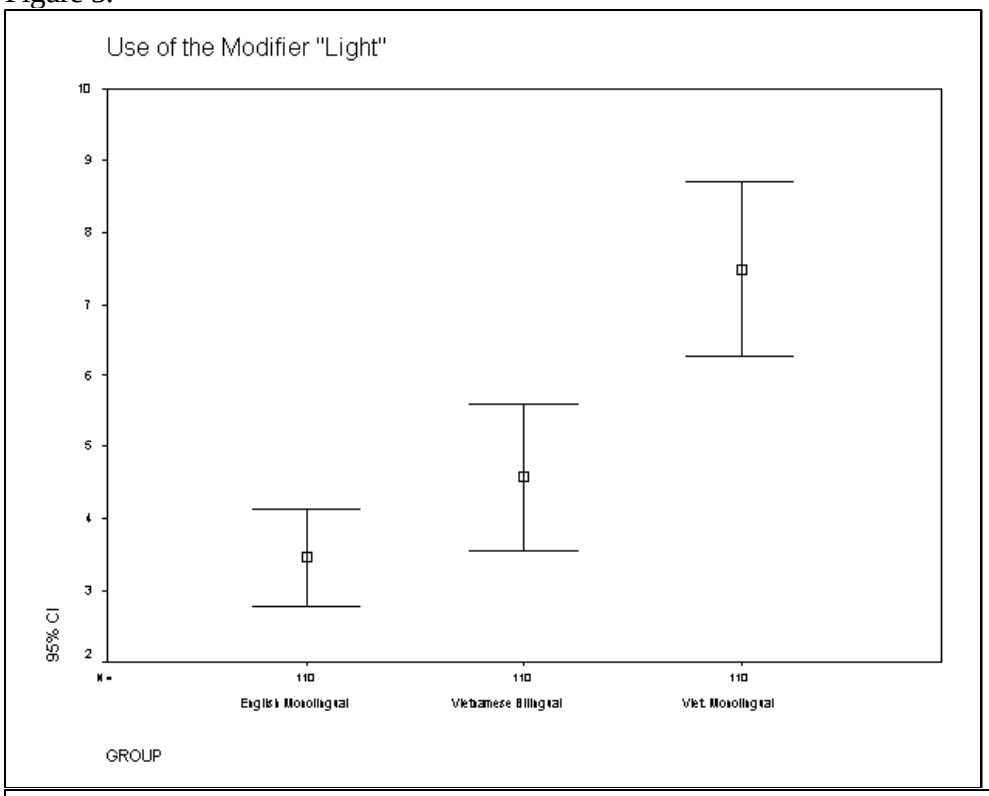

Compound Hue Terms
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
95% CI
N =
110
110
110
English Monolingual
Vietnamese Bilingual
Viet. Monolingual
GROUP

Figure 5.


Use of the Modifier "Light"
95% CI
10
9
8
7
6
5
4
3
2
N =
110
110
110
English Monolingual
Vietnamese Bilingual
Viet. Monolingual
GROUP

