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PROFICIENCY OF LANGUAGE AND ITEM FAMILIARITY: THEIR EFFECTS ON THE I-BNT IN BALINESE

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KEMAHIRAN BAHASA DAN FAMILIARITAS ITEM: EFEKNYA PADA PERFORMA I-BNT PADA SUKU BALI

Abstrak

Studi ini meneliti peran kemahiran berbahasa, familiaritas terhadap butir tes, lama waktu pendidikan, usia, jenis kelamin, dan domisili tempat tinggal terhadap performa individu bersuku Bali pada Boston Naming Test versi Indonesia (I-BNT). Sebanyak 154 partisipan yang berasal dari wilayah perdesaan dan perkotaan di Pulau Bali, dengan beragam usia dan lama waktu pendidikan, berpartisipasi dalam penelitian ini. Hasil penelitian menunjukkan bahwa familiaritas terhadap butir tes berkorelasi positif dengan performa tes. Selain itu, kemahiran berbahasa memainkan peran terhadap performa tes, tetapi efeknya tidak ditemukan setelah mengontrol usia dan pendidikan sebagai variabel kovariat. Efek domisili tempat tinggal tidak ditemukan dalam penelitian ini. Dapat disimpulkan bahwa skor normatif (norma) I-BNT tidak membutuhkan adaptasi selain pendidikan dan usia.

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Abstract

This study investigated whether language proficiency, familiarity with the test items, years of education, age, sex, and type of residential area affect the performance of the Indonesia-adapted Boston Naming Test (I-BNT) among Balinese. 154 participants from urban and rural parts of Bali Island, varying in age and years of education, divided into three language proficiency groups, participated in this study. The results showed positive correlations between familiarity with the items and performance scores. Also, language proficiency affected the scores. However, the effect of language proficiency disappeared after accounting for age and education as covariate variables. There were no residential area effects. It can be concluded that the normative scores for the I-BNT do not need an extra adaptation beyond education and age.

Keywords: Balinese, Boston Naming Test, bilingualism, cross-cultural neuropsychology, word production test

Impacts and Implication in the Indigenous Context

The investigation of language proficiencies on cognitive tests is rarely explored in the Indonesian context. Although most cognitive tests are adapted into Bahasa Indonesia, the lingua franca and national language, the challenge of ensuring fairness in psychological assessment within a multilingual population is often overlooked. This study was conducted in Bali, where the Balinese language is widely spoken in urban and rural areas. Through this research, we expand the existing literature by examining whether and how proficiency in local languages affects performance on cognitive tests administered in Bahasa Indonesia.

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INTRODUCTION

Neuropsychological assessment helps practitioners obtain an objective indication of various cognitive functions, diagnose brain-related diseases, identify treatment needs, and evaluate treatment programs (Lezak et al., 2012). Cross-cultural studies on neuropsychological assessment provide information regarding whether certain assessments can be delivered across cultures (Fernández & Abe, 2017), this is especially important in multicultural countries i.e., Indonesia, which inherits a bilingual culture (Sutama, 2019). Most Indonesians speak the local language as their first language and Bahasa Indonesia, the national language (Sutama, 2019), is their second language. Administering language tests, such as the adapted version of the Indonesian-Boston Naming Test (I-BNT) (Sulastri et al., 2018), in Bahasa Indonesia needs further investigations to make sure that the accuracy of the assessment is identical across a huge diversity of ethnic and language groups. The BNT, commonly used worldwide (see e.g. Patricacou et al., 2007), is an object naming task designed to identify word retrieval problems in which 60 cards with various objects (Kaplan et al., 1983), in sequence from easy to more difficult, are presented, and test takers have to produce the names of the objects.

Investigations on the fairness of assessment across ethnic groups have been done by several researchers throughout the last two decades (Baird et al., 2007; Elbulok-Charcape et al., 2014; Gasqouine, 2022; Puente & Perez-Gracia, 2020). The results revealed disadvantages of less education or a lack of more than nine years of education (Gasqouine, 2022). Next, literacy versus illiteracy (Baird et. al., 2007), and familiarity with the language used in the assessment were among the identified factors (Elbulok-Charcape et. al., 2014). Previously, we established effects on the I-BNT and other cognitive tests within the Indonesian context regarding whether Indonesian people speak Bahasa Indonesia at home or not (Immanuel et al., 2024; Pesau et al., 2023).

Balinese learn to speak Bahasa Indonesia from elementary school onwards and Bahasa Indonesia is used in formal conversation, e.g., conversation with teachers at school or co-workers at the office (Devi & Kasni, 2018). It is also the language of the mass media, among others the national television, in most businesses, and the language in which the government communicates. Preference and proficiency in speaking Bahasa Bali or Bahasa Indonesia are affected by environmental factors that include cultural diversity and interaction between people within the society (Beratha et al., 2017). Environmental factors imply demographic factors, i.e., residential in urban or rural areas. Heterogeneous conversations between ethnicities are more typical for urban areas, hence, the Balinese tend to speak Bahasa Indonesia for conversations with domestics, or English, for conversations with foreigners in tourism areas (Mulyawan, 2021). In contrast, the homogenous

conversation between Balinese in Bahasa Bali characterises and dominates the conversation in rural areas.

