Visualizing Words

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ABSTRACT
So far the five senses have been believed to be discrete. Each human faculty performs its own function. Devices have been invented to express and record each of these senses individually, for example: a microphone for voice, speakers for sound, camera/video-camera to capture and view images etc. In midst of this, a proposition that melds two senses and poses questions like “can colors be felt?”, “can smell be tasted?” or “can sound be seen?” triggers intriguing ideas. This paper presents a concept for visualizing words in the English language. The visualization is brought about by breaking a word into syllables that construct it and associating colors to each of the syllables. The colors are determined from survey responses. The final visualization incorporates these elements and proffers an artistic representation of words.

General Terms
Design, Human Factors

Keywords
Art, speech visualization, word visualization, synesthesia, phonesthesia, sound-image relationships, design, syllables.

1. INTRODUCTION
Successful and impressive attempts have been made in visualizing or “seeing” sound. By recording tone, pitch, duration, modulation etc., sound waves can be translated into visually significant patterns. This technology is used in audio equalizers and can be seen widely practiced in the audio and music industry. More and more attempts are being made today to visualize audio that can lend benefits towards audio and speech technology or in artistic expressions of speech or language. The word visualizations presented in this paper are based on previous work in speech visualizations which is discussed later in this paper.

The objective of this visualization is to offer an elementary design concept to envision words or “see” language/speech and is, at this stage, artistic and non-utilitarian. However, the paper concludes with suggestions on the probable uses of the word visualizations presented here.

To elaborate on the purpose of this paper, it is important to state clearly the similar and differing properties of speech, language and sound and then bring to perspective where word visualizations are situated amongst them. The following are the definitions of each of these terms.[1]

Speech (noun) is the (a) communication or expression of thoughts in spoken word, (b) exchange of spoken words, (c) something that is spoken, (d) an utterance, (e) the act of speaking etc.

Language (noun) is a (a) body of words and the systems for their use common to a people who of the same community or nation, the same geographical area, or the same cultural tradition, (b) any system of formalized symbols, signs, sounds, gestures used or conceived as a means of communicating, (c) the words, their pronunciation and the methods of combining them used and understood by a community etc.

Sound (phonetics) is (a) the audible result of an utterance or portion of an utterance, (b) a vocal utterance etc.

Thus, it can be deduced that a system of sounds make up a language and practice of language makes up speech. The link between these relationships is offered by words that are made up of a set of sounds. The system that the grouping of sounds follows results in the formation words. For example: the utterances sis and ter make up the word sister. A collection of words following a formalized system, example: she is my sister, makes up a language which in this case is English. The expression of the thought that follows the above sentence is known as speech.

For the word visualizations in this paper, syllables are considered. A syllable is a unit or a segment of sound that constructs a word. Each syllable in a word is represented as a circle and the concentric arrangement of the syllables together makes up the word. The purpose of placing the circles (that represent the syllables) in concentric circles as opposed to placing them separately is to allow the word visualization to take up an undivided and unbroken form as words are spoken in uninterrupted segments of syllables.

2. BACKGROUND
The roots of word visualizations lie in phonesthesi[2] or sound symbolism that suggests that vocal sounds have meaning; and synesthesi[3] that is a neurologically based phenomenon in which simulation of on sensory or cognitive pathway leads to automatic, involuntary experiences in a second sensory or cognitive pathway. Drawing inspiration from a classical phonesthetic experiment carried out by Wolfgang Kohler in 1927[4] where subjects were asked to associate meaningless words like maluma and takete to shapes. Nearly all viewers responded with the same answer, that maluma was a more rounded shape and takete was more angular. This was called the boubakaiki effect founded by Kohler. In 2001 Vilayanur S. Ramachandran[5], a neurologist, repeated the
experiment and found undisputed results where *bouba* was associated to a blobby shape and *kiki* to a spiked shape. Synesthesia, or more relevant to this research, color synesthesia suggests that letters or numbers are inherently colored. For example, words that start with “gl” as in glisten, gleam, glint, glare, etc. suggest something that is shiny; also, that louder sounds would be brighter in perceived hue, brightness and saturation than softer sounds.

![Bouba/kiki experiment repeated in 2001 by Ramachandran](image.png)

Artistic visualization of speech, apart from the aforementioned psychological experiments, has been attempted by artists before in animated short films such as *Reci, Reci, Reci* by Michaela Pavlatova. Visualization of speech have also been accomplished in interactive artworks such as *Hidden Worlds*, *Re:Mark* and performances such as *Messa di Voce*. More specific to word visualizations are works of Peter Cho. *Takeluma* is one such art installation whereby phonemes are assigned symbols by the artist and the resultant visualization is obtained when the symbols are arranged together. Another word visualization project by Peter Cho is *Wordscapes*, where the font and lettering reflects the meaning of the word. Usually, the words that appear in *Wordscapes* are verbs or adjectives that have strong visual associations to their meanings.