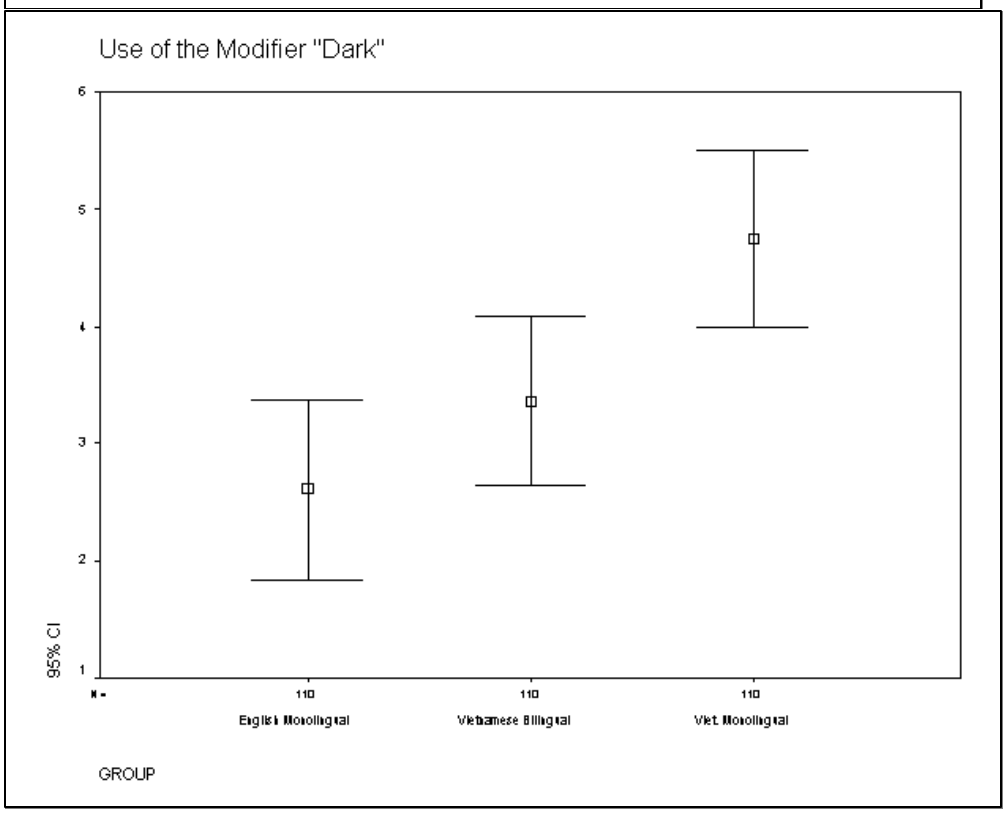
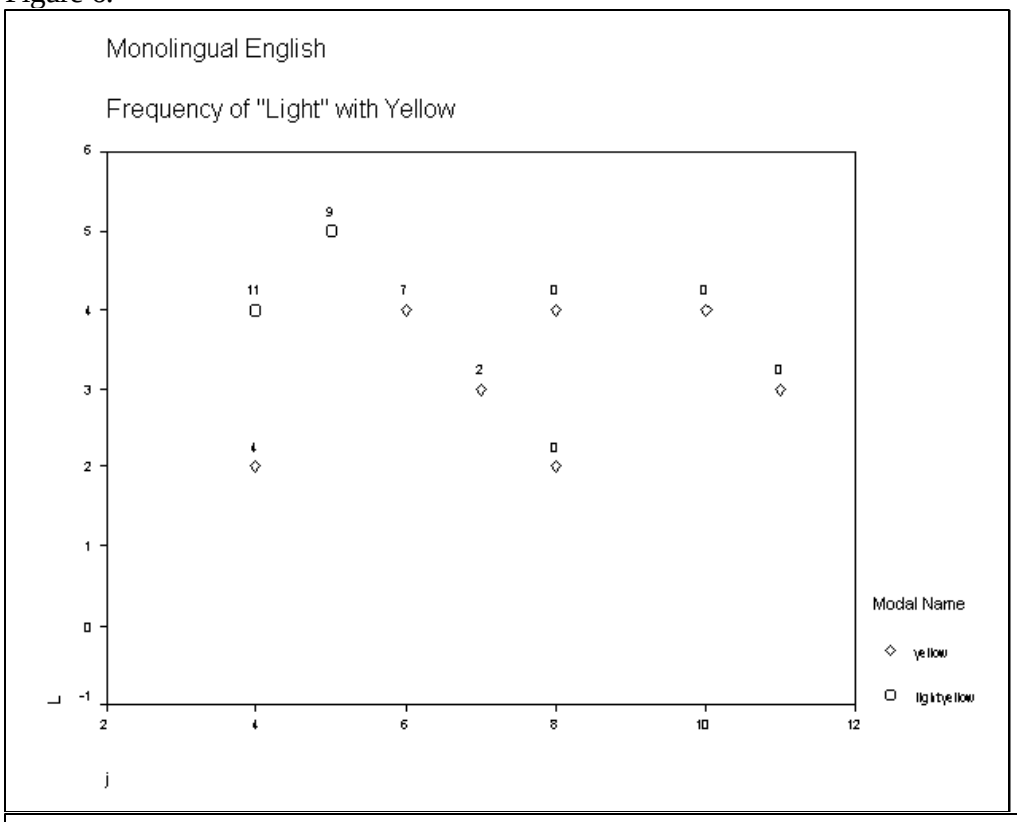

Use of the Modifier "Dark"
95% CI
6
5
4
3
2
1
N =
110
110
110
English Monolingual
Vietnamese Bilingual
Viet. Monolingual
GROUP

Figure 6.


