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Epidemiology and Determinants of the *Bouba-Kiki* Effect in Presence and at Distance

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Abstract

When the *bouba-kiki* test, an evolution of the primordial *baluma-takete* test, was administered by an expert operator to 343 participants (225 women and 118 men), the rounded figure was associated to the name *bouba* in 86.9% and the angular one to the name *kiki* in 13.1% of cases ($p < 0.0001$). In logistic regression, age was the only significant determinant of this answer ($p = 0.004$), while sex and years of formal school education did not enter the model. By means of the receiver operating characteristic curves, a cut-off value of age (>47 years) was found and significantly entered logistic regression having rounded = *bouba* as dependent variable and sex and years of school as independent covariables ($p = 0.024$). When, in sensitivity analysis, the same test was administered at distance *via* an Internet platform to other 62 comparable participants (21 women and 41 men) in the absence of an operator, the association of *bouba* to the rounded pictogram and of *kiki* to the angular one had a prevalence of 61.3% only ($p < 0.0001$ vs. test in presence, i.e. $p < 0.001$ in men and $p = 0.013$ in women). Associating the name *bouba* to a rounded pictogram therefore seems to depend on age and on the physical presence of an operator, while sex and age of formal school education are irrelevant.

Keywords

Psychology, Semantics, Test, Names, Age, School, Rapport, Cut-Off, ROC Curves, Pictogram, Alphabet, Baluma-Takete, COVID, Rounded, Angular, Cohort, Logistic Regression

1. Introduction

The so-called *bouba-kiki* test (Ramachandran & Hubbard, 2001; Kim, 2020; Peiffer-Smadja & Cohen, 2019), an evolution of the primordial *baluma-takete* test (Köhler, 1929), is a task usually administered saying participants that *bouba*

and *kiki* are the first two letters of a new alphabet (like *alpha* and *beta* in current Greek-Latin-derived Western alphabet). The two letters (actually, two pictograms, one rounded and one angular) (**Figure 1**) are randomly presented to participants independent to each other. The task consists in associating the sounds (names) to the figures. Independently of native language and culture (Ćwiek et al., 2022; Wong et al., 2022), the rounded pictogram receives more frequently the name *bouba* and the angular (spiky) one the name *kiki*.

It is interesting to note that the epidemiology of the *bouba-kiki* task is unknown. Although it is given for granted the combination rounded = *bouba* and angular = *kiki* is strongly prevalent (Kim, 2020), and that only a limited minority of people chose the combination rounded = *kiki*, to my knowledge the numerical amount of this correspondence has never been explored in a large scale or explored with statistical methods in epidemiological setting.

Another unanswered question is how the presence of the researcher influences the result of the task. The recent pandemic period due to SARS-nCov2 virus (COVID-19), making difficult to administer the *bouba-kiki* task to large groups of people in presence of a researcher, offered the occasion to administer it at distance. An on-line Internet-based platform was chosen to this aim, considering that even many psychotherapists, for fault of anything better, often practiced in this way during the pandemia in the last three years.

Up to now the *bouba-kiki* effect has been observed and illustrated with a descriptive approach, escaping a rigorous scientific and statistical approach. Aim of the present study was to verify if the *bouba-kiki* effect linking a pictogram to its name exists (i.e., if names are immanent to things), to quantify the results of this task in epidemiological setting in a cohort of men and women with a statistical approach, to clarify whether a sex-specific difference in response exists, if years of formal education are associated to the results of the test, if the task can be administered at distance (on-line) and, in this case, if the results are different from those obtained in presence.

