Changes in Muṭallaṭ Arabic color language and cognition induced by contact with Modern Hebrew

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I show how Modern Hebrew color terms influence linguistic and cognitive color categories in young native speakers of Muṭallaṭ Arabic who are also fluent in Modern Hebrew and exposed to Israeli culture and lifestyle. Muṭallaṭ Arabic is a Palestinian variety spoken in Israel. I compare basic color terms (BCTs) and cognitive categories (CCs) in Traditional Muṭallaṭ Arabic (TMA, speakers over age 65) and Neo-Muṭallaṭ Arabic (NMA, speakers under age 40). Results are compared to Modern Hebrew BCTs. Fourteen men and 14 women were tested for each group. Linguistic data came from spontaneous speech, direct questions ('what color is this object?' 'what has X color?'), and stimuli: 1. a naming task on the complete Munsell chart tested at three different levels of saturation (with chips submitted in a fixed random order), 2. culture-specific stimuli to elicit BCTs' association with objects/materials, and 3. director/matcher tasks. A cognitive test was performed on TMA and NMA speakers to detect influences of Modern Hebrew BCTs acquired by NMA speakers in adulthood on NMA cognition. The experiment is a modified version of Winawer et al.'s objective, perceptual discrimination task (2007), performed through fifty triads of color squares shown on the computer screen. Subjects had to choose which of the bottom squares matched the color of the top square. Results show that NMA has different BCTs and CCs than TMA: BCTs found in both TMA and NMA have slightly different foci and markedly different boundaries. TMA BCTs and CCs reflect desaturated and brightness-based categories, while NMA BCTs and CCs are hue-based and closer to those of Modern Hebrew. NMA color terms increase in number via associations with prototypical referents ('lemon-yellow'> 'yellow') borrowed from Modern Hebrew. Acquisition of Modern Hebrew BCTs in adulthood reshapes both NMA BCTs and CCs.

1. Introduction

Different languages divide color spaces differently (Agrillo & Roberson 2009; Berlin & Kay 1969; Kay & Maffi 1999; Kay & Regier 2006; Regier & Kay 2009; Roberson et al. 2000, 2005, 2008). Therefore, it is worthwhile to investigate the chromatic distinctions in bilingual communities (Athanasopoulos 2009). In particular, detecting color categories of a non-

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native language in the cognitive structures of bilingual speakers can contribute to the investigation of the ways in which color language shapes cognition (Winawer et al. 2007). Cross-linguistic differences in color perception and memory have been central in the debate on whether and to what degree language shapes thinking (Davidoff et al. 1999; Siok et al. 2009; Tan, L-H. et al. 2008; Thierry et al. 2009). If two colors are called by the same name in a language, speakers of that language will tend to confuse them in memory more than people whose language has different names for these colors. These cross-linguistic differences seem to develop in early childhood, together with the acquisition of color terms (Goldstein et al. 2009).

I present here a cross-generational survey of basic color terms (BCTs) and cognitive color categories (CCs) within the community of Muṯallaṯ Arabic speakers in Israel. Muṯallaṯ Arabic is a sedentary, rural variety of Palestinian Arabic spoken in the Israeli region called the Muṯallaṯ, which extends along the border between Israel and the Palestinian Authority from the village of Kfar Qāsim in the south to the city of Umm el-Faḥm in the north (Jastrow 2004). I refer here to the variety spoken by the elders, over 65 years of age, as Traditional Muṯallaṯ Arabic (TMA), while I term the variety spoken by people under age 40 Neo-Muṯallaṯ Arabic (NMA). TMA and NMA differ in terms of the nature and number of both BCTs and CCs, their foci, and their boundaries. I hypothesized that Modern Hebrew BCTs may be responsible for the current development of NMA BCTs and CCs, which are so different from those of TMA. Evidence of such influence would suggest that color categories of a second language, learned from native speakers in adulthood, influence cognitive structures.

To test my hypothesis, I surveyed BCTs and CCs in both TMA informants and monolingual Israeli speakers of Modern Hebrew and compared the results of both control groups with the NMA data. Modern Hebrew may affect the chromatic representations of young Muṯallaṯ Arabic speakers, as it is their second language, while elders are much less exposed to it and less proficient in it. In general, male TMA speakers, who have largely been employed in agricultural and construction companies or worked in commerce since the early days of the State of Israel, are more competent in Hebrew than elderly women, whose contact with Hebrew-speaking society has been minimal, since they generally led domestic lives dedicated to raising children, maintaining the household, taking part in agricultural activities for the family's subsistence, mainly in the fields adjacent to their villages, or engaged in crafts such as sewing, generally limited to the needs of their village communities. The Hebrew proficiency of TMA speakers of both genders is not comparable to that of NMA speakers, who have been educated from elementary school in Hebrew as a second language. In particular, the NMA informants who took part in the experiments described here had attended Tel Aviv University, where they studied in Hebrew, resided in the city among its Hebrew-speaking majority, and often worked in Hebrew-

speaking contexts to support themselves during their studies. Their proficiency in Hebrew as a second language is close to that of native speakers, especially in spoken language, and developed during the period of their university studies, i.e., between the age of 19 and 25. Before this age, the acquaintance of NMA speakers with Modern Hebrew is limited. They do start learning Modern Hebrew as a second language at the age of 7 or 8, but it is taught in their village schools by Arab teachers who are non-native speakers of Modern Hebrew. NMA speakers start to become proficient in Modern Hebrew when they embark on university studies and begin to take part in campus and city life. Having left their villages, the NMA speakers tested here participated for several years in the material culture of the Hebrew-speaking population, absorbing its fashion, beauty, design, food, and technology trends, of which colors are a fundamental material and symbolic component. Based on their contact with Modern Hebrew, NMA graduates of Tel Aviv University become drivers of the diffusion of innovations among the young Muṯallaṯ people at home, including their siblings and friends.

