The Grapheme-Personification Synaesthesia at Indian Glance

K. Vijayasree, T. Rajasekhar

Abstract—The present investigation of the study is to examine the grapheme-personifications in Indian context The study deals the linguistic characteristics of letters and numbers with regard to gender, personality, appearance and social relations with the subjects who are Synaesthetes (Experimental group) and non-Synaesthetes (control group). The subjects are considered Synaesthetes who perceive together with different modalities. The subjects consist of 6. The means, SDs, correlation, Z tests are employed for the investigation of the study to find- out relations/association of linguistic characteristics of letters and numbers with regard to gender, personality, appearance and social relations. The results indicate the significance relations influence partly of the linguistic characteristics of letters and numbers with regard to gender, personality, appearance and social relations. There is no phenomenological consistency in linguistic characteristics of letters and numbers with regard to gender, personality, appearance and social relations between synaesthetes and non-synaesthetes.

Keywords—grapheme-personification,synaesthesia, synaesthetes, linguistic characteristics, gender, personality, appearance and social relations.Research area- Synaesthesia area in cognitive psychology.

I. INTRODUCTION

Synaesthesia means perceive together with different modalities. It has a range of different sensory perceptual and cognitive experiences. Even within the same type, there are vast individual differences in the way that stimuli induce synaesthesia and in the form of subjective synaesthesia experiences. In all cases, the synaesthesia is characterized by the pairing and multiple thoughts combination of triggering stimulus or inducer with a cognitive modalities that would usually be experienced in different manner in terms of colour, sound, taste, smell letters, numbers etc., A synaesthesia might be associated colours with letters and digits is called coloursynaesthesia (Simmer,Glover and Mowat, 2006).In the majority of cases, the synaesthesia inducers are language units. However a variety of neural network with different combination and concurrent involves in such personalities.

Most of the researchers have been concentrating on the grapheme-coloursynaesthesia in cognitive psychology area. Even though it was scientifically reported by Sir Fransis Galton in 1883, but still the field has been ignored by the scientists to investigate the variety of types in synaesthesia. There is no an iota of research in the area of synaesthesia in all variety of dimensions in Indian context.

K.Vijayasree, Assistant Professor cum Scientist,Cognitive Science Centre, LakiReddy Bali Reddy College Of Engineering,Mylavaram-521230. Krishna Dt. A.P.India**.**

T.Rajasekhar, Associate Professor Cum Psychologist,Head Of Cognitive Science Centre LakiReddy Bali Reddy College Of Engineering, Mylavaram-521230. Krishna Dt. A.P.India

In addition to colour and spatial patterns, attributed to graphemes some may report personifications. Such people reveals that A is a wise male person, and B is active alert and so on which should different perceptual thoughts individual to individual. The literature point of view, the little attention has been paid by Scientists in the growing synaesthesia literature, also sequence in personality synaesthesia or Ordinal Linguistic Personification (OLP) or personification of numbers and letters.

In Indian glance, the synaesthesia research cannot take place with Indian subjects by Indian scientists. Based on our strong intention, the present investigation of the study is focused on grapheme- personification with Indian subjects to pursue.

II. REVIEW OF LITERATURE

Ordinal-linguistic personification is a form of synaesthesia in which ordered sequences, such as ordinal numbers, days, months and letters are associated with personalities (Simner& Hubbard 2006). For synaesthete MT subject revealed that "I [is] a bit of a worrier at times, although easy-going; J [is] male; appearing jocular, but with strength of character; K [is] female; quiet, responsible, (Cytowic 2002). In other study, AP subject has said that February is "an introverted female", while F is a "[male] dodgy geezer". Similarly, May is reported to be "soft-spoken" and "girly" while M is an "old lady [who] natter[s] a lot", and while August is "a boy among girls", A is a female "mother type" (Simner&Holenstein 2007; Simner& Hubbard 2006).

Personifications tend to co-occur with grapheme-color synaesthesia and share many of the characteristics that are definitional of synaesthesia, such as being consistent over considerable time intervals and generating concurrents automatically (Simner&Holenstein 2007).