Previous analysis of the adapted I-BNT among Balinese and Banjarese revealed that the Balinese sample showed lower performance on the spontaneous naming of objects and the time to complete the test (total time) and that Balinese needed more phonemic and a-phonemic (semantic) cues in comparison to Banjarese when the test was administered in Bahasa Indonesia (Pesau et al., 2022). A lower test score increases the chance of getting a false diagnosis, a lower chance of being admitted to an education program, or not being selected for a job. The outcome of the assessment might have been different in case that the test had been administered in Bahasa Bali.

The lower score in I-BNT performance among Balinese might be due to the proficiency in Bahasa Indonesia. Balinese predominantly use Bahasa Bali at home and a majority of them also use Bahasa Bali in public (Pesau et al., 2022). From a sociocultural perspective, Bahasa Bali is embedded in the social relationship between Balinese (Machdalena, 2014), hence, the conversation is mostly in Bahasa Bali. For almost all Balinese, Bahasa Bali is their primary language irrespective of whether the conversation occurs in public or at home and whether this conversation is formal or informal (Devi & Kasni, 2018; Sutama, 2019). Furthermore, Balinese people and the Balinese Village Government (*Desa Adat*) believe that speaking Bahasa Bali will nurture the Balinese culture throughout generations (Sosiawan et al., 2021), and Bahasa Bali exposure in public is also endorsed by the rules of Bali's Government (Mulyawan, 2021). Therefore, Bahasa Bali is widely and often spoken (in terms of frequency) by Balinese at home and in public. Here we will investigate the role of proficiency in speaking Bahasa Indonesia and Bahasa Bali on the I-BNT, assessed in Bahasa Indonesia.

Another reason for the low performance of the Balinese might be their familiarity with the 60 I-BNT items. The familiarity of the depicted objects might differ between cultures (Himmanen et al., 2003). Although previous research in a mixed US sample did not find clear differences within their sample of native-born, highly acculturated, and English-proficient participants (Misdraji-Hammond et al., 2015), it should be remembered that the BNT was developed by Americans and suited for the western-white-well educated-predominantly Christian population. Importantly, our population of interest is rather different regarding ethnicity, environmental factors, health care, socio-cultural, and type of religion. Others found that familiarity with the test stimuli of the BNT affected the response time of individuals; the speed in processing information is relevant as a behavioral measure for clinical purposes (Soble et al., 2016). Familiarity with presented stimuli is part of what is called “instrument bias” that might affect the results of neuropsychological assessment and their

interpretation (Fernández & Abe, 2017). Hence, we will investigate the role of familiarity with the stimulus cards and how this affects the I-BNT performance among Balinese.

Hypotheses of this study are that: 1) familiarity with the I-BNT stimuli correlates positively with the number of correct responses and negatively with response time; 2) the proficiency of the preferred language in Balinese bilinguals determines the performance on the I-BNT; and 3) people who live in rural areas will show lower scores than people who live in urban areas on the I-BNT performance. In the latter two research questions, it is important to control for age and education, since these two factors are known to have major effects on the scores of the BNT and I-BNT (Karstens, et al., 2024; Sulastri et al., 2018; Wahyuningrum et al., 2023). Large positive correlations were consistently found between education and the performance on the BNT, whereas, negative, smaller correlations were observed between age and BNT. The factor sex played either no or a minor role in the explanation of individual differences (Olabarrietta-Landa et al., 2015). The significant role of these independent variables is the reason for adapting the normative data, as is commonly done in neuropsychological assessment (Vanderploeg, 2014; Iñesta et al., 2022). To accurately investigate BNT score differences between bilingual groups in the present study, we controlled for age, education, and sex as covariates, consistent with our previous approach to examining the role of spoken language in language and non-language tests of the INTB (Pesau et al., 2023, Immanuel et al., 2024). We used a within-subject design: this has the consequence that an earlier assessment of the I-BNT affects the familiarity scores of the items. Therefore, half the subjects were first exposed to the I-BNT before the familiarity was assessed, and the other half got the familiarity test first and this was followed by assessing the I-BNT scores.

METHODS

Participants

Participants of this study were 154 healthy Balinese living in Bali Island. The health status of the participants was established through self-reported questionnaires. Demographic data, such as age, education, and ethnicity were collected additionally. Participants' age should be above 16 years old. The minimum age point, 16 years old, was chosen considering that most of the cognitive skills are fully developed at this age (except executive functions), that not all these tests were adapted for Indonesian children, and to sustain other I-BNT adaptation and psychometric studies (Sulastri et al., 2018; Wahyuningrum et al., 2022). Non-probability sampling approaches using quota sampling were used to include participants (Howitt & Cramer, 2016). Participants' categories were residential areas (urban and rural areas) and language proficiency (monolingual, balanced bilingual, bilinguals who

are better at speaking Bahasa Bali, and bilinguals who are better at speaking Bahasa Indonesia). Urban and rural areas were based on the data from Badan Pusat Statistik/Statistics Indonesia/Central Agency on Statistics, Republic of Indonesia (2021).

Ethical clearance of the research protocols was provided by the Research Ethics Committee, Faculty of Medicine, Universitas Udayana (protocol number 2022.02.1.1301). Information about research aims, data security, incentives for subjects, and consequences of participation was given, and subjects signed the written informed consent. The protocols adhered to the ethical principles of the Helsinki Declaration and local legislation. Informed consent was obtained in the same language as the administration of the tests, Bahasa Indonesia.