The topic is of particular interest because it is important to clarify whether the names attributed to things are arbitrary, or immanent to the things themselves. The *bouba-kiki* task is of great speculative interest as the language is the basis of thought. By showing that things have a pre-packaged preferential names would

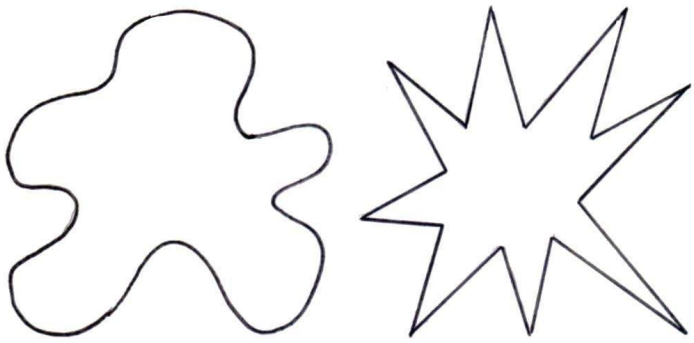

Figure 1. The roundish figure and the spiky one shown to the participants.

demonstrate that mind or brain work according to predetermined archetypal schemes. As the *bouba-kiki* effect is independent of language, its demonstration is consistent with the idea that human thought is similar regardless of the written language used (alphabetical, syllabic, ideographic etc.). Furthermore, knowing the determinants of the *bouba-kiki* effect means also to precise better the determinants of thought. Both language and symbolic ability vary greatly with age, but also with the level of formal school education. It is therefore interesting to investigate whether age and years of school are predictive of the *bouba-kiki* linguistic-symbolic task.

2. Subjects and Methods

2.1. Study Cohort and Data Collection

The study cohort was composed of 405 subjects, 343 of whom studied in presence and 62 in sensitivity analysis at distance. The task in presence was administered by a researcher who gave to subjects, taken individually, two sheets of paper, one with the rounded figure and one with the angular figure, in a random sequence. The task at distance was administered by sending to subjects the two figures in a random sequence and obtaining a response *via* a special program. Subjects were asked to say which pictogram was *bouba* and which was *kiki*. All the procedure was anonymized.

2.2. Main Statistical Analysis

Linearity assumption of continuous variables was ascertained by the residuals method and normality assumption by the Kolmogorov-Smirnov one-sample test. Variables putatively not independent from each other were previously logarithmized when proper. Continuous variables were expressed as mean ± standard deviation and compared with analysis of variance. Categorical variables were compared by means of the Pearson χ^2 test. The null hypothesis was always rejected for values of $p < 0.05$.

The receiver operating characteristic (ROC) curves method was used to search for prognostic cut-off of age. The De Long et al. method (De Long et al., 1988) was used to this aim. Ratio of cases associating *bouba* to the rounded pictogram (prevalence), sensitivity and specificity were calculated. The cut-off value was identified as the curve point nearest to the 100% of axis of the ordinates. In practical terms, this was made by identifying the point associated to the highest values of the sum sensitivity + specificity. Youden's index defined for all points of ROC curves was used as a criterion for selecting the optimum cut-off. The area under the curve was also shown for each ROC curves analysis (Schisterman et al., 2005). The same procedure was used to find a cut-off of years of school education.

2.3. Validation of the Cut-Off Values

The cut-off values of age and of DC identified by means of the ROC curves were

used as independent variables in separate multivariate Cox analyses using each event as dichotomous dependent variable and the term rounded congruent to *bouba* as the independent covariables, and adjusting for age, sex and years of school. A cut-off value identified via the ROC curves method was considered as valid if accepted in the model, being the null hypothesis rejected, otherwise it was considered a false cut-off. The corresponding HR with 95% confidence intervals (CI) were obtained from each analysis. Outcome curves according to the Kaplan-Meier non-parametric estimator of limit product were produced. Log-rank tests were used to assess differences between curves.

2.4. Sensitivity Analysis

In sensitivity analysis, other 62 subjects (21 women and 41 men) examined at distance via an Internet platform were studied with the same methods.

3. Results

3.1. General Characteristics of the Cohort

The 343 cases examined in presence (225 women and 118 men) were aged in average 45.7 ± 12.8 years (range 19 to 72 years, 95% CI 44.4 - 47.1) and had a geometric mean of age of 47 years. The kurtosis of age distribution was −0.837. Age was in average 46.3 ± 11.4 (95% CI 44.9 - 47.6) years in women and 44.7 ± 15.1 (95% CI 41.9 - 47.5) years in men ($p = 0.3$). Years of formal education were in average 20.5 ± 7.3 (range from 8 to 55 years, 95% CI 19.7 - 21.3) and the geometric mean of formal education was 18.4 years, and its kurtosis was 7.523. Years of formal education were in average 19.3 ± 5.6 (95% CI 18.6 - 20.1) years in women and 22.7 ± 9.3 (95% CI 21.0 - 24.4) years in men ($p < 0.01$).