![Figure 1. Wolfgang Kohler's phonesthesia experiment in 1927](image.png)

![Figure 2. Bouba/kiki experiment repeated in 2001 by Ramachandran](image.png)

![Figure 3. Michaela Pavlatova’s animation Reci Reci Reci](image.png)

![Figure 4. Hidden Worlds installation](image.png)

![Figure 5. Re:Mark Installation](image.png)

![Figure 6. Messa di Voce performance](image.png)

![Figure 7. Peter Cho’s Takeluma installation](image.png)

![Figure 8. Peter Cho’s Wordscapes](image.png)
3. VISUALIZATION

The visualization presented here is an attempt to envision words creatively that goes beyond linguistic norms and lends unconventional eminence to the perception of words and speech. Basing this idea on phonesthesia, words are broken further down into syllables. These syllables are assigned colors based on color synesthetic principles. The syllables are denoted by circles and by placing each syllable together as concentric circles, the final word visualization is achieved. Therefore, to be incorporated as an implementation, a person would speak a word into a microphone and the utterance of each syllable would appear onto a screen. The person would be able to see his word “pronunciation” on the screen, based on how he/she spoke it.

The size, shape and color of the “words” (concentric circles) are elaborated here. The size/breadth of each concentric circle depends upon the duration of the utterance of the syllable. Longer the duration or more stress on the syllable, thicker the concentric circle. On the other hand, the colors of each syllable are determined through a survey. The survey consisted of syllables and required respondents to assign a color to the syllables. During the first phase of the survey, the original words were provided with the syllables. When the words were provided, the respondents seemed assign colors on the meaning of the words. For example, when the word “relax” was provided along with the syllables “ri” and “laks”, more respondents associated cooler colors than warm[See Figure14]. This was accidental and unintentional when the survey was designed; however, for the second phase of the survey the words were not provided and the respondents assigned colors to the syllables. Therefore, respondents assigned colors to “ri” and “laks” without the supporting presence of the word to bias their choices [See Figure15]. The words picked up for this visualization are the ones that showed consistency in the assigned colors. The majority of colors assigned to a particular syllable were picked, and their average RGB values were taken. So if different hues of yellows were assigned by respondents to a syllable, they were singled out and the average RGB value was calculated and determined as the color for the relevant syllable. The science behind choosing a shape to represent words was a predicament. The shapes chosen to represent words in the boubã/kiki and the maluma/takete experiments were tricky to replicate for a bigger body of words and to find a system of shapes that could be used to shape words. The choice of using circles is a mere start in this direction. While in this visualization, colors represent the words and are important discerning factors of one word from another, concentric circles are used to give the words an enclosed shape. This is unlike Peter Cho’s system of symbols for consonants and vowels and the arrangement of which makes different words look very similar to each other.

4. DISCUSSION

Before implementing this visualization, it is necessary to discuss some of the limitations that had arisen during the research phase. Syllables in the English language are numerous. Although they are finite, to determine color coding system for each syllable in the English language would be a little too problematic. On the other hand, if structures of syllables were studied, a natural way that syllables occur in English as a cluster of consonants and vowels, a more universal system of color codes for syllables could be arrived upon. Another limitation that impedes this kind of word visualization is that it is only possible in English. It would be perhaps valuable and applicable to a wide range of languages if perhaps phonemes were used. Phonemes are the smallest linguistically distinctive unit of sound. The number of phonemes is smaller when compared to syllables and in addition to that, the International Phonetic Alphabet (IPA) lists the different phonemes that occur in a vast array of languages. Therefore, using phonemes instead of syllables would help in terms of sheer manageability and universal applications of these word visualizations to multiple languages. A feedback from the survey that constantly surfaced was in assigning colors to meaningless syllables. Therefore, here again it can be understood that perhaps assigning colors to sounds, i.e, phonemes could be easier and more efficient. Although this visualization is an artistic representation, it can be utilized as a tool for learning new languages or in speech training in applied or allied branches of speech, linguistics and audio. Also, word visualizations can be used in graphic design and branding in developing corporate images for companies. In essence of assigning colors to words, it would benefit and further research on word visualizations, if words colors were assigned to the words, as colors have emotion evoking qualities. Thus more explorative studies are required on the debate if word meanings or word sounds would offer more elegant word visuals.

5. ACKNOWLEDGMENTS

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6. REFERENCES

[1] Merriam-Webster’s dictionary
[2],[3] en.wikipedia.org
illinois = ill ih noy

Figure 9. Word visualization for Illinois.

stuttering = stuh ter ing

Figure 10. Word visualization for Stuttering.
beautiful = byoo ti ful

Figure 11. Word visualization for Beautiful.

bacteria = bak teer ee uh

Figure 12. Word visualization for Bacteria.
dreaden = ded en

Figure 13. Word visualization for Dreaden.

relax = ri laks (when word was provided)

Figure 14. Visualization of the word Relax when word was provided with the syllables “ri” and “laks” in the survey.
relax = ri laks (when word was not provided)

Figure 15. Visualization for the word Relax when only the syllables were provided.