Procedure

After the explanation of the informed consent, subjects filled in the questionnaire regarding their demographic data and health status, followed by the Bilingualism self-rating questionnaire. Participants were randomly divided into two groups: participants in group A were given the I-BNT first, and this was followed by the familiarity questionnaire; group B was given the two tests in the reverse order. This allowed us to control for a putative order of test administration effect. The assessments were done by trained research assistants (trained psychology undergraduate students who are proficient in speaking Bahasa Bali and Bahasa Indonesia). The assistants recorded the answers in the answer sheet, provided the cues if necessary, and measured the response time for each of the 60 items.

The participants were divided into four groups based on the z-score from the bilingualism self-rating questionnaire. The four groups, consisting of Monolinguals (ML), Balanced Bilinguals (BB), Bilinguals who are better in Bahasa Bali (BL), and Bilinguals who are better at speaking Bahasa Indonesia (IL), were based on the difference of (transformed into z-score) their proficiency of Bahasa Bali and Bahasa Indonesia (Lai & O'Brien, 2020). The difference z-score started from -.50 to +.50 indicating no difference in Bahasa Bali and Bahasa Indonesia proficiency; therefore, participants who scored within this range were classified as Balanced Bilinguals (BB). A difference z-score below -.50 indicated that the proficiency in Bahasa Indonesia is higher than in Bahasa Bali, they were classified as the Bahasa Indonesia (IL) group. Participants with a difference z-score above +.50 were classified as Bilinguals who are better at speaking Bahasa Bali (BB).

Instruments

Adapted Indonesian Boston Naming Test (I-BNT). The I-BNT from the Indonesian Consortium of Neuropsychology was used; it consists of 60 pictorial stimuli (objects) with target

words in Bahasa Indonesia (Sulastri et al., 2018). The reliability of the I-BNT, based on both score and time measures, was previously examined using intra-class correlation and a test-retest approach. The results showed acceptable reliability indices, with ICCs ranging from .70 to .80, and test-retest correlation ranging from .84 to .88. For further details on the validity evidence of the I-BNT, see Wahyuningrum et al., (2022).

Participants were given the 60 pictorial stimuli and were asked to name the object within 20 seconds. If the participants failed at a trial, a phonemic cue was given, and if the participants failed again, a phonemic cue was given. Responses from participants were recorded using voice recording and written in the answer sheets. Response time was noted, as well as the number of both given cues.

Familiarity with the I-BNT questionnaire. The familiarity of 60 I-BNT pictorial stimuli was tested using Thurstone's method of successive intervals (Edwards & Gonzales, 1993). Participants were asked to rate the familiarity of all sixty objects on a scale of 1 (not familiar at all) to 9 (very familiar).

Demographic questionnaire. A questionnaire was used to identify demographic factors age, years of education, sex, language spoken in public, language spoken at home, and ethnicity of mother and father (Pesau et al., 2023; Sulastri et al., 2018). The questionnaire also gathered information about the medical history and current status of the health of the participants, including the present and past history of use of alcohol and drugs, current medication, and earlier or current psychiatric or neurological issues, including head trauma.

Bilingualism self-rating questionnaire. A bilingualism self-rating questionnaire was used to identify language proficiencies for Balinese using subjective self-rating. This questionnaire followed the protocols from Kamat et al. (2012). Participants were asked to rate his/her proficiency in two languages (Bahasa Bali and Bahasa Indonesia) on a scale of 0 to 6 (0 = no proficiency, 1 = very poor, 2 = fair, 3 = functional, 4 = good, 5 = very good, 6 = like native speakers).

Analysis Strategies

Pearson product-moment correlations were used to infer the correlation between the familiarity of each of the 60 I-BNT stimuli and the scores per item (the number of spontaneous generated items, the total number of correct items, and the response time per item (the time until a correct answer was given). The correlations between the sum of familiarity scores over all items with the total scores of the I-BNT were also calculated. However, if an interaction between familiarity score and testing order was observed, moderation regression analysis (MRA) was used to infer the correlation between familiarity scores and scores per item with testing order as a moderator variable.

An Omnibus three-factor ANOVA for each dependent variable was used to test the main effects (testing order, two levels; residential area, rural and urban; language proficiency, four levels ML, BB, BL, and IL) and their interactions on, I-BNT performance scores (spontaneously generated number of words, number of a-phonemic (semantic) and phonemic cues, total number of correct words, and total time). If a factor does not have a main effect or interaction with the other factors, then this factor was removed from all further analyses.

Further analyses, multiple regression analyses were used to establish the contribution of age, education, and sex on the familiarity scores and I-BNT performance scores. In case a factor predicted more than 1 percent of the total variance, their effect was controlled via separate ANCOVAs for each dependent variable with these demographic factors as covariates to reveal the role of proficiency of Bahasa Bali/Bahasa Indonesia on the I-BNT.

RESULTS

Demographic Characteristics

154 self-declared healthy Balinese participated in this study (Female = 104, M_{age} = 31.74, SD_{age} = 16.04). Their mean of years of education was 13.30 with *SD* = 3.04, 75 of them (48.7%) were living in urban and 79 (51.3%) were in rural areas. The age variables were categorized into age decade-groups as is often done in I-BNT research (Pesau et al., 2023; Wahyuningrum et al., 2022). Years of education variables were categorized according to Indonesian education levels (Elementary School, 1-6 years; Junior High School, 7-9 years; Senior High School, 10-12 years; Vocational or University Degree, 13-16 years; and Graduate Degree, >17 years). We collapsed elementary school and junior high school as junior high school and below (0-9) and master's degree and doctoral degree as graduate degrees (>17) due to the small number of participants in each group. Participants' demographic characteristics are presented in Table 1.