At linear regression, years of formal education correlated directly with age (r = 0.227, $p < 0.0001$) (Figure 2).

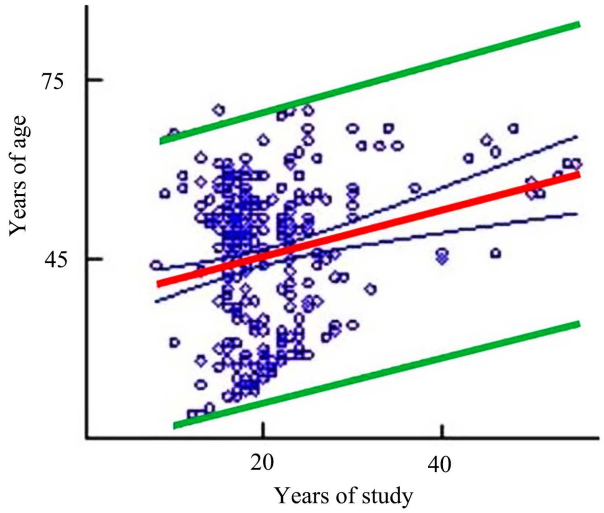

Figure 2. Linear regression of years of school and years of age in 405 participants. Plot of residuals vs. predicted values. Confidence intervals and *p* prediction intervals.

3.2. Association of *Bouba* and *Kiki* to the Figures

In the 343 case treated in presence, the rounded figure was called *bouba* in 298 cases (86.9%) and *kiki* in 45 cases (13.1%, $p < 0.0001$), i.e. in 88.4% of women and in 83.9% of men ($p = 0.2$ between sexes).

In logistic regression model adjusted for sex and for the years of formal school education, the congruence rounded = *bouba* was significantly and directly associated to age (Table 1).

3.3. Search and Validation of a Cut-Off of Age

As age was associated to congruence rounded = *bouba* in multivariate analyses, the ROC curves methods was used in order to find a cut-off value of age, if any, able to discriminate subjects prone to say that the rounded figure was *bouba* and the angular figure was *kiki*.

The ROC curves produced a plausible cut-off (>47 years) over which the rounded figure was mainly called *bouba* and the angular figure was mainly called *kiki*. The ROC curves are shown in Figure 3 and the ROC parameters in Table 2.

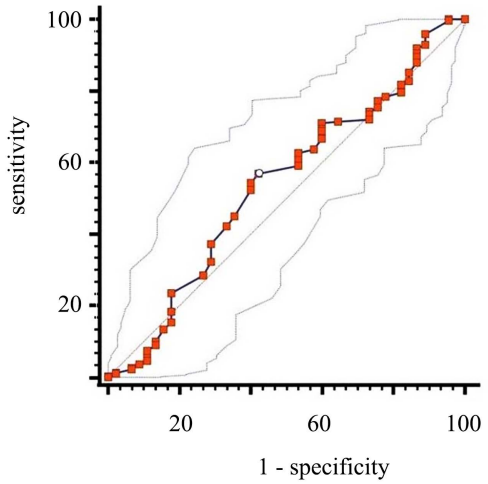

Figure 3. Receiver operating characteristic (ROC) curves indicating the cut-off value of age among the 343 participants treated in presence.

Table 1. Logistic regression having *round figure = bouba* as categorical dependent variable, the continuous variable *age* as independent variable, and age of education and sex as confounders.

Parameter	Estimate (SE)	*z* statistics	*p* value
Independent variable			
Age (years)	1.022 (0.011)	1.001	0.04
Confounders			
Sex (1: men; 0: women)	0.477 (0.320)	1.489	0.1 (NS)
Formal school education (years)	0.029 (0.021)	1.336	0.2 (NS)

Table 2. Receiver operating characteristic (ROC) curves parameters, identifying in 343 subjects treated in presence the variable *age* > 47 as cut-off of age over which the probability to call the round figure *bouba* and the angular figure *kiki* increases. SE: standard error. CI: 95% confidence intervals.