Very little is known about the neural basis of this form of syneasthesia, but one possibility is that OLP arises from cross-talk in the region of the inferior parietal lobe between regions of the angular gyrus involved with representing ordinal sequences, and adjacent regions involved with the identification of personality and theory of mind near the supramarginalgyrus(Simner& Hubbard 2006). Rucker (1988) concluded that the synaesthetes personified the natural numbers by assigning gender to them; the odd numbers were male and the even female.

Although synaesthesia is traditionally defined as an experience in one sensory modalityelicited when a stimulus is presented in another modality, it soon became clear that some of the most common types of synaesthesia are actually elicited by ordinal sequences such as letters, numbers, or time units (e.g., Sagiv, 2005).

Indeed, chromatic graphemicsynaesthesia (coloured letters and numbers) has been the focus of amultitude of recent studies. The perceptual reality of synaestheticcolours was demonstrated (e.g., Palmeri, Blake, Marois, Flanery, &Whetsell, 2002; Ramachandran& Hubbard, 2001; Smilek, Dixon, Cudahy, &Merikle, 2001) and sceptics could no longer dismiss synaesthetes' reports as confabulatory in origin. However, the emphasis on the perceptual reality of synaesthete experience may have detracted attention from related phenomena in which the concurrent experience extends beyond purely sensory imagery and involves, for example, spatial, affective, or even social components. For example, letters, numbers, and time units may be associated not only with colours but also with locations in space (e.g., Sagiv, Simner, Collins, Butterworth, & Ward, 2006; Jonas, Taylor, Hutton, Weiss, &Ward, 2011). Individuals with number forms can point to a precise location in space associated with each number, but not all of them visualize it. Like synaestheticcolours, the spatial patterns associated with ordinal sequences seem to be automatically and reliably evoked in a consistentmanner (e.g., Jarick, Dixon,Maxwell, Nicholls, &Smilek, 2009; Smilek, Callejas, Dixon, &Merikle, 2007).

However, in addition to colours and spatial patterns associated with graphemes, some synaesthetes also report personifying them. A grapheme may be described as having gender (e.g., seven is a male, eight is a female) or in some cases – a rather elaborate biography including personality traits such as 'old-fashioned'; 'generous loyal friend'; 'unimaginative, interested in technical subjects, reliable'; and 'physically active, inclined to rush about'.

In another study, Simner and Hubbard (2006) showed that graphemes' colour and gender attributes interact: the synaestheticcolourStroop interference occurs only when incongruent colours correspond to letters with a matching gender, indicating that different graphemes may be associated with a single gender node. They also showed that naming time for the genders associated with graphemes are slower when graphemes are coloured with an incongruent colour associated with a grapheme of a different gender (but unaffected when the colour is suggestive of a grapheme with the same gender). This indicates that colour may be implicitly associated with gender and further strengthens the conclusion that grapheme personification is just as real as grapheme colours.

Ramachandran and Hubbard (2001)reveals that Since regions involved in the identification of letters and numbers lie adjacent to a region involved in color-processing (V4), the additional experience of seeing colors when looking at graphemes might be due to "cross-activation" of V4.

Functional neuro-imaging studies using positron emission tomography (PET) and functional magnetic resonance imaging (fMRI) have demonstrated significant differences between the brains of synaesthetes and non-synaesthetes. The first such study used PET to demonstrate that some regions of the visual cortex (but not V4) were more active when auditory word → color synaesthetes listened to words compared to tones (Paulesu et al. 1995). More recent studies using fMRI have demonstrated that V4 is more active in both word → color and grapheme → color synaesthetes (Nunn et al. 2002; Hubbard and Ramachandran. 2005a; Sperling et al. 2006).

III. HYPOTHESES

Based on the above mentioned views, **the hypotheses** are formulated as follows.

1. There is significant relations/association of linguistic characteristics of letters with regard to gender, personality, appearance, and social relations between the Synaesthetes.
2. There is significant relations/association of linguistic characteristics of numbers with regard to gender, personality, appearance, and social relations between the Synaesthetes.
3. There is a phenomenological consistency scores of letters and numbers with regard to gender, personality, appearance and social relations in Synaesthetes than non-Synaesthetes.