The data in Table 1 show that the majority (61%) of the participants were young (16-29), well educated (13 or more than 13 years of education), and spoke Bahasa Bali at home (61.7%), representing the rather young Balinese population. All of them considered themselves bilingual, and a bit more than fifty percent as Balanced Bilinguals, close to 20% were better at speaking Bahasa Indonesia, and close to 30% were better at Bahasa Bali. There were no monolinguals, and only 10% of the subjects spoke only Bahasa Indonesia at home. The lack of monolinguals reduced the number of language groups to three. However, most of the participants in this study also learned other languages such as English, Korean, French, German, or the Javanese languages as their third language (L3) or fourth language (L4).

Table 1.
Demographic Characteristics of Participants

Demographic Characteristics	***Group***	***n***	***(%)***
Age	16–19	36	23.4
	20–29	58	37.7
	30–39	14	9.1
	40–49	16	10.4
	50–59	20	13.0
	>60	10	6.5
Years of education	0–9	20	13
	10–12	49	31.8
	13–16	76	49.4
	>17	9	5.8
Language spoken at home	Bahasa Indonesia	16	10.4
	Bahasa Bali	95	61.7
	Bahasa Indonesia and other language(s)	43	27.9
Language spoken in public	Bahasa Indonesia	68	44.2
	Bahasa Bali	9	5.8
	Bahasa Indonesia and other language(s)	75	48.7
	English	2	1.3
Type of Bilingualism	Balanced Bilingual (BB)	80	51.9
	Bilingual with Predominantly Speaking Bahasa Indonesia (IL)	29	18.8
	Bilingual with Predominantly Speaking Bahasa Bali (BL)	45	29.2
Residential area groups	Urban	75	48.7
	Rural	79	51.3
Testing order	Testing order A	77	50
	Testing order B	77	50

Preliminary analyses I: The effect of testing order, residential area, and type of bilingualism on familiarity index and I-BNT performance

The Omnibus three-factor ANOVAs examined the effects of testing order (group A and B), residential area (urban and rural), and type of bilingualism (BB, IL, and BB) on I-BNT performance (spontaneous, a-phonemic, phonemic, total number of correct items or total score, and total time) and I-BNT object familiarity. The results are presented in Table 2.

Table 2.
Omnibus Three-Factor ANOVAs (Testing Order, Type of Bilingualism, and Residential Area) on I-BNT Performances and Object Familiarity)

Dependent Variables	***Independent Variables***	***F***	***p***	η^2
I-BNT spontaneous	Testing order	1.028	.312	.007
	Type of bilingualism groups	6.662$^{**)}$	.002	.085
	Residential area	.575	.449	.004
	Type of bilingualism groups*Residential area	.104	.901	.001
	Testing order*Type of bilingualism groups	.040	.961	.001
	Testing order*Residential area groups	.070	.792	.000
	Testing order*Type of bilingualism groups*Residential area	.848	.431	.012
I-BNT a-phonemic (semantic) cues	Testing order	.759	.358	.005
	Type of bilingualism groups	6.863$^{**)}$	.001	.088
	Residential area	.430	.513	.003
	Type of bilingualism groups*Residential area	.204	.816	.003
	Testing order*Type of bilingualism groups	.247	.781	.003
	Testing order*Residential area	.120	.730	.001
	Testing order*Type of bilingualism groups*Residential area	.837	.435	.012
I-BNT phonemic cues	Testing order	1.609	.207	.011
	Type of bilingualism groups	.298	.743	.004
	Residential area	.602	.439	.004
	Type of bilingualism groups*Residential area	2.492	.086	.034
	Testing order*Type of bilingualism groups	2.146	.121	.030
	Testing order*Residential area	.413	.522	.003
	Testing order*Type of bilingualism groups*Residential area	.616	.541	.009
I-BNT total score	Testing order	.451	.503	.003
	Type of bilingualism groups	4.815$^{*)}$	.009	.064
	Residential area	.770	.382	.005
	Bilingualism groups*Residential area	.743	.478	.010
	Testing order*Type of bilingualism groups	.212	.810	.003
	Testing order*Residential area	.107	.745	.001
	Testing order*Type of bilingualism groups*Residential area	.442	.643	.006
I-BNT total time	Testing order	.585	.446	.004
	Type of bilingualism groups	6.024$^{**)}$	.003	.078
	Residential area	.077	.782	.001
	Type of bilingualism groups*Residential area	1.971	.143	.027
	Testing order*Type of bilingualism groups	.701	.498	.010
	Testing order*Residential area	.924	.338	.006
	Testing order*Type of bilingualism groups*Residential area	.269	.764	.004
I-BNT object familiarity	Testing order	5.865$^{*)}$	.017	.040
	Type of bilingualism groups	2.379	.096	.032
	Residential area	1.025	.274	.008
	Type of bilingualism groups*Residential area	.500	.608	.007
	Testing order*Type of bilingualism groups	.322	.725	.005
	Testing order*Residential area	.035	.851	.000
	Testing order*Type of bilingualism groups*Residential area	.269	.764	.004

Note: ** = $p < .01$; * = $p < .05$

The data in Table 2 show only a significant effect of testing order on the object familiarity [$F(1,142) = 5.865$, $p < .05$, $\acute{\eta}^2 = .040$]: this implies that the participants, who were asked to rate the object familiarities first followed by the assessment with the I-BNT [$M = 473.8$, $SE = 10.8$, 95% C.I = (454.2, 495.3)] gave higher familiarity scores than participants who were asked to rate the object familiarity after the assessment of the I-BNT [$M = 438.2$, $SE = 9.9$, 95% C.I = (418.7, 457.7)]. The differences between the mean scores of the two groups of test orders A and B were used as the moderation variable reflecting familiarity scores in further analyses.