Parameter	Values
Cut-off of age	>47 years
CI of cut-off	22.2 - 63.0
Area under curve (SE)	0.541 (0.048)
CI of area under curve	0.187 - 0.596
Z statistics	0.848
Youden index	0.1482
CI of Youden index	0.079 - 0.239
Sensitivity %	57.0
Specificity (%)	57.8

The subsequent validation, made using in logistic regression the independent categorical variable *age > 47* instead of the continuous covariable age and sex, demonstrated this cut-off was accepted in the model (Table 3), confirming that subjects aged > 47 years actually were significantly more prone to call *bouba* the rounded figure and *kiki* the angular one despite adjustment for confounders. Male sex and years of formal school education played a significant direct role in the equation, but did not nullify the role of being over the cut-off of age.

3.4. Sensitivity Analysis

In sensitivity analysis, other 62 subjects comparable to the 343 ones were examined at distance, without the presence of a researcher. In these setting, the rounded figure was called *bouba* in 38 cases (61.3%) and *kiki* in 24 cases (38.7%). The comparison of response rates in the main group (in presence) and in sensitivity group (at distance) is shown in Table 4. The way of administration of the task (presence or distance) was accepted in confounder-adjusted logistic regression model of the response with an HR of 4.116 (95% CI 2.444 - 7.703) and $p < 0.0001$. In logistic regression, no covariables influenced the model.

A univariate cut-off of years of education (>25 years) was determined with the ROC curves method (Figure 4 and Table 5). Nevertheless, in logistic model using education > 25 as the categorical dependent variable, and age > 47 or age together with sex as independent covariables, the cut-off of education identified in univariate analysis was not confirmed in multivariate analysis, therefore being a mere false cut-off.

4. Discussion

Although known for some time, the *bouba-kiki* effect has so far been described in small groups of people or sometimes administered as a test to patients with

the criteria of narrative disciplines, but not adequately described with a scientific approach or well analyzed with statistical methods. Although the *buba-kiki* effect is considered established, its determinants have never been specifically investigated. In particular, when this analysis was started, it was not known if age, sex and education influenced the results of the *bouba-kiki* test.

Table 3. Logistic regression having *rounded figure = bouba* as categorical dependent variable, the categorical variable *age over 47 years* as independent variable, and age of education and sex as confounders.

Parameter	Estimate (SE)	*z* statistics	*p* value
	Dependent variable		
Age > 47 years	0.727 (0.322)	2.255	0.024
	Confounders		
Sex (1: men; 0: women)	0.608 (0.299)	2.031	0.042
Education (years)	0.055 (0.012)	4.418	<0.0001

Table 4. Comparison between the answers to the bouba-kiki task in presence and at distance.

Response rate	**All (n, %)**	**Men (n, %)**	**Women (n, %)**	***p* between sexes**
Setting in presence	298/343 (88.9)	99/118 (83.9)	199/205 (88.4)	0.25 (NS)
Setting at distance	38/62 (61.3)	12/20 (60.0)	26/42 (61.9)	0.89 (NS)
***p* between settings**	**<0.0001**	**0.013**	**<0.0001**	

Table 5. Receiver operating characteristic (ROC) curves parameters, identifying in 62 subjects treated at distance the variable *age* > 25 as cut-off of age over which the probability to call the round figure *bouba* and the angular figure *kiki* increases. SE: standard error. CI: 95% confidence intervals.