2. BCT systems in Arabic history and dialectology

Arabic color systems are rich and complex. The Old Arabic word stock and the pre-Islamic Arabic poetry attest to a large number of terms (Fischer 1965), among which BCTs relate to natural, desaturated categories (Borg 1999). A similar system of desaturated categories is observed in the traditional varieties of Negev Arabic and related Bedouin languages (Borg 2007). The nomadic varieties seem to have been infiltrated by hue-oriented categories in use among Levantine urban Arabic societies that preserved the local pre-Islamic Aramaic and Canaanite substrata, which already in antiquity possessed a pigment industry that was more advanced than those of the nomadic groups. The Old Arabic five-term color system (abyaḍ ‘white, bright’; aswad ‘black, dark’; aḥmar ‘red, light brown’; axḍar ‘green, blue, black’; and aṣfar ‘yellow’ [Fischer 1965]), paralleled in ancient Hebrew and Aramaic, is the basis of most modern colloquial color paradigms. While urban Arabic vernaculars, spoken in Cairo, Beirut, Jerusalem, and so on, display BCT systems that approximate the Berlin and Kay eleven-term stage, co-territorial nomadic and semi-nomadic communities tend to retain archaic color paradigms, with fewer desaturated BCTs (abyaḍ ‘white, bright’; azraq ‘black, dark, grey’; aḥmar ‘red, brown, yellow’; axḍar ‘green, blue, dark’; aṣfar ‘yellow, pale’; ašhab ‘blue, grey’) alongside a rich non-basic nomenclature that encodes ecological hues (ṣīni ‘blue, grey’; aṭlas ‘muddy-colored jackal’; kaḥla ‘goat with reddish ears or eyes’).

The investigations carried out so far on BCT systems in Arab varieties have employed a philological approach and focused on etymology, referent objects/materials associated with color terms, and their symbolic values.

Until now, no cognitive studies or experimental linguistic surveys have been conducted on Muṯallaṯ Arabic chromatic categories and neighboring dialects. The experiments presented here for TMA and NMA provide the first available data on both varieties.

In particular, the experimental results shown here for the TMA control group reveal a complex chromatic system in this rural, conservative dialect, with six desaturated basic categories (abyaḍ 'white, bright'; aswad 'black, dark, grey'; aḥmar 'red, brown, yellow'; axḍar 'green, dark'; aṣfar 'yellow, pale'; azraq 'blue, shining, transparent, grey') alongside some ecological and artificial modern hues for more specific uses (nīli 'electric blue'; laymūn 'lemon [yellow]'). TMA BCTs are therefore more similar to the categories described by Fischer for Old Arabic and by Borg for Negev Bedouin Arabic than to those of Levantine, Egyptian, and Arabian urban varieties. BCTs in urban dialects of Damascus, Jerusalem, Haifa, Nablus, Ramallah, Cairo, and Mecca often attain or approximate the maximal set of eleven terms that represent stage VII in Berlin and Kay's evolutionary sequence. In Nablus, Ramallah, and Jerusalem, the BCTs are: abyaẓ 'white'; aswad 'black'; aḥmar 'red'; axẓar 'green'; aṣfar 'yellow'; azraq 'blue'; bunni 'brown'; ramādi 'grey'; zahri 'pink'; burtuqāni 'orange'; lēlaki or banafsağı 'violet.'

Despite belonging to an advanced developmental stage and being hue-oriented, the BCTs of the urban southern Levantine Arabic vernaculars do not constitute a driving force that transforms NMA BCTs from a restricted and desaturated set of categories to a large, hue-oriented system. Indeed, in preparation for the present analysis and in order to exclude the possibility of foreign influences other than Modern Hebrew, I conducted a background survey to investigate NMA BCTs in two groups of young Muṯallaṯ speakers: 1. thirty NMA speakers of pre-university age and 2. thirty NMA speakers who did not attend Hebrew-speaking universities and were the same age as the NMA speakers who had graduated from Tel Aviv University were tested in the same experiments shown in the methodological section of this paper. Data elicited in the survey show that the BCTs of NMA speakers who did not come in contact with Modern Hebrew are similar to TMA BCTs, indicating that there are no external influences on NMA other than Modern Hebrew.

Indeed, the young generations of NMA speakers under discussion here, born after the establishment of the State of Israel, are not influenced by urban, educated Arabic varieties, such as the dialects of the main southern Levantine cities (Nablus, Ramallah, Haifa, Jerusalem). These were considered prestigious and were, to some extent, imitated by the rural and Bedouin populations in the pre-State days, when the main Palestinian cities housed newspaper offices, radio stations, and central markets, and were easily accessible within a continuous territorial area. The influence of local standards was apparent in the southern Levant, which was also influenced by the urban vernaculars of Damascus and Cairo. In general, the Arabic linguistic space from inner Asia to Africa is characterized by the coexistence