There were no significant effects of testing order and its interactions on any of the I-BNT scores, see also Table 2. The same was found for the residential factor: no main effects and interactions with the residential factor. These results imply that testing order and residential area did not affect participants' performance on the I-BNT and that these factors can be eliminated from further analyses of the I-BNT performance measures.

Significant effects of preferred language on I-BNT scores were observed. This regarded the number of spontaneously generated words [$F(2,142) = 6.66$, $p < .01$, $\acute{\eta}^2 = .085$], I-BNT the number of a-phonemic cues [$F(2,142) = 6.86$, $p < .01$, $\acute{\eta}^2 = .088$], the total number of correct words, [$F(2,142) = 4.81$, $p < .05$, $\acute{\eta}^2 = .078$], and total time [$F(2,142) = 6.02$, $p < .01$, $\acute{\eta}^2 = .078$]. However, these bilingualism group effects were examined later by ANCOVAs with age, education, and sex as covariates. They are commonly considered to affect neuropsychological functioning (Fernández, 2022; Johnson et al., 2012; Wahyuningrum et al., 2023).

As a second preliminary analysis, Multiple regression analyses were done to examine the effect of age, years of education, and sex on the I-BNT performances and object familiarity. Its outcomes will be influential regarding whether these demographic factors will indeed be used as covariates.

Preliminary Analyses II: The Effect of Age, Education, and Sex on I-BNT Performance

The outcomes of the multiple regression analyses are presented in Table 3. The regression analyses confirmed the effects of age on the number of spontaneous correct answers ($b = -.311$, $SE = .032$, $t = -9.766$, $p < .01$), the number of a-phonemic cues ($b = .062$, $SE = .009$, $t = 6.714$, $p < .01$), the total number of correct answers ($b = -.228$, $SE = .030$, $t = -7.692$, $p < .01$), and total time ($b = 8.289$, $SE = 1.522$, $t = 5.446$, $p < .01$). These results, and in particular the beta coefficients, demonstrated that higher age leads to lower ability to produce correct answers and longer time to retrieve object names. A negative effect for age was also found for object familiarity ($b = -1.140$, $SE = .388$, $t = -2.935$, $p < .01$): a higher age leads to a lower familiarity index.

Table 3.
The Effect of Age, Education, and Sex on I-BNT Performance as Determined with Regression Analyses

	F	R^2	*beta*	*SE*	*t*
I-BNT spontaneous					
(Intercept)	57.017$^{**)}$	.533	43.523	2.705	16.091$^{**)}$
Age			-.311	.032	-9.766$^{**)}$
Education			.952	.166	5.720$^{**)}$
Sex			1.178	1.048	1.124
I-BNT a-phonemic (semantic)					
(Intercept)	18.414$^{**)}$	.269	.830	.788	1.053
Age			.062	.009	6.714$^{**)}$
Education			-.054	.048	-1.120
Sex			-.046	.305	-.152
I-BNT phonemic					
(Intercept)	4.833$^{**)}$	.090	.092	.794	.116
Age			.017	.009	1.782
Education			.154	.049	3.158$^{**)}$
Sex			-.650	.305	-2.129$^{*)}$
I-BNT total score					
(Intercept)	47.089$^{**)}$	.485	44.685	2.515	17.766$^{**)}$
Age			-.228	.030	-7.692$^{**)}$
Education			1.021	.155	6.594$^{**)}$
Sex			.308	.975	.316
I-BNT total time					
(Intercept)	16.384$^{**)}$	.252	636.072	129.166	4.924$^{**)}$
Age			8.289	1.522	5.446$^{**)}$
Education			-23.000	7.949	-2.893$^{**)}$
Sex			-18.290	50.055	-.365
I-BNT object familiarity index					
(Intercept)	9.650$^{**)}$	.162	389.741	32.968	11.822$^{**)}$
Age			-1.140	.388	-2.935$^{**)}$
Education			7.196	2.029	3.547$^{**)}$
Sex			6.124	12.776	.479

Note: ** = p<.01; * = p<.05

Years of education also played an important role in predicting the I-BNT performance: this was the case for the number of spontaneously generated words (b = .952, SE = .166, t = 5.720, p < .01), the number of phonemic cues (b = .154, SE = .049, t = 3.158, p < .01), the total number of correct words (b = 1.021, SE = .155, t = 6.594, p < .01), and total time (b = -23.00, SE = 7.949, t = -2.893, p < .01). These results revealed that the more years of education leads to higher ability to produce correct answers and shorter time to retrieve the names of the objects. A positive education effect was also found for the familiarity index (b = 7.196, SE = 2.029, t = 3.547, p < .01): more years of education is accompanied by higher familiarity scores.