Monolingual English
Frequency of "Light" with Yellow
L
j
Modal Name
yellow
light yellow

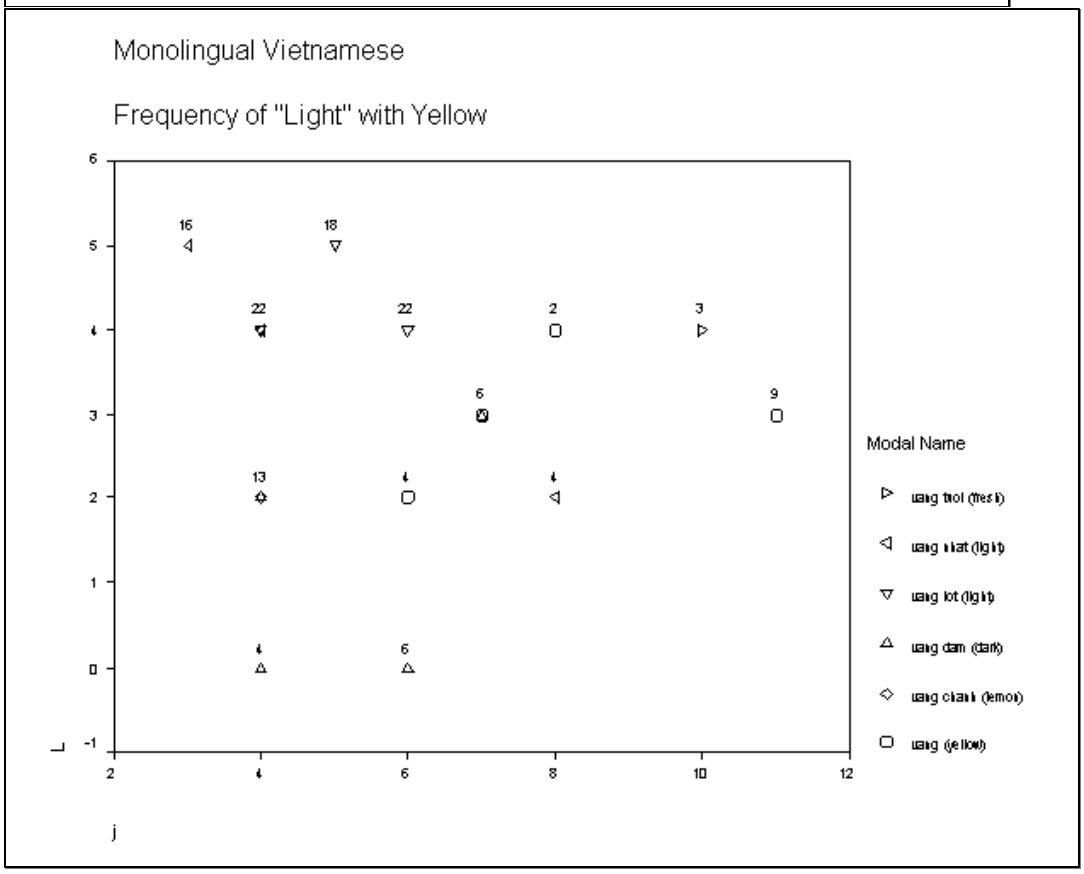
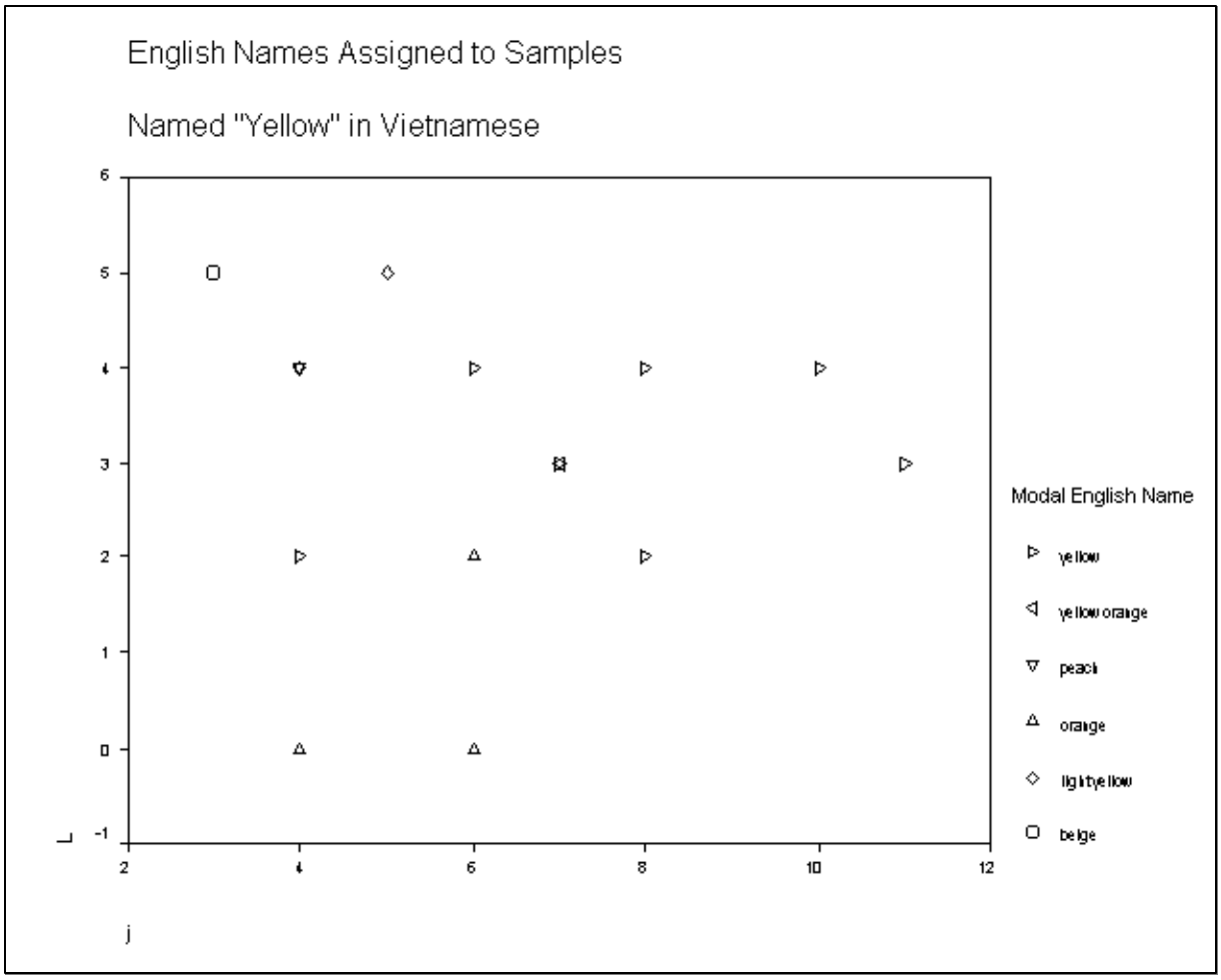

Monolingual Vietnamese
Frequency of "Light" with Yellow
L
j
Modal Name
vàng tươi (fresh)
vàng nhạt (light)
vàng lợt (light)
vàng đậm (dark)
vàng chanh (lemon)
vàng (yellow)

Figure 7.


English Names Assigned to Samples
Named "Yellow" in Vietnamese
L
j
6
5
4
3
2
1
0
-1
2
4
6
8
10
12
Modal English Name
yellow
yellow orange
peach
orange
light yellow
beige