of a continuum of registers—from less educated to elevated, sub-standard, and normative—called 'diglossia' between spoken and literary language (Ferguson 1959)—and by the existence of numerous centers that diffuse local sub-standard norms ('polycentricity') (Abd-el-Jawad 2011; Walters 1994).
Today, the Muṯallaṯ is still a prevalently agricultural region between the Shefelah and Sharon coastal plains and the Samarian foothills, between Jewish settlements to the west and the border with the Palestinian Authority to the east. Historically, within the Muṯallaṯ region, large urban centers have been considered local cultural models. After the establishment of the State of Israel, Ramallah and Nablus, traditionally cultural references for the Muṯallaṯ area, remained beyond the border. Rural Muṯallaṯ villages such as Umm al-Faḥm, Bāga al-Ġarbiyya, Ǧalǧūlya, and Kfar Qāsim developed into densely populated urban settlements, progressively losing their cultural and linguistic bonds to the Palestinian urban centers beyond the border, and redirecting economic, commercial, and educational networks toward Israeli cities.
The Arab coastal city of Haifa has continued to serve as the traditional cultural and linguistic model for rural Galilean dialects, while the Arab population of the Negev looks to Jerusalem and Hebron as sources of linguistic innovation and inspiration in matters of taste and lifestyle.

3. Modern Hebrew BCTs

The Hebrew BCT system has evolved in three main historical stages: Biblical Hebrew (Brenner 1982), Medieval Hebrew, and Modern (Israeli) Hebrew. A detailed survey of these three phases is found in Sovran (2013), where the author shows through selected examples that Biblical BCTs seem to have been used as desaturated categories, while hue-oriented uses have developed over time by association with materials that possess specific chromatic values, especially in the Modern stage. The same path leading from desaturated/brightness-oriented categories to hue-oriented tints seems to have characterized the evolution of other Semitic languages as well (Bulakh 2007), including Arabic vernaculars (Borg 1999, 2007).
In the Bible, the words אָדֹם ʾăḏōm, translated today as 'red,' יָרֹק yārōq 'green,' and צָהֹב ṣāhōḇ 'yellow,' as well as שָׁחֹר šāḥōr 'dark,' and לָבָן lāḇān 'bright,' (Brenner 1982) belong to the same grammatical pattern. The Biblical words šāḥōr and lāḇān are used in Modern Hebrew for 'black' and 'white' hues. The Biblical referents associated with the words ʾāḏōm, yārōq, and ṣāhōḇ, used in Modern Hebrew as red, green, and yellow hues respectively, reveal their ancient non-hue-oriented use:

ʾāḏōm: פָּרָה אֲדֻמָּה pārā ʾădummā 'red heifer' (Num. 19.2); סוּסִים אֲדֻמִּים sūsīm ʾădummīm 'red horses' (Zech. 1.8; 6.2). King David was אַדְמוֹנִי עִם־יְפֵה עֵינַיִם ʾaḏmōnī ʿim-yəpē ʿēnayīm 'ruddy with beautiful eyes' (1 Sam. 16.12). אָדֹם ʾāḏōm is used by Esau when

he asks Jacob for some of his lentil stew: הַלְעִיטֵנִי נָא מִן־הָאָדֹם הָאָדֹם הַזֶּה halʿiṯēnī nāʾ min-hāʾ-ʾāḏōm hāʾ-ʾāḏōm haz-zɛ ‘Let me swallow, I pray thee, some of this red, red pottage’ (Gen. 25.30).

yāʾrōq: This word is used for ‘grass’ and in other contexts where it seems to denote shimmering light effects. Its attenuative pattern, yəraqraq ‘greenish,’ describes a visual quality of gold (יְרַקְרַק חָרוּץ yəraqraq ḥāʾrūṣ, lit. ‘greenish gold’): כַּנְפֵי יוֹנָה נֶחְפָּה בַכֶּסֶף וְאֶבְרוֹתֶיהָ בִּירַקְרַק חָרוּץ kanpe yōnāʾ nɛḥpāʾ bak-kɛsɛp̄ wə-ʾɛḇroṯɛha b-īraqraq ḥāʾrūṣ ‘the wings of the dove are covered with silver, and her pinions with the shimmer of gold’ (Ps. 68.14). In other contexts, the same root is used to denote pale and yellowish nuances, as in this series of plagues sent as punishment by God: וּבַדַּלֶּקֶת וּבָחַרְחֻר וּבַחֶרֶב וּבַשִּׁדָּפוֹן וּבִירָקוֹן וּרְדָפוּךָ עַד אָבְדֶךָ u-ḇad-dallɛqɛṯ u-ḇa-ḥarḥur u-ḇa-ḥɛrɛḇ u-ḇaš-šiddāp̄ōn u-ḇay-yərāqōn u-rəḏāp̄ōḵā ʿaḏ ʾāḇḏɛḵā ‘illnesses with burning fevers, a disease which causes unquenchable thirst, with the sword, with blast, and with yellowing, and they will pursue you until you perish’ (Deut. 28.22).

ṣāʾhōḇ: This word appears only four times in the Bible, associated with the blondness of hair: וּבוֹ שֵׂעָר צָהֹב דָּק u-ḇō śaʿāʾr ṣāhōḇ dāʾq ‘and in it is a thin yellow hair’ (Lev. 13.10).