The effect of sex was found only on the number of phonemic cues (b = -.605, SE = .305, t = -2.129, $p < .05$): males needed fewer cues. No sex effects were found on the other I-BNT performance measures and the familiarity score.

Research Question I: The Role of Object Familiarity on I-BNT Performance

Our first hypothesis was that object familiarity positively correlates with the I-BNT's correct responses, and that object familiarity negatively correlates with the I-BNT's response time. Since testing order affected the familiarity score (see preliminary analyses I), the testing order factor was suspected to be a moderator variable in determining the correlation between familiarity and I-BNT correct response and response time, and was therefore checked using moderated regression analysis.

This analysis showed however, that there was no effect of testing order in moderating the correlation between familiarity score and I-BNT total score (b = -.013, SE = .015, p = .392), familiarity score and I-BNT spontaneous score (b = -.006, SE = .016, p =.724), and familiarity score and I-BNT total time (b = -.082, SE = .640, p = .898). Therefore, testing order can be excluded for the determination of the correlation between familiarity and I-BNT number of correct words and familiarity and I-BNT total time.

The familiarity scores were all high for the first two dozen items and decreased slowly over the following items. The correlation analysis for each item between familiarity score and spontaneous and total I-BNT score showed generally positive values (range -.068 to .460; mean .213 spontaneous and range -.043 to .514; mean .204 total score), and negative for time (range .006 to -.711; mean -.213). The correlations tended to increase somewhat for the higher trial numbers and were, in most cases, significant. Correlation coefficients for each I-BNT item can be seen in Table 4.

Table 4.
Correlation Coefficients Between the Familiarity of the 60 Items and Performance of I-BNT

Object	***BNT Familiarity Mean Score & SD***	***BNT Spontaneous***	***BNT Total Score***	***BNT Time***
Item 1	8.708 (1.114)	.281**)	.104	-.122
Item 2	8.864 (.584)	-.038	-.019	-.119
Item 3	8.818 (.530)	NaN	NaN	-.041
Item 4	8.903 (.533)	-.015	-.015	-.711**)
Item 5	8.435 (1.226)	-.053	-.037	-.063
Item 6	8.812 (.602)	NaN	NaN	-.070
Item 7	8.519 (1.184)	.221**)	.221**)	-.296**)
Item 8	8.578 (1.125)	.278**)	.140	-.102
Item 9	8.552 (1.210)	-.068	-.043	.006
Item 10	8.857 (.736)	.118	.134	-.151
Item 11	6.773 (2.633)	.228**)	.110	-.130
Item 12	8.344 (1.602)	.017	.017	-.130
Item 13	8.052 (1.785)	.100	NaN	-.204*)

Object	*BNT Familiarity Mean Score & SD*	*BNT Spontaneous*	*BNT Total Score*	*BNT Time*
Item 14	8.734 (.817)	-.038	NaN	-.021
Item 15	7.318 (2.289)	.005	-.034	-.077
Item 16	7.318 (2.240)	.288$^{**)}$	.299$^{**)}$	-.367$^{**)}$
Item 17	7.344 (2.350)	.105	.087	-.189$^{*)}$
Item 18	7.494 (2.185)	.169$^{*)}$	.210$^{**)}$	-.217$^{**)}$
Item 19	7.318 (2.381)	.226$^{**)}$	.281$^{**)}$	-.144
Item 20	6.909 (2.506)	.318$^{**)}$	.290$^{**)}$	-.275$^{**)}$
Item 21	8.682 (.988)	.263$^{**)}$	.127	-.405$^{**)}$
Item 22	7.669 (2.045)	-.012	.027	-.007
Item 23	7.597 (2.219)	.345$^{**)}$	.407$^{**)}$	-.353$^{**)}$
Item 24	6.409 (2.685)	.265$^{**)}$	.265$^{**)}$	-.267$^{**)}$
Item 25	7.091 (2.521)	.367$^{**)}$	.362$^{**)}$	-.309$^{**)}$
Item 26	6.968 (2.573)	.212$^{**)}$	.154	-.102
Item 27	7.279 (2.361)	.212$^{**)}$	.215$^{**)}$	-.228$^{**)}$
Item 28	7.981 (1.845)	.212$^{**)}$	.133	-.140
Item 29	8.052 (1.741)	.460$^{**)}$	.452$^{**)}$	-.422$^{**)}$
Item 30	7.357 (2.189)	.311$^{**)}$	.309$^{**)}$	-.266$^{**)}$
Item 31	7.552 (2.068)	.416$^{**)}$	.257$^{**)}$	-.315$^{**)}$
Item 32	8.123 (1.662)	.238$^{**)}$	-.015	-.176$^{*)}$
Item 33	7.513 (2.040)	.188$^{*)}$	.100	-.226$^{**)}$
Item 34	6.299 (2.794)	.213$^{**)}$	.218$^{**)}$	-.200$^{*)}$
Item 35	6.695 (2.757)	.330$^{**)}$	.238$^{**)}$	-.291$^{**)}$
Item 36	7.617 (2.296)	.423$^{**)}$	.424$^{**)}$	-.495$^{**)}$
Item 37	8.552 (1.091)	.059	.115	-.178$^{*)}$
Item 38	6.981 (2.511)	.187$^{*)}$	.293$^{**)}$	-.296$^{**)}$
Item 39	7.701 (2.081)	.399$^{**)}$	.514$^{**)}$	-.332$^{**)}$
Item 40	7.734 (1.782)	.195$^{*)}$	.190$^{*)}$	-.146
Item 41	8.708 (.900)	.131	.242$^{**)}$	-.210$^{**)}$
Item 42	7.299 (2.194)	.194$^{*)}$	.220$^{**)}$	-.183$^{*)}$
Item 43	7.734 (2.026)	.348$^{**)}$	.398$^{**)}$	-.289$^{**)}$
Item 44	6.870 (2.579)	.246$^{**)}$	.166$^{*)}$	-.232$^{**)}$
Item 45	7.409 (2.342)	.105	.119	-.086
Item 46	7.240 (2.304)	.242$^{**)}$	.118	-.273$^{**)}$
Item 47	6.455 (2.662)	.247$^{**)}$	.211$^{**)}$	-.197$^{*)}$
Item 48	7.753 (1.958)	.215$^{**)}$	.148	-.208$^{*)}$
Item 49	6.981 (2.364)	.221$^{**)}$	.163$^{*)}$	-.166$^{*)}$
Item 50	6.338 (2.645)	.302$^{**)}$	.340$^{**)}$	-.322$^{**)}$
Item 51	7.299 (2.393)	.339$^{**)}$	.382$^{**)}$	-.267$^{**)}$
Item 52	8.383 (1.315)	.139	.214$^{**)}$	-.223$^{**)}$
Item 53	6.468 (2.610)	.300$^{**)}$	.374$^{**)}$	-.328$^{**)}$
Item 54	7.532 (2.176)	.116	.221$^{**)}$	-.115
Item 55	4.662 (2.808)	.246$^{**)}$	.256$^{**)}$	-.319$^{**)}$
Item 56	6.584 (2.504)	.276$^{**)}$	.169$^{*)}$	-.255$^{**)}$
Item 57	5.532 (2.735)	.179$^{*)}$	.239$^{**)}$	-.089
Item 58	6.974 (2.479)	.129	.186$^{*)}$	-.126
Item 59	6.487 (2.372)	.238$^{**)}$	.186$^{*)}$	-.180$^{*)}$
Item 60	6.032 (2.886)	.259$^{**)}$	.237$^{**)}$	-.152

