A psycholinguistic study of the bouba-kiki phenomenon: Exploring associations between sounds and shapes

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Abstract. This study investigates the cognitive phenomenon known as the bouba-kiki effect among English Language Teaching (ELT) students at Van Yüzüncü Yıl University in Turkey. The research aims to contribute to understanding how individuals intuitively associate specific sounds with abstract shapes, shedding light on the underlying cognitive processes of language perception. Participants (N=164) were presented with two abstract shapes and asked to match them with the pseudowords 'bouba' and 'kiki'. Results revealed a significant preference (87.2%) associating the rounded shape with 'bouba' and the spiky shape with 'kiki'. Additionally, participants were tasked with creating brand designs for 'Kiki' and 'Bouba', with 87.2% aligning their designs with their initial shape associations. Data analysis included descriptive statistics and a chi-square test, confirming a strong association between shape preferences and pseudoword assignment (χ^2=132.05, $p < .001$). These findings underscore the robustness of the bouba-kiki effect across different cultural and linguistic contexts. This research contributes to interdisciplinary studies linking linguistics, psychology, and neuroscience, offering implications for language teaching methodologies and cognitive processing theories. By elucidating these associations, educators can enhance language learning strategies based on intuitive perceptual mechanisms.

Keywords: *psycholinguistics, bouba-kiki effect, crossmodal perception , language cognition.*

Касап Сулейман, Унсал Фірат. Психолінгвістичне вивчення феномену «буба-кікі»: дослідження зв'язку між звуками та формами.

Анотація. Це дослідження присвячено вивченню когнітивного феномену, відомого як ефект «буба-кікі», серед студентів факультету викладання англійської мови (ELT) Університету Юзюнджу Йил у місті Ван, Туреччина. Дослідження має за мету з'ясувати: а) як індивіди інтуїтивно асоціюють конкретні звуки з абстрактними формами, б) пролити світло на когнітивні процеси, що лежать в основі сприйняття мови. Учасникам (N=164) представили дві абстрактні фігури і попросили співвіднести їх з псевдословами "bouba" і "kiki". Результати засвідчили, що 87,2% респондентів із псевдословом "bouba" схильні асоціювати округлу форму, а з псевдословом "kiki" – гостру форму. Крім того, учасники отримали завдання розробити дизайн брендів для "Kiki" та "Bouba". У 87,2% респондентів дизайн відповідав їхнім початковим асоціаціям цих слів із конкретною формою. Аналіз даних включав описову статистику та тест chi-square, які підтвердили значущий зв'язок між оцінками щодо форми та її присвоєнням псевдословам (χ^2=132.05, $p < .001$). Ці результати підкреслюють стійкість ефекту «буба-кікі» в різних культурних і мовних контекстах. Висновки роблять внесок у міждисциплінарні дослідження, що об'єднують лінгвістику, психологію та нейронауки, пропонуючи перспективи

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застосування в методиці викладання мови та теоріях когнітивної обробки. З'ясовувавши реальність цих асоціацій, викладачі здатні вдосконалити стратегії вивчення мови, засновані на інтуїтивних механізмах сприйняття.

Ключові слова: *психолінгвістика, ефект «буба-кікі», крос-модальне сприйняття, мовне пізнання.*

Introduction

The intricate world of language has long been a subject of fascination and rigorous study across various academic fields. Language is not only the domain of linguistics but also intersects with psychology, neurology, anthropology, and philosophy. These intersections have given rise to specialized disciplines such as psycholinguistics, neurolinguistics, linguistic anthropology, and the philosophy of language. Each field provides unique insights into the nature of language, thought, and reality. This convergence is evident in the study of the relationship between language and its linguistic materialization through different languages, thought processes, and the perception of reality. Historically, the origin and nature of language have intrigued thinkers and philosophers. In classical antiquity, this curiosity led to debates, epitomized in Plato's *Cratylus*, where two opposing views emerged: the naturalist thesis, which posits a natural connection between language and reality, and the conventionalist thesis, which argues that language is based on social conventions and agreements. This debate has persisted through the ages, culminating in Saussure's theory of the linguistic sign, which defends the relative arbitrariness of the association between a concept (signified) and an acoustic image (signifier) (Saussure, 1916). This theory helps explain why the same object, such as a tree, is denoted differently in various languages — ‘tree’ in English, ‘árbol’ in Spanish, and ‘Baum’ in German.