The present investigation of the study is to concentrate on 'Grapheme-Personificationsynaesthesia' in Indian context. The authors are more exited while interacting with the synaesthesia people. It is amazing that there are variety of hidden cognitive and sensory perceptions which are observed by the authors.

In addition to that, subjects' identification is also typical task. In this connection, there is no any statistical survey in order to identify such Synaesthesia people in India. There is no thought of identification of subjects by the psychologists and other scientists who are working in their own fields. As per the source of the statistical survey of synaesthesia people, it said that 1:2000 in Britain and American Countries. However, there is no any type of work for subjects' identification in India.

IV. SUBJECTS

In the investigation of the study, the 6 subjects are considered and examined in several cognitive and behavioural perspectives. The subjects identification is primary task. Through awareness programs, interactive sessions in school, colleges, professional arts and painting schools, Software Maya & Graphics training centres, hyperactive and autism children and blind children schools etc. and pamphlets, news papers etc., subjects were identified for the investigation study. The authors visited different parts of Andhrapradesh, Tamilanadu and Karnataka for subjects' identification. Besides, the synaesthesia tests were used for subjects' identification and followed by an interview method and questionnaire method.

V. INSTRUMENTS USED:

The subjects were given screening test. The "Synaesthesia Questionnaire" is designed based on synaesthesia tests available in the internet and Synaesthesia questionnaires were collected. The consistency of the test-retest of reliability is 0.79. However the questionnaires were given to the subjects and conformed the subjects by consistency scores of pre and post tests.

*Procedure:*There are different steps mentioned below.

1. For subjects' identification, have visited schools, colleges, and centre and conducted awareness programs, interactive sessions.
2. Conducted pre and post tests for subjects identification through questionnaires.
3. The questionnaires were filled by the subjects in terms of type of synaesthesia, cognitive and behavioural perspectives. (Questionnaire relating to grapheme-colourSynaesthesia, developed by Dr. David M. Eagleman and personification of letters and numbers, developed by Dr. Noam Sagiv, Centre for Cognition and Neuro-imaging, Brunel University.)
4. The subjective information of subjects and tests scores are considered as Synaesthetes for investigation of the study.
5. However, only the grapheme-personification Synaesthetes are found in our hectic schedule of survey, but not found the other types of synaesthetes.

VI. RESULTS

The means and SDs scores of linguistic characteristics of letters with regard to gender, personality, appearance and social relations of Synaesthetes are mentioned in table.

TABLE.I Presents the Number, Mean SDs of linguistic characteristics of letters with regard to gender, personality, appearance and social relations, reported by synaesthetes.

S.NO	Gender	Personality	Appearance	Social Relations
N	6	6	6	6
Mean	33.59	18.61	24.45	16.89
SDs	9.68	13.28	9.01	11.70

The Synaesthetes reported that they have previously, before being asked, considered that letters had gender (Mean.33.59 and SD.9.68), personality (Mean.18.61 and SD.13.28), and appearance (Mean.24.45 and SD.9.01), and social relations (Mean.16.89 and SD.11.70) respectively. Based on the mean scores, gender characteristic followed by appearance, personality and social relations are considered for inspection. In other perspective, the gender is consciously considered to familiarize the variety of objects in a given environment based on his cognitive tasks. In the case of social relations, they are not having more awareness in most of the perceptual dimension relating to familiarizing the objects which does not have more complexity. Regarding personality and appearance are considered moderately have awareness in all familiarizing perspectives with the association of letters.

However, the Synaesthetes have more clarity relating to awareness in adding the variety of characteristics of letters with gender.

Besides, the reliability test and Z test are employed to identify the significance relationship/association of the different characteristics – gender, personality, appearance and social relations with the letters, shown in table.2

TABLE.II shows that means, SDs, correlation and Z scores of linguistic characteristics of letters with regard to gender(G), personality(P), appearance(A) and social relations(S).