Note: ** = $p < .01$; * = $p < .05$; NaN=*Not-a-Number (correlation coefficient can be inferred due to zero variance of the variables)*

Pearson correlation coefficients between total familiarity score on the one side, and I-BNT total number of correct words and I-BNT total time on the other showed a positive correlation between total familiarity and I-BNT number of correct words, $r(152) = .428$, $p < .01$, the higher score of object familiarity leads to a higher number of correct responses. The correlation between the total familiarity score and I-BNT total time was significant and negative: $r(152) = -.398$, $p < .01$, a higher score of object familiarity correlated with a shorter time to respond to I-BNT stimuli.

Research Question II: The Type of Bilingualism and Its Effects on I-BNT Performance

ANCOVAs were used to infer differences between types of bilingualism groups on I-BNT performance controlling for age, education, and sex as covariate variables. The results can be seen in Table 5.

Table 5.
The Effect of Bilingual Groups on I-BNT Performance and Total Familiarity Index by Controlling Age, Education, and Sex as Covariates

Variables	*F*	*p*	$\acute{\eta}^2$
Spontaneous score	.521	.595	.007
A-phonemic (semantic) score	2.402	.094	.031
Phonemic score	.894	.411	.012
Total score	.054	.948	.001
Total time	1.243	.291	.017
Total familiarity	.092	.644	.001

According to the outcomes of the ANCOVAs, presented in Table 5, the effect of types of bilingualism was no longer observed in any of the I-BNT performance scores after controlling for age, education, and sex. Before controlling for covariate variables, we observed that Balanced Bilinguals (BB) and Bilinguals with Predominantly Speaking Bahasa Indonesia (IL) had higher spontaneous and total scores than Bilinguals with Predominantly Speaking Bahasa Bali (BL) in both spontaneous scores and total scores, but lower scores in a-phonemic scores. To complete the I-BNT, BB and IL showed shorter total time than BL. However, our final analyses indicated that after controlling for covariate variables, the differences in all I-BNT scores, total time, and familiarity were not statistically significant. As a result, post-hoc tests were not conducted to compare differences between types of bilingualism groups due to non-significant findings.

The comparison of the latter results with those presented in Table 2 (ANOVAs) shows that age, education, and sex fully explain the bilingualism effect on the performance of I-BNT. A comparable result was obtained for the familiarity score; also, for this variable, the demographic factors explained the language effect.

Table 6 provides the descriptive statistics contrasting the mean I-BNT scores, time, and familiarity between the language groups (BB, IL, and BL), before and after controlling for age, years of education, and sex.

Research Question III: The Role of Residential Areas on I-BNT Performance

The outcomes of the ANOVAs (see Table 2) showed that there were no differences in I-BNT performance regarding the residential area.