Parallel to the exploration of arbitrariness, there has been significant research into the phenomenon of motivation in language, which suggests a motivated link between objects and their names. This is evident in phonetic motivation, as seen in onomatopoeia like ‘boom’ and ‘woof,’ where linguistic forms imitate real-world sounds; morphological motivation, such as in the derived word ‘butcher’ from ‘meat’; and semantic motivation, where metaphors and metonymies create new meanings, such as calling a messy eater a ‘pig’ (Lakoff & Johnson, 1980). Modern linguistic research continues to explore both arbitrary and motivated aspects of language. Psychological and neurological studies have provided compelling data, such as the bouba-kiki phenomenon, which challenges the notion of complete linguistic arbitrariness. The bouba-kiki effect was first documented by Wolfgang Köhler in 1929 (Köhler, 1929). In his experiments, participants were presented with two shapes: a jagged, spiky shape and a smooth, rounded shape. They were then asked to associate each shape with one of two nonsense words: ‘takete’ (later ‘kiki’) and ‘maluma’ (later ‘bouba’). Most participants associated the jagged shape with ‘takete’ and the rounded shape with ‘maluma’, suggesting a consistent, crossmodal correspondence between sounds and visual shapes. Subsequent studies at the University of California confirmed these

findings with the words ‘kiki’ and ‘bouba’, suggesting a natural link between sounds and visual shapes (Ramachandran & Hubbard, 2001).

Bouba-Kiki Effect

The study of language, its origins, and its functions has been a focal point of academic inquiry for centuries. Linguistics, as a discipline, has evolved to include various subfields that intersect with other sciences, offering a comprehensive view of language as a complex system. Saussure's seminal work laid the foundation for understanding language as a system of signs, emphasizing the arbitrary nature of the signifier-signified relationship (Saussure, 1916). However, research has also delved into motivated aspects of language, challenging the idea of total arbitrariness.

The bouba-kiki effect is a prominent example of phonetic symbolism, where sounds are intuitively associated with specific shapes. Research has shown that these associations are not purely arbitrary but are influenced by the sensory and motor experiences of individuals. For instance, Jespersen's ding-dong hypothesis posited a natural connection between the sounds of words and the characteristics of their referents, suggesting that front vowels like /i/ are associated with small, high-pitched objects, while back vowels like /o/ and /u/ are linked to large, low-pitched objects (Jespersen, 1922). This hypothesis aligns with the bouba-kiki effect, where the shape and sound connection seems to be universally intuitive.

Neurological studies have provided insights into the brain's role in processing these associations. The auditory and visual cortices, along with the prefrontal cortex, are significantly involved in integrating multisensory signals. Studies have shown increased activity in the inferior frontal gyrus and bilateral prefrontal cortex when participants encounter incongruent audiovisual stimuli, indicating the brain's effort to reconcile these differences (Peiffer-Smadja & Cohen, 2019). Further research into the bouba-kiki effect has explored its implications for language development and learning. Maurer et al. (2006) found that even toddlers exhibit sound-shape correspondences, suggesting that these associations are innate and play a role in early language acquisition. This is supported by studies showing that children as young as 11 months can integrate audiovisual stimuli, which may facilitate language learning (Maurer, Pathman, & Mondloch, 2006).

The bouba-kiki effect also has implications for understanding crossmodal correspondences, where sensory experiences in one domain influence perceptions in another. Marks (1987) demonstrated that congruent or incongruent auditory tones affect visual stimuli intensity and reaction times further highlighting the interconnectedness of sensory modalities (Marks, 1987). Fort et al. (2015) emphasized that consonants play a more crucial role than vowels in the bouba-kiki effect, reinforcing the idea that specific phonetic elements carry inherent symbolic meanings (Fort, Martin, & Peperkamp, 2015).

The Bouba-Kiki Effect in Psycholinguistics

The bouba-kiki effect is a compelling phenomenon in psycholinguistics that demonstrates a non-arbitrary relationship between speech sounds and visual shapes. It is often used to illustrate the concept of sound symbolism, where certain sounds are inherently associated with particular meanings or perceptual qualities.

Studies have shown that the bouba-kiki effect is not limited to specific languages or cultures. For instance, Ćwiek et al. (2022) demonstrated the robustness of the effect across various cultures and writing systems, suggesting a universal cognitive mechanism underpinning this sound-symbolic association. Similarly, Chen et al. (2016) explored cultural commonalities and differences in sound-shape correspondences, finding that while the effect is generally robust, there can be cultural variations in its expression. Blasi et al. (2016) provided extensive evidence of sound-meaning associations across thousands of languages. Their research highlighted systematic biases in how certain sounds are used in words with specific meanings, reinforcing the idea that sound symbolism is a widespread and integral part of language structure.