NO	G - P	G - A	G - S	P- A	P - S	A- S
Mean	33.59-18.61	33.59-24.45	33.59-16.89	18.61-24.45	18.61-16.89	24.45-16.89
SD	9.68-13.28	9.68-9.01	9.68-11.70	13.28-9.01	13.28-11.70	9.01-11.70
r	0.15	0.87*	0.38	0.66	0.22	0.48
Z	1.44	1.56	1.76	0.16	0.08	0.80

*Significant at 0.05 level

Based on the analysis, there is no significance relations/association between the characteristics of gender, personality, appearance and social relations attributed to letters. But there is consistency nature individually. It means that Synaesthetes attributed the characteristics with letters because of their cognitive network development and social cognition and their needs, interests, attitudes, intensions, environmental conditions attracted etc.,

Based on the results obtained the 1st hypothesis which is assumed that "There is significant relations/ association of linguistic characteristics of letters with regard to gender, personality, appearance, and social relations between the Synaesthesia" is partly accepted as warranted by the results.

VII.DISCUSSIONS

Based on the results, it can be said that Synaesthetes are differed in their perceptions in terms of self-reported phenomenology and quantitative measures of the depth of their description in their mental cues and consistency overtime. However, Synaesthetes are significantly more consistent individually even though tested over period of time 3 to 6 months. The consistency scores in percentage level of Synaesthetes range of gender, personality, appearance and social relations are 81.95 to 98.70, 65.79 to 78.62, 82.57 to 89.83 and 61.46 to 76.32 respectively.

The personification is influenced by the shape of letter in different perspectives. Regarding gender, our subjects attributed A for male, female: B for boy and girl; C for female: D for male and female: F for female: G for female: H for female: P for male: Q for female and R for female in their personification. With regard to personality, the subjects reported that A for attitude, good and happiness: C for fun: D for happiness: E for bad: F for happiness: H for gloomy in their personification. Relating to appearance, A for frock in baby: B for fat girl: C for old student and old person: D for old: E for three boys on one stick and ugly: H for strong and straight lines. With regard to social relations, the subjects attributed that A for king, and B's sister: B for A's brother: C for D's wife: D for grand father, brother and husband: E for brother: F for brother: G for aunty, H's mother: H for A's son and G's son: M for brother: N for brother: O for sister: M for brother: N for brother: O for sister: P for messenger and brother: R for Queen: T for brother:

U for brother: Y for husband and Z for wife.

In this perspective the attributions are different in terms of gender, personality, appearance and social relations subject wise and seldom similar in their personification with letters.

Hence the lower level of consistency for Synaesthetes shown here which indicate, as a data-driven fact, the consistency can be lower in this type of complex, high-order cognitively mediated.

Based on the results obtained the 1st hypothesis which is assumed that "There is significant relations/ association of linguistic characteristics of letters with regard to gender, personality, appearance, and social relations between the Synaesthesia" is partly accepted as warranted by the results.

Results:

The means and SDs scores of linguistic characteristics of numbers with regard to gender, personality, appearance and social relations of Synaesthetes are mentioned in table.3.

TABLE.III Presents the Number, Mean SDs of linguistic characteristics of Numbers with regard to gender, personality, appearance and social relations, reported by Synaesthetes.

S.NO	Gender	Personality	Appearance	Social Relations
N	6	6	6	6
Mean	38.98	23.45	27.19	26.89
SDs	5.12	11.64	3.84	6.12

Based on the data evaluated, the Synaesthetes stated that they genuinely before and after conducting the tests, and considered that numbers have also gender (Mean.38.98 and SD.5.12), personality (Mean.23.45 and SD.11.64), and appearance (Mean.27.19 and SD. 3.84), and social relations (Mean.26.89 and SD.6.12) respectively. It can be said that most probably, the significance association with linguistic characteristics of numbers and attributed with numbers, is gender followed by appearance, social relations and personality. It means that the gender is consciously consider to familiarize the variety of objects in designing the meaningful ways through their modalities. In the case of personality, they does not have awareness in familiarizing the tasks linked which could not be typical. Regarding appearance and social relations, they have often awareness to identify the different perceptual components.