Other names in patterns not specifically associated with colors originally denoted objects or materials, e.g., כסף kɛsɛp̄ ‘silver (material and color)’, זהב zahāʾḇ ‘gold, golden’, כַּרְמִיל karmīl ‘crimson’ (2 Chron. 2.6, 13; 3.14), and אַרְגָּמָן ʾargāʾmān ‘purple’ (Exod. 25.4; 26.1). Red-colored fabrics are denoted by the words שָׁנִי šāʾnī ‘crimson’ and תּוֹלָע tōlāʾʿ ‘scarlet,’ among others. The color terms borrowed from the lexicon of gemstones represent bright surface effects, while a series of pigments appears in cosmetics (Sovran 2013). In the Bible, the word ḥūr was used for ‘white,’ and təḵēlɛṯ is translated today as ‘light blue’ חוּר כַּרְפַּס וּתְכֵלֶת ḥūr karpāʾs u-tḵēlɛṯ ‘white, wool (or cotton), and blue’ (Est. 1.6). The association of təḵēlɛṯ with ‘light blue’ is a recent development. Təḵēlɛṯ is the color of the stripes of the prayer shawl. The Mishnah states that the moment when the stripes can be distinguished from the white parts of the shawl defines the time when the morning prayer can be said (Mishnah, Berakhot 1.2) (Sovran 2013).

In the Rabbinic period, כחול kaḥol was associated in the Talmud with burnt materials and ashes, designating dark greyish nuances (Babylonian Talmud Hullin 98.2). Today, it designates ‘blue.’ The word שָׁחוֹר šāʾḥōr is associated with fire-scorched pots, tar, olives, and grapes. ‘Golden’ and ‘yellow’ are distinguished, designating non-hue, natural categories. In the Mishna (Ḥullin 22.2) the following is written: מאימתי התורין כשרין? משיזהיבו. ומאימתי בני יונה פסולין? משיצהיבו me-ʾematay hat-torin kešerin? mi-šey-yazhiḇu. u-me-ʾematay bene yona pesulin? mi-šey-yaṣhiḇu. ‘When do turtle-doves become fit (for sacrifice)? When they become golden. And when do doves become

unfit? When they become yellow.' In the Babylonian Talmud (Soṭa 17.1 and Ḥullin 89.1) תְּכֵלֶת təḵēlɛṯ is said to be similar to the sea and the sky, which is in turn similar to אֶבֶן סַפִּיר ʾɛḇɛn sappīr 'sapphire stone' (Brenner 1982:185).
Finally, in Modern Hebrew, many new color terms are created via associations with foods, drinks, flowers, gemstones, metals, and loanwords from foreign languages: קרם qrem 'cream colored,' בורדו bordo 'the color of Bordeaux wine,' שמפניה šampanya 'champagne-colored,' קוניאק qonyaq 'cognac,' טורקיז ṭurqiz, from turquoise, בז׳ bež 'beige,' תפוז tapuz 'orange,' אבוקדו ʾavoqado 'avocado,' חציל ḥaṣil 'eggplant, aubergine,' נחושת neḥošet 'copper,' מַהגוני mahagoni 'mahogany,' דבש dvaš 'honey,' and קוֹרָל qoral 'coral,' among many others (Rabin and Raday 1976:867–871). Yet agreement among speakers across genders and ages regarding the meanings of these colors is not consistent and unanimous.
The Modern Hebrew linguistic categories, detected experimentally for the purpose of this paper across gender, age groups, and sociolinguistic heritages, are the following hue-oriented BCTs: šaḥor 'black'; lavan 'white'; adom 'red'; yaroq 'green'; ṣahov 'yellow'; kaḥol 'blue'; afor 'grey'; ḥum 'brown'; katom 'orange'; varod 'pink'; segol 'purple'; ḥaṣil 'eggplant'; teḵelet 'light blue'; ḥardal 'mustard'; and turqiz 'turquoise.' Detailed explanations on methodology and elicited data are provided in the following sections.
Preliminary observations revealed that NMA spoken by graduates of Tel Aviv University was influenced by Modern Hebrew in the following immediately perceptible ways:
1. The division of the blue spectrum into dark and light spaces by means of azraq 'blue' and samāwi 'sky-color' follows the Modern Hebrew distinction between kaḥol 'blue' and teḵelet 'light blue.'
2. The division of the violet spectrum into dark and light spaces by means of biṭinğāni, lit. eggplant color, 'purple, dark violet,' and lēlaki 'light violet' follows the Modern Hebrew distinction between ḥaṣil lit. eggplant, 'purple, dark violet' and sagol 'cold/light violet.'
3. There is an independent category for the color 'mustard.'
4. Modern Hebrew color names are frequently used.

4. Methodology

In this contribution, I show how and to what extent NMA BCTs and cognitive categories are affected by the Modern Hebrew BCT system. I tested NMA speakers who had spent at least five years at Tel Aviv University, in a Modern Hebrew linguistic environment that provided intensive daily exposure in spoken and written forms. I used two control groups, one consisting of TMA speakers and one of Modern Hebrew

speakers, both tested on the same linguistic stimuli as those used with the NMA informants. TMA and NMA were also tested for color cognition.

For the purpose of this investigation, NMA informants were selected from among graduate students from different faculties in the humanities and exact sciences, not including design, architecture, visual arts, and fashion, where specific training on chromatic categories conveyed in Modern Hebrew during the period of studies is particularly intense. Fourteen men and 14 women were tested for each of the three groups.