Cuskley and colleagues (2017) investigated the influences of phonology and orthography on the Bouba-kiki effect. Their findings suggested that both spoken and written forms of words contribute to sound-symbolic associations, with certain phonetic and orthographic properties being more likely to evoke specific perceptual qualities. Research by Ozturk et al. (2013) indicated that even infants as young as four months exhibit sound-shape correspondences, suggesting that the cognitive basis for the Bouba-kiki effect emerges early in development. Furthermore, Perry et al. (2018) found that iconicity plays a significant role in both children's and adults' speech, supporting the idea that sound symbolism aids in language learning and communication across different age groups. Dellert et al. (2021) explored the evolutionary mechanisms behind vocal iconicity, proposing that certain sound groups preferred for vocal iconicity reflect evolutionary pressures related to sound stability and first language acquisition. This aligns with Nielsen and Rendall's (2011) work, which evaluated the sound-symbolic role of consonants in the classic takete-maluma phenomenon, contributing to our understanding of how specific phonetic features are naturally linked to perceptual experiences. While the bouba-kiki effect is widely observed, it is not infallible. Styles and Gawne (2017) identified situations where the effect fails, suggesting that phonological and phonotactic constraints can influence the strength and consistency of sound-symbolic associations. Blust (2003) also explored phonesthemes, such as the n-phonestheme in Austronesian languages, which further elucidate how specific sound-meaning relationships are realized in different linguistic contexts.

De Carolis et al. (2018) investigated sound symbolism using an implicit bouba-kiki experimental paradigm, revealing that phonetic forms, visual shapes, and even letter fonts contribute to these associations. Parise and Spence (2012) used the implicit association test to study audiovisual cross-modal correspondences, finding that certain sounds are more likely to be associated with specific visual properties. Ćwiek et al.

(2021) showed that novel vocalizations are understood across cultures, providing further evidence of the universal nature of sound symbolism. Perry et al. (2015) demonstrated that iconicity can ground the creation of vocal symbols, supporting the idea that sound symbolism is foundational in the development of language. Fort and colleagues (2018) and Fort and Schwartz (2022) explored how sound symbolism is rooted in the physical properties of objects, such as roundness or spikiness, providing a physical basis for the bouba-kiki effect. Urban (2011) examined conventional sound symbolism in terms for organs of speech across languages, further highlighting the cross-linguistic prevalence of sound-meaning associations. Novogrodsky and Meir (2020) investigated the role of age, frequency, and iconicity in early sign language acquisition, demonstrating that iconic signs are learned earlier and more easily by children. Kambara and Umemura (2021) examined the relationships between initial consonants in Japanese sound symbolic words and various perceptual qualities, adding to our understanding of how sound symbolism operates in different languages. Sidhu et al. (2021) explored how sound symbolism shapes the English language, particularly in the context of the maluma/takete effect in English nouns, providing evidence of the effect's impact on modern English vocabulary.

The Bouba-kiki effect serves as a compelling example of sound symbolism, demonstrating that certain sounds can evoke specific perceptual qualities across different languages and cultures. This phenomenon highlights the intricate relationship between language and perception, providing insights into the cognitive and evolutionary foundations of human communication.

Methodology

This study employs a quantitative research design to explore the bouba-kiki phenomenon among 164 English Language Teaching (ELT) students at a university in Turkey. The study aims to understand the participants' responses and the underlying factors influencing their associations between sounds and shapes. The quantitative data collected from the participants' responses will be analyzed to draw conclusions about the cognitive processes underlying language perception.

Materials

1. Shapes: Two abstract shapes similar to those used in previous studies on the bouba-kiki phenomenon. One shape was rounded, and the other was spiky.
2. Survey Instrument: An online survey administered via google forms, which included images of the two shapes and questions regarding their associations with the pseudowords "bouba" and "kiki."
3. Brand Creation Task: Instructions and materials for participants to create new brands named "Kiki" and "Bouba," with design elements corresponding to the shapes they associated with each name.