However, the Synaesthetes have consistently the awareness in adding the linguistic characteristics of numbers with the gender based on their cognitive perceptual process.

In addition to that the correlation analysis is employed for the investigation of the study relating to attribution of different characteristics with number, shown in table.4.

TABLE.IV Shows that means, SDs, correlation and Z scores of linguistic characteristics of Numbers with regard to gender(G), personality(P), appearance(A) and social relations(S).

NO	G - P	G - A	G - S	P- A	P - S	A - S
Mean	38.98-23.45	38.98-27.19	38.98-27.19	23.45-27.19	23.45-26.89	27.19-26.89
SD	5.12 -11.64	5.12-3.84	5.12-6.12	11.64-3.84	11.64-6.12	3.84-6.12
r	-0.61	-0.48	-0.09	0.32	-0.06	-0.43
Z	2.88	2.72	2.74	0.24	0.23	0.08

But it reveals that there is no significance relation in such dimension. The consistency might be expected individually while attributing the characteristics with numbers.

The consistency scores in percentage level of range of numbers with regard to gender, personality, appearance and social relations are 79.28 to 98.73, 69.13 to 82.16, 76.98 to 87.04 and 69.64 to74.89 respectively.

Based on the results obtained the 2nd hypothesis which is assumed that "There is significant relations/ association of linguistic characteristics of numbers with regard to gender, personality, appearance, and social relations between the Synaesthesia" is partly accepted as warranted by the results.

Discussions:

Personification is also influenced by the shape of numbers in different perspectives. Regarding gender, the subjects attributed that 1 for male: 2 for female: 3 for male and female: 4 for male: 5 for male and female: 16 for male and female: 56 for 5 for male and 6 for female: 67 for male and female and 5000 for male and 6000 for female. The subjects reported that relating to personality, 1 for happiness and helping person: 2 for higher authority: 3 for moody, dull soft, fighting: 4 for good boy and fear: 5 for powerful. Alienation, narrow mind: 6 for shy and sad: 7 for harsh husband: 8 for perfect, bad friend give ideas for trouble to 6: 9 for positive idea and cheating: 18 for help for 9: 20 for two higher authorities on the top of the zero. With regard to appearance, 1 for thin, weak, handsome and heavy muscle: 2 for body builder: 3 for fat boy: 4 for husband, rough, risks and fight: 5 for fit, strong and flat: 6 for smart and beautiful: 7 for handsome and stylish: 8 for fat and black dress lawyer: 9 for beautiful: 10 for one boy stand in front of big stone and fat boys. Regarding social relations, 1 for king, husband, hero and friend: 2 for wife of 1, and aunty: 3 for daughter of 1and 2, and brother: 4 for father and lovers: 5 for daughter of 4: 6 for lover of 7 and wife of 7. 7 for wife and husband: 8 for 7'ssister: 9 for brother: 18 for son-in law and aunties: 67 for lovers: 88 for twins and 6000 for 6 is mother and 0000 are children.

Based on the results, the lexical frequency of numbers influence the gender attributed the different characteristics namely to gender, personality, appearance, and social relations. Synaesthetes tended to associate more agreeable somewhat high frequency numbers. They have more complexity phenomena in cognitive dimensions. In specifying familiarity, they have considered more connective channels by their perceptual cues in cognitive process. The fact that ordinal linguistic personification most of the perceptual dimensions, the linguistic characteristics of letters are associated with gender followed by personality, appearance, and social relations than linguistic characteristics of numbers which are associated with gender. However, it is contradictory whether it is cognitive perceptual process or sensory perceptual process in familiarizing the various characteristics of objects attributed with letters and numbers. Even though characteristics should be different, easily be understood by the Synaesthetes and acknowledge in typical situation also. In the Indian society, people are every conscious about gender differences that is why, consistency can be expected easily to attribute with numbers.

Based on the results obtained the 2nd hypothesis which is assumed that "There is significant relations/ association of linguistic characteristics of numbers with regard to gender, personality, appearance, and social relations between the Synaesthesia" is partly accepted as warranted by the results.