Preliminary linguistic observations were collected during spontaneous speech interactions, both between speakers and myself and among speakers of the same language, and from direct impromptu questions that I asked the informants (e.g., 'what color is this object?' or 'which entity or material is X color?'). I never disclosed my research interests in order not to influence the speakers, who might have wanted to demonstrate their competence in color terminology using modern terms derived from different varieties of Arabic or foreign languages and used by young people. Therefore, I stated that my questions were for the purpose of learning to speak the local traditional dialect. Doing so also helped to prevent intergenerational accommodation, that is, the phenomenon of elderly speakers using a more modern color lexicon with me, approximating what they hear from their grandchildren of my age. Linguistic data were experimentally tested, as indicated below. A series of visits to the families of former students and their friends in Mu̱talla̱t villages and towns between 2015 and 2019 allowed me to collect a large amount of lexical material and thus establish the set of BCTs and their reference entities and materials. In particular, the presence of natural objects, different types of soil, wood, flowers and fruits, animal coats and plumages, and traditional fabrics and embroidery motifs that comprise the linguistic ecosystem of the elderly speakers helped to reveal archaic uses of the chromatic lexemes and determine the boundaries of the desaturated BCTs.

Both linguistic and cognitive testing consisted of various experiments.

I used a preliminary naming task to test the center and boundaries of the BCTs in the three groups under observation. The stimulus kit is a booklet with 960 pages, each of which contains a single color chip. The stimuli are standardized Munsell colors, as used in the *World Color Survey*. The original kit contains 320 chips with 40 equally spaced hues, eight degrees of brightness, all with maximum saturation, and 10 achromatic chips. I added two degrees of saturation (intermediate and low) to the entire chart. After a preliminary test for color blindness, the naming task was performed individually by all informants, according to the protocol described by Majid and Levinson (2007), in natural morning light, with color chips submitted on matte paper support, one after another, in a fixed random order. In line with Berlin et al.'s suggestion (1976), consultants were asked in their native language, 'What color is this?' since the term 'color' is present in TMA, NMA (lōn), and Modern Hebrew (ṣeva). Consultants were requested to

produce the most concise codification of color names. Each response was analyzed for (1) category and (2) consistency across consultants. Special attention was devoted to the classification of non-prototypical modern hues and desaturated categories. Each informant was given four seconds to name each color chip.

The second linguistic experiment consisted of a director/matcher test. Each group of 14 consultants was divided into seven pairs and the partners each played the role of director and matcher once. Each pair of partners sat at a table, one partner next to the other, divided by a screen and able to hear each other's voices, but unable to see each other. Both received the same group of six chips, made up of colors similar in terms of saturation, brilliance, or hue, whose categorization and level of agreement among speakers were the target questions. The director received the chips set in a given array on the table in front of him, and was requested to instruct the matcher, who had the same chips in random order, to replicate the same array within two minutes. Each pair completed the same six games, three for each director/matcher combination, all under the same morning light conditions.

The third linguistic experiment consisted of a variation of the naming task, individually performed on all informants under the same light conditions to elicit BCTs' association with culturally salient objects/materials, which characterizes TMA and other Arabic traditional varieties. TMA informants tend to refer to light brown soil as aḥmar 'red,' based on its fertility, and dark brown soil as axḍar 'green,' as they assume it to be wet. The light brown color of a horse's coat, as seen as an abstract color square, is referred to as asfar 'yellow,' but once the stimulus appears as a horse, it becomes aḥmar 'red,' as the horse breed in question is defined by its redness. A set of ten ecological hues, based on animal coats and plumages, herbs and flowers, and soil nuances were submitted to each informant (1) as an abstract color chip, (2) as a chip representing a picture of the actual material, and (3) as a picture of the actual, entire object. Responses were analyzed for consistency across the three stimulus types.

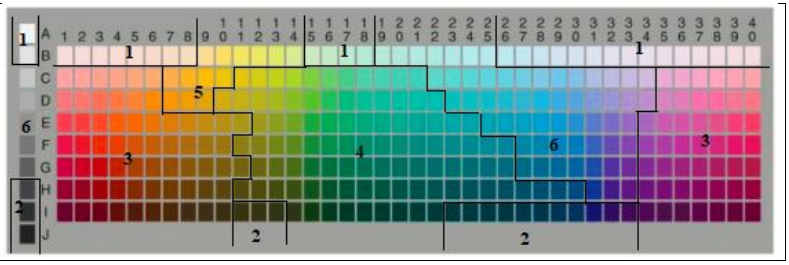
After the linguistic results were analyzed, highlighting the major aspects of divergence between TMA and NMA and the role of Modern Hebrew with respect to these aspects, a cognitive experiment was performed on the same TMA and NMA informants to check for deterministic effects of the linguistic changes on the cognitive structures. The objective perceptual discrimination test consisted of a modified version of the experiment designed by Winawer et al. (2007) and focused on detecting cognitive reflexes of different linguistic divisions of the three color dimensions (hue, saturation, brightness) in TMA and NMA. Like TMA, NMA distinguishes pink, purple, orange, and brown from red; grey, violet, and light blue from blue; and mustard from yellow. TMA and NMA informants were tested by means of a rapid color discrimination task using stimuli that included the respective borders. I expected that NMA speakers would discriminate more quickly between two

colors when they fell into different NMA linguistic categories (e.g., one pink, one red) than when they were from the same linguistic category (e.g., both pink or both red), while TMA would not show any category advantage. While Winawer et al. (2007) focused only on the chromatic dimension of hue, I extended the protocol to include stimuli with different degrees of saturation and brightness. For example, linguistic TMA data show that bright grey is called azraq 'blue' and bright brown is called aḥmar 'red,' while matte dark blue, grey, and brown are both called aswad 'black.' Many highly desaturated colors, whether red, green, or blue, are called aswad 'black,' while moderately desaturated colors are called axḍar 'green.' NMA is definitely hue-oriented and shows no such brightness- or saturation-based differences. In these cases, I expected that TMA speakers would discriminate more rapidly between two colors when they fell into different TMA linguistic categories (e.g., fully saturated red, highly desaturated red) than when they were from the same linguistic category (e.g., both highly desaturated green and red), while NMA would not show any category advantage. In total, the experiment consisted of fifty triads of color squares shown on the computer screen in full illumination mode. Informants were instructed to choose which one of two bottom squares matched the color of a top square. The maximal given time was five seconds. A qualitative analysis of the results is provided in the following section.