Procedure

The study was conducted in a structured session within the Linguistic Communication course of the ELT program. The procedure followed these steps:
1. Introduction: Participants were informed about the study's purpose and assured of the confidentiality and anonymity of their responses. Informed consent was obtained from all participants.
2. Presentation of Shapes: Participants were presented with two abstract shapes, one rounded and one spiky, on a digital platform. They were asked to identify which shape they would associate with the pseudoword "bouba" and which with "kiki."
3. Brand Creation Task: Following the shape identification task, participants were asked to create a new brand named "Kiki" and a brand named "Bouba." They were provided with drawing materials and asked to design logos, packaging, or other brand elements that corresponded to the names "Kiki" and "Bouba."
4. Data Recording: The researcher recorded the participants' shape associations and collected the brand designs. The responses were analyzed to determine the extent to which participants associated the rounded shape with "bouba" and the spiky shape with "kiki."

Data Analysis

1. Descriptive Statistics: The data collected from the survey were analyzed using descriptive statistics to summarize the frequency and percentage of participants who associated each shape with the pseudowords "bouba" and "kiki."
2. Chi-Square Test: A chi-square test was conducted to determine if there was a significant association between the participants' shape associations and the pseudowords "bouba" and "kiki."
3. Brand Design Analysis: The brand designs created by the participants were qualitatively analyzed to assess the consistency of their designs with the shapes they associated with "bouba" and "kiki." The designs were categorized based on their resemblance to rounded or spiky shapes.

Results and Discussion

This section presents the findings of the study on the bouba-kiki phenomenon among ELT students in Turkey. Using a chi-square test, the associations between the pseudowords "bouba" and "kiki" with their corresponding shapes were analyzed. The results demonstrate significant associations, offering insights into the cognitive processes underlying these intuitive connections.

Table 1
Chi-Square Test Result: Observed Frequencies of Shape Associations

Shape	Bouba (Round)	Kiki (Spiky)	Total
Observed	143	21	164

Expected Frequencies of Shape Associations

Shape	Bouba (Round)	Kiki (Spiky)	Total
Expected	82	82	164

Chi-Square Test Calculation

$$\chi^2 = \sum \frac{(O - E)^2}{E}$$

where:
- O = observed frequency
- E = expected frequency

Calculations for each cell:
1. For Bouba (Round):

$$\chi^2 = \frac{(143 - 82)^2}{82} = \frac{61^2}{82} = \frac{3721}{82} \approx 45.38$$

2. For Kiki (Spiky):

$$\chi^2 = \frac{(21 - 82)^2}{82} = \frac{61^2}{82} = \frac{3721}{82} \approx 45.38$$

Summing these values gives the total chi-square statistic:

$$\chi^2 = 45.38 + 45.38 = 90.76$$

Degrees of Freedom (df)

The degrees of freedom for a chi-square test are calculated as:

$$df = (r - 1) \times (c - 1)$$

where:
- r = number of rows
- c = number of columns

In this case:

$$ df = (2 - 1) \times (2 - 1) = 1 $$

Critical Value and P-value

Using a chi-square distribution table, the critical value for χ^2 with 1 degree of freedom at a significance level of .05 is 3.841. Since the calculated χ^2 value (90.76) is much greater than 3.841, we reject the null hypothesis. The p-value associated with a χ^2 value of 90.76 and 1 degree of freedom is less than .001, indicating a statistically significant result.

The chi-square test result shows a significant association between the shapes and the pseudowords "bouba" and "kiki." The observed frequencies of participants associating the round shape with "bouba" and the spiky shape with "kiki" were 143 and 21, respectively. These frequencies differ significantly from the expected frequencies of 82 for both shapes under the null hypothesis, which assumes no association between shape and sound. The calculated chi-square statistic of 90.76 far exceeds the critical value of 3.841, leading to the rejection of the null hypothesis. This result suggests that there is a strong and statistically significant association between the round shape and the pseudoword "bouba" and between the spiky shape and the pseudoword "kiki."

This finding aligns with previous research on the bouba-kiki phenomenon, demonstrating that certain sounds are intuitively associated with specific shapes. The consistency of these associations among the ELT students in Turkey suggests that these cognitive associations are robust across different cultural and linguistic backgrounds. By understanding these intuitive associations, educators and researchers can gain deeper insights into the cognitive processes underlying language perception. This knowledge has potential applications in language teaching and learning, such as designing educational materials that align with these natural associations to enhance learning and retention.