Results:

Based on the data, the synaesthetes are differed to non-Synaesthetes in three dimensions: 1. They are different in the phenomenology of their reported experience. Synaesthetes reported that conscious access to acknowledge about gender, personality, appearance and social relationship in accordance with their modalities, while non-synaesthetes do not. Non-synaesthetes does not have such multi cognitive or sensory cues to familiarize the objects. Their cognitive modalities and social cognition and their process should be different. 2. Synaesthetes also reported that details of the association and connectivity of cues between gender, personality, appearance and social relations. 3. Synaesthetes have more consistency in their report relating to these linguistic characteristics of letters and numbers with regard to gender, personality, appearance and social relations (mentioned in table.5 compared with non-synaesthetes).

TABLE.V shows that the consistency scores in % of letters and numbers with regard to gender, personality, appearance and social relations between synaesthetes and non-synaesthetes.

Sl.No	Synaesthetes (Consistency Scores in %)	Non-Synaesthetes (Consistency Scores in %)	Synaesthetes (Consistency Scores in %)	Non-Synaesthetes (Consistency Scores in %)
Variable	Letters		Numbers	
Gender	98.70	34.70	98.73	38.73
Personality	78.62	16.37	82.16	21.32
Appearance	89.83	22.82	87.04	19.17
Social Relations	76.34	24.13	74.89	20.39

Even when non-Synaesthetes controls more tested after only 3 weeks, they were not shown any consistency while attributing the linguistic characteristics with numbers and letters.

Based on the results obtained the 3rd hypothesis which is assumed that "There is a phenomenological consistency scores of letters and numbers with regard to gender, personality, appearance and social relations in synaesthetes than non synaesthetes", is accepted as warranted by the results.

VIII. DISCUSSIONS

Based on the results obtained, the Synaesthetes have such cognition modules in a different way to acknowledge easily by the association of numbers and letters which we cannot expect such different modalities to endorse in non-synaesthetes. Synaesthetes have such cognitive modules in multi-dimensional aspects to endorse. However, whether it is advantage or disadvantage to synaesthetes, it is contradictory question.

Based on the results obtained the 3rd hypothesis which is assumed that "There is a phenomenological consistency scores of letters and numbers with regard to gender,

personality, appearance and social relations in synaesthetes than non synaesthetes", is accepted as warranted by the results.

IX. CONCLUSIONS

1. Synaesthetes have significance association of attributing the linguistic characteristics – gender, personality, appearance and social relationships with letters and numbers.
2. The gender has good association with letters and numbers while attributing.
3. The significance association of linguistic characteristics of letters has less with regard to social relationships and less associates with personality with linguistic characteristics of numbers.
4. The synaesthetes have consistency in different modalities in associating of linguistic characteristics of numbers and letters with regard to gender, personality, appearance and social relationships compared with non-synaesthetes.

Implications:

1. The synaesthetes have different modalities to familiarize the objects with the association of linguistic characteristics of numbers and letters. This category is different, called "grapheme-personificationsynaesthesia". There are different synaesthesia people, who have different modalities with different associations. If we examine such dimensions in cognitive perspectives, the variety of facts will come-out which should be proved with empirical evidences, whether synaesthesia is cognitive perception or sensory perception or both. However, the synaesthesia area is ignored by the psychologists and other scientist in Indian context.
2. Based on my survey experience for subjects-identification, I found that most of the people are having "grapheme personifications" in different areas where I have concentrated in India. I did not find any different Synaesthesia people. I was suspected few cases are grapheme- coloursynaesthetes, but not. In this regard, national Statistical Survey is essential to find-out the different types of synaesthetes. Till now, there is no any scientific study on Synaesthesia in Indian context. we assumes that my work has to contribute in this Synaesthesiaarea in Indian context. I have strong intension to expand my research focus in this area and describe the fact in this area.