5. Results

The data show a neat convergence of NMA BCTs and cognitive categories (CCs) toward the Modern Hebrew model, in both average number and quality of basic chromatic categories. These findings are surprising, as they suggest that cognition is deeply affected by a second language learned and mastered only in adulthood with regard to the function of objective perceptual discrimination.

Figure 1, below, reports the combined results of the first two linguistic experiments (individual naming task and director/matcher communicative task) in TMA:

Fully Saturated	

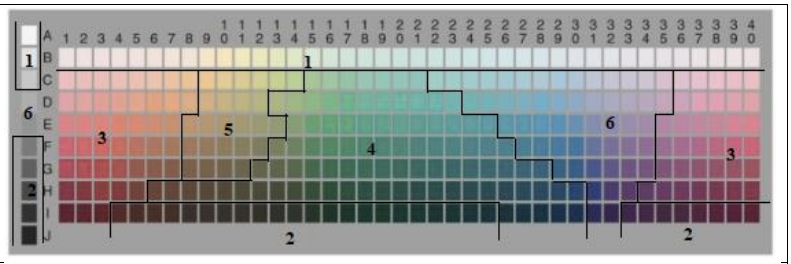
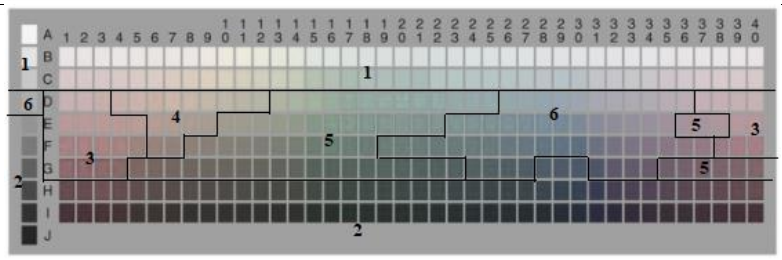
Semi-Desaturated	
Highly Desaturated	

Figure 1. TMA linguistic results of individual naming task and communicative task

Figure 2 reports the combined results of the first two linguistic experiments (individual naming task and director/matcher communicative task) in NMA:

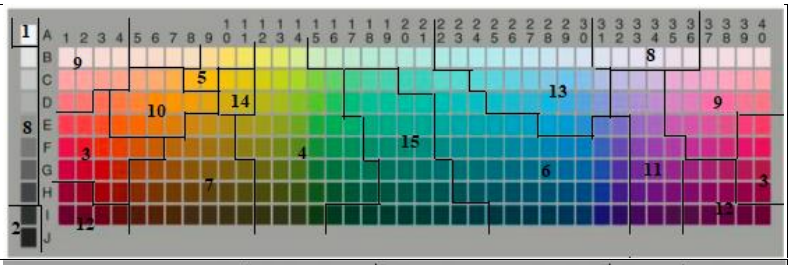
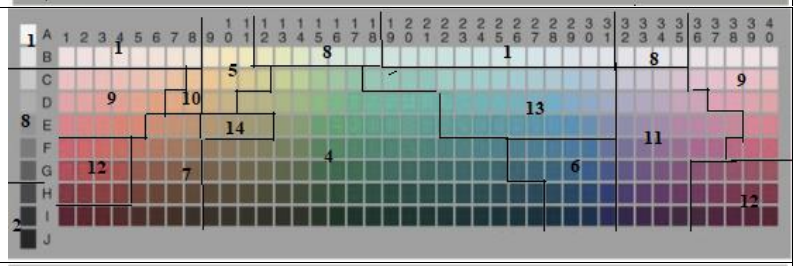
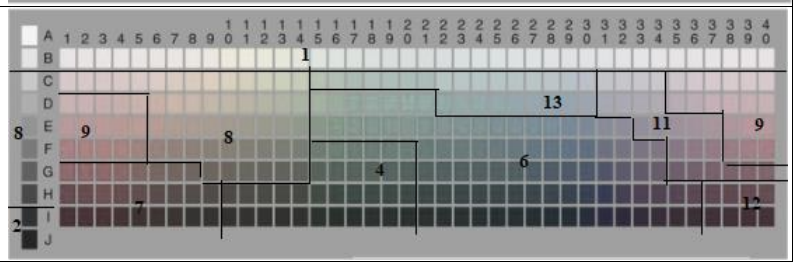
Fully Saturated	
Semi-Desaturated	
Highly Desaturated	

Figure 2. NMA linguistic results of individual naming task and communicative task

Figure 3 reports the combined results of the first two linguistic experiments (individual naming task and director/matcher communicative task) in Modern Hebrew:

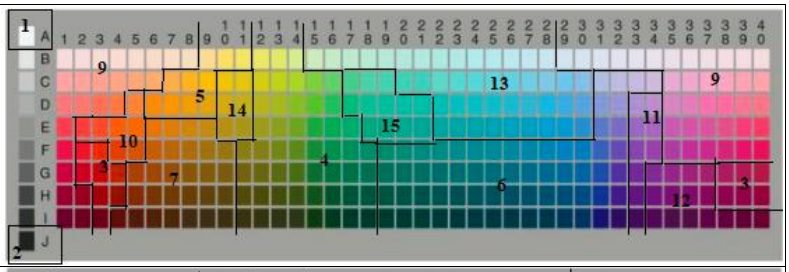
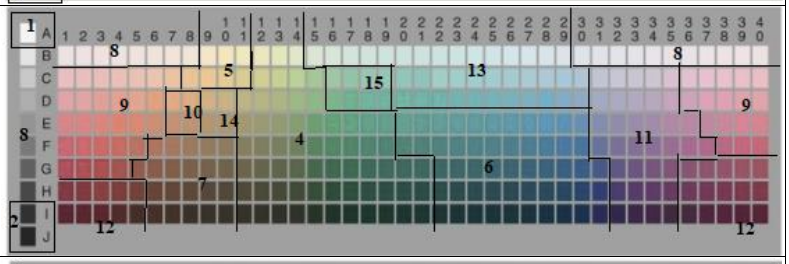
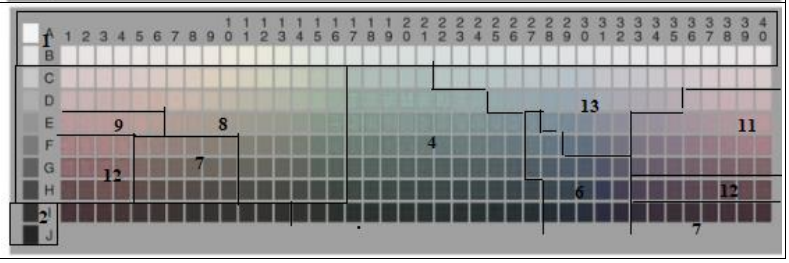
Fully Saturated	
Semi-Desaturated	
Highly Desaturated	

Figure 3. Modern Hebrew linguistic results of individual naming task and communicative task

Below, I provide a description and comments with respect to the chromatic categories observed in each group, regarding which I obtained the agreement of at least 85% of the answers for each variety. I indicate in brackets the coordinates of the focal color of each BCT according to the first of the three Munsell charts provided for each group.

TMA BCTs reflect Stage V in Berlin and Kay's typology, while both NMA and Modern Hebrew are beyond Stage VII, showing the same number of basic linguistic categories, with strikingly similar boundaries and, in many cases, close, yet not identical, foci.

There are six BCTs in TMA, as observed in other conservative nomadic and semi-nomadic dialectal varieties of the southern Levant: 1. abyaḍ 'white,' including a number of bright, light-colored chips (A); 2. aswad 'black,' but also 'dark' and 'dull,' including a number of matte, dark grey, blue, green, and brown spaces and most of the highly desaturated colors (J); 3. aḥmar 'red,' but also 'brown,' 'light brown,' 'pink,' 'orange,' 'intense yellow,' 'purple,' and even 'bright' and 'striking,' as it is used in a more restricted set of semi-desaturated and highly desaturated tints, while it is very frequently

used for fully saturated stimuli (G4); 4. axḍar ‘green,’ but also ‘dark’ and ‘semi-dull,’ as it covers many dark colors and most of the grey and dark shades of the semi-desaturated stimuli as well as ‘blue,’ as many TMA informants, especially in the communicative task, called bright, intense, blue chips axḍar, revealing the survival of a previous GRUE stage (G15); 5. aṣfar ‘yellow,’ which also covers bright-orange-golden nuances of brown and ecological light brown hues (B10); 6. azraq ‘blue,’ but also ‘shining,’ ‘shimmering’ and ‘iridescent,’ being the color of the plumage that covers the necks of doves, the shimmer of fish and snake scales, especially when in motion, and also ‘bright grey,’ ‘shining grey,’ and ‘silver’ (F31).

The situation of NMA and Modern Hebrew is different from that of TMA, especially because both modern languages have a large number of BCTs upon which speakers consistently agree, and their BCTs constitute neatly hue-oriented systems:

NMA: 1. abyaḍ ‘white’ (A); 2. aswad ‘black’ (J); 3. aḥmar ‘red’ (G3); 4. axẓar ‘green’ (E15); 5. aṣfar ‘yellow’ (C9); 6. azraq ‘blue’ (H31); 7. bunni ‘brown’ (I8); 8. ramādi ‘grey’ (F); 9. zahri ‘pink’ (C3); 10. burtuqāni ‘orange’ (E4); 11. lēlaki ‘violet’ (E34); 12. biṭinğāni ‘eggplant purple’ (I37); 13. samāwi ‘light blue’ (C28); 14. ḥardal ‘mustard’ (D11); 15. turqiz, ‘turquoise’ (G20).

Modern Hebrew: 1. lavan ‘white’ (A); 2. šaḥor ‘black’ (J); 3. adom ‘red’ (G2); 4. yaroq ‘green’ (E15); 5. ṣahov ‘yellow’ (C9); 6. kaḥol ‘blue’ (H31); 7. ḥum ‘brown’ (I8); 8. afor ‘grey’ (F); 9. varod ‘pink’ (C38); 10. katom, ‘orange’ (E4); 11. segol, ‘violet’ (F34); 12. ḥaṣil ‘eggplant purple’ (I36); 13. teḵelet ‘light blue’ (C27); 14. ḥardal ‘mustard’ (D11); 15. turqiz, ‘turquoise’ (D18)

The effect of Modern Hebrew BCTs on NMA informants was made evident by the fact that these speakers often resorted to Hebrew color names, especially in the communicative task, with a very high level of mutual agreement on each meaning. NMA informants often added further attributions, also in Hebrew, to the Hebrew BCTs, including referent entities and levels of brightness, e.g.: ṣahov limon ‘lemon-yellow,’ sagol kehe ‘dark violet,’ or adom bahir ‘light red.’ The use of Hebrew has the advantage of immediately recalling the Hebrew color system, where, differently from TMA, ‘light red’ and ‘pink’ belong to different categories, not only to the broad, desaturated TMA aḥmar ‘red.’