Parameter	Values
Cut-off of school education	>25 years
CI of cut-off	19 - 30
Area under curve (SE)	0.523
CI of area under curve	0.468 - 0.578
Z statistics	0.467
Youden index	0.091
CI of Youden index	0.051 - 0.111
Sensitivity %	11.3
Specificity (%)	79.8

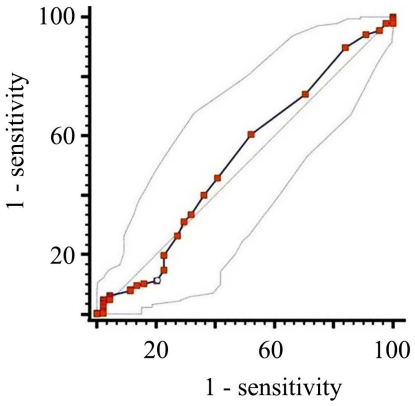

Figure 4. Receiver operating characteristic (ROC) curves indicating the univariate cut-off of years of formal education among the 62 participants treated at distance.

Our results first confirm that, as expected, a *bouba-kiki* effect exists. In fact people tend in 86.9% of cases to call *bouba* a rounded figure and *kiki* an angular one. This tendency increases with increasing age (p = 0.04), and *age* as a continuous variable enter the logistic model of the *bouba-kiki* effect. In particularly, a cut-off value of age (>47 years) exists, and the dichotomic variable *age > 47* enter the logistic model as well. This is in agreement with the concept that quality of thought, represented here by the *bouba-kiki* effect. This is in agreement with the concept that thought changes and becomes more homogeneous in the population with growing age, being however significantly different after 47 years.

Another consideration is that the bouba-kiki effect is markedly less pronounced when the task is administered at distance, i.e. without a researcher physically in front of participants. It is therefore plausible that the rapport created by the personal researcher-participant direct interaction act as a confounder. The test maintains its validity on-line too, and the frequency of the names *bouba* for rounded figure and the name *kiki* for spiky figure remain prevalent in both settings, but although the figure-name association is reduced.

Sex of participants and years of formal school education have, on the contrary, no impact on the association between the figure and its name, nor in presence or at distance.

According to Ramachandran & Hubbard (2001), subjects tend to map the name *kiki* onto the angular figure and the rounded contours onto the name *bouba* because of the sharp inflection of the visual shape. It is therefore plausible the results indicate that names tend to be archetypically immanent in things.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

References

Ćwiek, A., Fuchs, S., Draxler, C., Asu, E. L., Dediu, D., Hiovain, K. et al. (2022). The

Bouba/Kiki Effect Is Robust across Cultures and Writing Systems. *Philosophical Transactions of the Royal Society B, 377*. https://doi.org/10.1098/rstb.2020.0390

De Long, E. R., De Long, D. M., & Clarke-Pearson, D. L. (1988). Comparing the Areas Under Two or More Correlated Receiver Operating Characteristic Curves: A Non Parametric Approach. *Biometrics, 44,* 837-845. https://doi.org/10.2307/2531595

Kim, S. H. (2020). Bouba and Kiki inside Objects: Sound-Shape Correspondence for Objects with a Hole. *Cognition, 195,* 104132. https://doi.org/10.1016/j.cognition.2019.104132

Köhler, W. (1929). *Gestalt Psychology*. Liveright, New York.

Peiffer-Smadja, N., & Cohen, L. (2019). The Cerebral Bases of the Bouba-Kiki Effect. *Neuroimage, 186,* 679-689. https://doi.org/10.1016/j.neuroimage.2018.11.033

Ramachandran, V. S., & Hubbard, E. M. (2001). Synaesthesia—A Window into Perception, Thought and Language. *Journal of Conscious Studies, 8,* 3-34. https://www.researchgate.net/publication/318494178

Schisterman, E. F., Perkins, N. J., Liu, A., & Bondell, H. (2005). Optimal Cut-Point and Its Corresponding Youden Index to Discriminate Individuals Using Pooled Blood Samples. *Epidemiology, 16,* 73-81. https://doi.org/10.1097/01.ede.0000147512.81966.ba

Wong, L. S., Kwon, J., Zheng, Z., Styles, S. J., Sakamoto, M., & Kitada, R. (2022). Japanese Sound-Symbolic Words for Representing the Hardness of an Object Are Judged Similarly by Japanese and English Speakers. *Frontiers in Psychology, 13,* 830306. https://doi.org/10.3389/fpsyg.2022.830306