REFERENCES

1. Amin, Maina, OlufemiOlu-Lafe, Loes E. Claessen, Monika Sobczak-Edmans, Jamie Ward, Adrian L. Williams, and Noam Sagiv. (2011).Understanding grapheme personification: A social synaesthesia?, *Journal of Neuropsychology*; 5: 255-282.
2. Cytowic, R. E. (2002), *Synaesthesia: A Union of the Senses, 2nd ed*, Cambridge, MA: MIT Press
3. Galton F (1880). "Visualized Numerals". *Nature*21 (543): 494–495.
4. Galton F. (1883). *Inquiries into Human Faculty and Its Development*. Macmillan. Retrieved 2008-06-17.
5. Hubbard EM, Arman AC, Ramachandran VS, Boynton GM (2005),Individual differences among grapheme-color synesthetes: Brain behavior correlations. Neuron 45:975–985.
6. Jonas, C. N., Taylor, A. J. G., Hutton, S.,Weiss, P. H.,&Ward, J. (2011). Visuo-spatial representations of the alphabet in synaesthetes and non-synaesthetes. *Journal of Neuropsychology*, *5*, 302–322.
7. Jarick, M., Dixon, M.J., Maxwell, E.C., Nicholls, M.E.R. and Smilek, D. The ups and downs (and lefts and rights) of synaesthetic number forms: Validation from spatial cueing and SNARC-type tasks. Cortex, (2009),Volume: 45, 10, 1190-1199.
8. Nunn Ja, Bregorylj, Grammer M, Williams Scr, ParslowDm, Morgan Mj, (2002), Functional magnetic resonance imaging of synesthesia: activation of ,4/8 by spoken words. Nat Neuroscience,5:371–375.
9. Palmeri, Thomas J., Randolph Blake, René Marois, Marci A. Flanery, and William Whetsell, Jr, (2002) "The perceptual reality of synesthetic colors." *Proceedings of the National Academy of Science.* 99,19 ,4127-4131.
10. Paulesu, E., J. Harrison, S. Baron-Cohen, J.D.G. Watson, L. Goldstein, J. Heather, R.S.J. Frackowiak, and C.D. Frith. (1995). The physiology of coloured hearing: A PET activation study of colour-word synaesthesia. Brain; 118: 661-676.
11. Ramachandran, V.S., Hubbard, E.M. "Synaesthesia – A window into perception, thought and language", (2001) *Journal of Consciousness Studies,* 8.12 , 3-34.
12. Rucker, R. (1995), *Infinity and the Mind*, Princeton University Press,
13. Sagiv, N.; Amin, M.; Olu-Lafe, O.; Ward, J. (2005), "Beyond Colour: Further Varieties of Synaesthetic Experience", *14th European Society for Cognitive Psychology meeting, Aug 31 - Sep 3, Leiden, The Netherlands*
14. Sagiv, N., Simner, J., Collins, J., Butterworth, B., & Ward, J. (2006). What is the relationship between synaesthesia and visuo-spatial number forms? *Cognition,* 101, 114-128.
15. Simner J, Glover I, Mowata (2006) Linguistic mechanisms of grapheme- coloursynaesthesia. Cortex, 42:281–289.
16. Simner, J.; Hubbard, E. M. (2006), "Variants of synaesthesia interact in cognitive tasks: Evidence for implicit associations and late connectivity in cross-talk theories", *Neuroscience*143 (3): 805–814,
17. Simner J, Holenstein E (2007). "Ordinal linguistic personification as a variant of synesthesia". *Journal of Cognitive Neuroscience*19 (4): 694–703.
18. Simner, Julia, Louise Glover, and Alice Mowat. (2006). "Linguistic determinants of word colouring in grapheme-coloursynaesthesia." Cortex; 42: 281-289
19. Smilek, D., Callejas, A., Dixon, M. J., &Merikle, P. M. (2007). Ovals of time: Time-space associations in synaesthesia. *Conscious.Cogn,* 16, 507-519.
20. Sperling, Julia M., David Prvulovic, David E.J. Linden, Wolf Singer and AglajaStirn. (2006). Neuronal correlatates of colour-graphemicsynaesthesia: an fMRI study., Cortex; 42: 295-3.