In the experiment, semi-desaturated and highly desaturated stimuli were treated in TMA very similarly to the way in which the fully saturated series was treated, reaffirming the broad value of TMA BCTs, while both NMA and Modern Hebrew show a different partition of the areas covered by each BCT between the full and the semi-saturated charts. In the highly desaturated TMA chart, the six BCTs appear in similar areas, as in the semi-desaturated and fully saturated charts. This is not the case of NMA, where compared to the situation of the fully saturated stimuli, ‘red’ and ‘turquoise’ do not appear in the semi-desaturated chart, the blue area is restricted, and ‘white,’ ‘green,’ and ‘violet’ extend over wider areas. In the highly desaturated stimuli,

'yellow' disappears from NMA BCTs. The same trends present in NMA are observed in Modern Hebrew responses over different degrees of saturation.
Interestingly, in the series of fully saturated stimuli, NMA consultants produced similar responses to the Modern Hebrew data, especially with regard to the foci of the categories, while the boundaries were interpreted somewhat differently, especially in the more basic colors (red, green, yellow, blue), testifying to the effects of the substratum of native categories of their mother tongue (TMA).
The third linguistic experiment, performed to elicit BCTs' association with culturally salient objects/materials, confirmed a series of preliminary observations on TMA differential perception of chromatic categories across entities and textures. Among TMA informants, indeed, the same chromatic value seen as an abstract color chip, as a picture of an actual material (e.g., a horse's coat, fish scales), and as a picture of an entire object, produced divergent color terms in a very consistent manner across all TMA informants, revealing effects of cultural constraints and traditional symbolic structures expressed through desaturated and brightness-oriented categories. The same natural dark brown was submitted isolated as a monochrome chip, as a close-up picture of a clod of soil, and in a picture of the surface of a field with some grass and pebbles. The first stimulus produced the answer aswad 'black/dark/ dull,' the close-up of the soil texture elicited the response aḥmar 'colored/ brown,' and the picture of the field's surface prompted the answer axḍar 'fertile dark (wet) soil,' based on cultural inference and symbolism. NMA and Modern Hebrew informants produced the same hue-oriented responses across stimulus types, without traces of symbolic influences, cultural constructs, or desaturated categories.
The cognitive tests showed isomorphism between linguistic and cognitive structures in both TMA and NMA. BCTs shape cognition. In particular, the isomorphism between NMA recently acquired BCTs, based on the influence of Modern Hebrew, and NMA CCs demonstrates that linguistic categories acquired by means of intensive training in adulthood can significantly affect cognition, at least with regard to the function of objective perceptual discrimination. NMA distinguishes pink, purple, orange, and brown from red; grey, violet, and light blue from blue; and mustard from yellow, both in language and in cognition, as color discrimination is much more rapid when the two responses belong to two different categories than when both belong to the same one, while TMA shows no such category advantage (863 NMA vs. 1.376 TMA msec on average). In contrast, TMA speakers discriminated much more quickly between two colors when they fell into different TMA linguistic categories than when they were from the same TMA linguistic category, while NMA speakers showed no category advantage for saturation and brightness (992 TMA vs. 1.235 NMA msec on average). In general, it should be noted that NMA speakers discriminated between colors more

quickly according to their own categories than TMA speakers did, probably due to age and vision quality.

6. Conclusion

BCTs found in both TMA and NMA have slightly different foci and markedly different boundaries. TMA BCTs and CCs reflect desaturated and brightness categories, while NMA BCTs and CCs are hue-based and closer to those of Modern Hebrew. NMA informants show how the BCTs of Modern Hebrew, a second language they have acquired through intensive training in adulthood, shapes their linguistic and cognitive color categories in a permanent manner. It should be emphasized that one third of the NMA consultants involved in this research completed their studies at Tel Aviv University at least ten years ago. The continued maintenance of the structures acquired from Modern Hebrew following the period of intensive exposure to the language may be attributable to the modern hue-oriented color system that dominates visual arts and market products in fashion, design, and esthetics. Ecological, desaturated, and brightness-oriented chromatic categories in use among TMA speakers are insufficient for describing the plethora of artificial industrial pigments and hues that dominate contemporary digital technology and dying techniques and are used by NMA speakers. NMA color terminology increases via both associations with prototypical referents and the addition of degrees of brightness (ṣahov limon 'lemon-yellow'> limon 'lemon,' yaroq avoqado> avoqado, adom bahir 'light red,' yaroq kehe 'dark green,' ḥaṣil mat, 'matte purple,' yaroq mavriq 'glossy green') borrowed from Modern Hebrew. To summarize, NMA shows a transitional BCT system, gradually shifting from desaturated to hue-oriented categories under the influence of Modern Hebrew. The shift occurs first in the foci of the color categories and at later stages in the boundaries. Consistently with the results presented by Winawer et al. (2007) concerning the influence of linguistic categories on color perception in Russian, NMA data support the hypothesis that linguistic categories influence color judgments even at the time of the perceptual decision, and not only when memory is involved, as previous cross-linguistic comparisons have demonstrated (Roberson & Davidoff 2000; Roberson et al. 2000).

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