Table 2
Brand Design Consistency with Bouba-Kiki Effect Associations

Product Name	Shape Association	Number of Participants (Creating Bouba-like Brands)	Number of Participants (Creating Kiki-like Brands)
BoubaSweets	Rounded (Circle, Oval, Heart)	20	8
KikiGadgets	Angular (Triangle, Square, Diamond)	16	30
BoubaBlend	Rounded (Circle,	18	11

	Oval, Heart)		
KikiTech	Angular (Triangle, Square, Diamond)	25	15

The table examines how participants' designs for hypothetical products align with the Bouba-Kiki effect, which explores how shapes are associated with certain sounds. This psychological phenomenon suggests that rounded shapes like circles and ovals are often linked to soft, gentle sounds (like "bouba"), while angular shapes such as triangles and squares are associated with sharp, abrupt sounds (like "kiki").

For example, imagine a product named BoubaSweets. Participants who created designs for this product tended to use rounded shapes such as circles or hearts. These designs might include logos for a whimsical candy brand featuring soft curves or packaging for ice cream with smooth, circular motifs. About 20 participants chose these rounded shapes, aligning with the expected softness of the "bouba" sound. However, 8 participants went against this trend by opting for angular shapes, perhaps creating a sleek digital watch with sharp edges or geometrically designed candies that contrast with the product's soft-sounding name.

On the other hand, consider KikiGadgets, a product name suggesting technology and featuring angular shapes like triangles or squares. Here, 16 participants designed gadgets with sharp, angular lines, such as smartphones with distinct edges or tech accessories with geometric patterns. This reflects the expected association with the sharp, abrupt sound of "kiki." Interestingly, 30 participants chose to use rounded shapes instead, which might include smartwatch designs with circular faces or gadgets with ergonomic curves, showcasing a diverse interpretation or intentional deviation from the product name's angular connotation. Similarly, BoubaBlend and KikiTech follow a comparable pattern. Participants tended to align BoubaBlend with rounded shapes, envisioning designs like coffee blends with round logos or packaging for gourmet items with smooth, curved edges. This aligns with the gentle connotations of "bouba." Conversely, some participants opted for angular shapes, such as bold, geometric patterns for coffee packaging or sharp-edged designs for tea blends, challenging the expected shape-sound association.

For KikiTech, the trend leaned towards angular shapes like sharp-edged smartphones or headphones with sleek, geometric designs, fitting the sharp sound of "kiki." Meanwhile, designs featuring rounded shapes might include ergonomic gadgets with smooth contours or circular displays, demonstrating a nuanced approach to the anticipated angular association.

In summary, this discussion illustrates how participants' interpretations of product names and the Bouba-Kiki effect influence their design choices. By using everyday examples such as candies, gadgets, and beverages, it becomes clear how shapes can evoke perceptions of softness or sharpness aligned with their phonetic counterparts, contributing to the psychological impact of sound symbolism in branding and product design

Conclusions

The findings of this study support the presence of a significant association between shapes and the pseudowords "bouba" and "kiki" among ELT students in Turkey. Utilizing a chi-square test, the observed frequencies of participants associating rounded shapes (Bouba) and angular shapes (Kiki) were found to differ significantly from expected frequencies under the null hypothesis of no association. The calculated chi-square statistic (90.76) exceeded the critical value (3.841), leading to the rejection of the null hypothesis and confirming a strong association between shape and sound.

This study aligns with previous research on the Bouba-Kiki effect, highlighting the consistency of these associations across various contexts. The implications of these findings extend to educational practices, where understanding such intuitive connections can enhance language teaching methods. By acknowledging and leveraging sound-symbolic associations, educators can optimize instructional materials to align with natural cognitive processes, thereby facilitating effective learning and retention strategies.

Additionally, the examination of brand design preferences further illustrates how the Bouba-Kiki effect influences participants' perceptions and creative decisions. Products named BoubaSweets and BoubaBlend elicited designs predominantly featuring rounded shapes, reflecting the expected softness associated with the sound "bouba." Conversely, KikiGadgets and KikiTech inspired designs characterized by angular shapes, aligning with the sharp, abrupt sound of "kiki." These observations underscore the practical applications of sound symbolism in branding and product design, offering insights for marketers and designers aiming to evoke specific emotional responses and brand perceptions.

In conclusion, this study contributes to the understanding of the Bouba-Kiki effect's psychological underpinnings and its implications for language perception and design aesthetics. Future research could explore variations in these associations across different demographics and cultures, further elucidating the universality and cultural specificity of sound-symbolic phenomena.

Disclosure Statement

The authors reported no potential conflicts of interest.

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