Table 6.
Differences between mean and std. deviation of the scores from ANOVAs before (mean scores) and after (adjusted mean scores) controlling for age, years of education, and sex as covariates) from ANCOVAs of the I-BNT and Familiarity scores

Variables	ANOVAs' Descriptive Statistics Mean Score (Std. Deviation)				ANCOVAs' Descriptive Statistics Adjusted Mean Score (Std. Error)		
	BB (*n* = 80)	IL (*n* = 29)	BL (*n* = 45)	ANOVA's Post-hoc test	BB (*n* = 80)	IL (*n* = 29)	BL (*n* = 45)
Spontaneous score	47.6 (7.9)	50.2 (3.4)	42.7 (11.1)	BB > BL; IL > BL	47.1 (.7)	46.6 (1.2)	46.0 (.9)
A-phonemic (semantic) score	1.9 (1.8)	1.1 (1.1)	3.0 (2.5)	BB < BL; IL < BL	2.0 (.2)	1.6 (.3)	2.5 (.3)
Phonemic score	2.3 (1.9)	2.9 (1.5)	2.5 (1.9)		2.3 (.2)	2.8 (.3)	2.5 (.3)
Total score	51.7 (6.5)	54.1 (2.8)	48.2 (10.6)	BB > BL; IL > BL	51.3 (.6)	51.0 (1.1)	50.9 (.9)
Total time	545.5 (280.9)	477.2 (197.5)	726.5 (423.1)	BB < BL; IL < BL	561.9 (32.2)	564.2 (55.2)	647.5 (44.7)
Total familiarity	453.9 (74.0)	472.8 (61.9)	432.6 (92.4)		451.5 (8.3)	455.8 (14.2)	447.8 (11.5)

Note: *BB=Balanced bilingual; BI=Bilingual with Predominantly Speaking Bahasa Indonesia; BL=Bilingual with Predominantly Speaking Bahasa Bali; Post-hoc test p < s.05. Note that the significant language proficiency effect found in the ANOVA are no longer present in the ANCOVA, when the data were adjusted for age and education effects.*

DISCUSSION

The major outcomes of the study were that familiarity with the objects correlated positively with the number of correct items and negatively with the time to complete the test, that the proficiency of the preferred language in Balinese bilinguals determines the performance on the I-BNT, but that this effect is completely due to the demographic effects education and age.

Earlier, it was found that familiarity affects the naming of the objects in the BNT and this may be confounded with what the researcher or clinician is interested in (Misdraji-Hammond, et al., 2015; Himmanen et al., 2003). Also, the speed of information processing was affected by familiarity with the BNT items since an increase in familiarity speeded up the processing of BNT word representations

(Ferraro & Lowell, 2010). That is why studying familiarity may have relevance, also considering what is called in the literature the "White privilege in neuropsychology" (Cory, 2021), emphasizing that many of the neuropsychological tools and procedures have "ethnoracial and linguistic characteristics and are quite disparate from those characteristics of the population" that is studied here. The present results, regarding the relation between object familiarity and I-BNT performances, confirm the relationships on the item and group level by positive correlations between the familiarity and correct scores and negative correlations between response time (speed) and correct scores. Interestingly, these relations with the familiarity of the items were found in a completely different ethnoracial and linguistic environment as previously investigated (Himmanen et al., 2003). A similar result, a positive correlation between familiarity of items in a picture naming test with correct scores was also reported in an Indian cohort (George et al., 2007). This suggests that familiarity with the items is a universal factor affecting the scores of the BNT.

Familiarity ratings are sensitive to the testing order. Our study confirmed that rating trends tended to be higher if the familiarity rating was asked before the I-BNT test. In contrast, lower familiarity ratings were observed if the familiarity rating was asked after the I-BNT test. These phenomena might be affected by failure and success in responding to I-BNT items. However, there were no signs of testing order in moderating familiarity and I-BNT performances.

We could not establish whether the familiarity of the items might differ within Indonesian ethnic groups; earlier differences between Banjarese and Balinese were found on the I-BNT (Pesau et al., 2022). It is quite possible that the depicted objects are encountered with varying frequencies across cultures. However, considering the outcomes of the present study, in which we found that age and education predicted the familiarity index, as well as that age and education, predicted the I-BNT and that familiarity was no longer significant in the analyses controlling for the demographic factors, we conclude that the role of familiarity of the I-BNT items is completely explained by the demographic variables. Therefore, it is not likely that the familiarity of the items is a cause of the lower Balinese scores.

We investigated the role of proficiency in speaking Bahasa Bali compared to proficiency in speaking Bahasa Indonesia on I-BNT performance by measuring self-rating language proficiency in both languages. Our results showed that Balinese are inherently bilingual speakers, none of them declared to be monolingual, and this was irrespective of whether participants came from rural or urban parts of Bali. The number of people who predominantly speak Bahasa Bali is higher than the number of people who predominantly speak Bahasa Indonesia. More precisely, by calculating the difference in standardized scores between proficiency in Bahasa Indonesia and Bahasa Bali, about

half of them consider themselves balanced bilinguals, close to 30% bilinguals with predominantly speaking Bahasa Bali, and almost 20% bilinguals with predominantly speaking Bahasa Indonesia. These distributions were expected since others also reported that most Balinese used Bahasa Bali as their primary language during conversations at home and in public. Furthermore, all Balinese learn to speak Bahasa Indonesia at school, and Bahasa Indonesia is mainly used in formal conversations (Devi & Kasni, 2018; Sutama, 2019).

It was hypothesized that bilinguals indicating having a better proficiency in Bahasa Indonesia compared to those indicating to be better in Bahasa Bali, would perform better on the I-BNT. Although clear effects were found confirming our hypothesis, a check regarding the role of the demographic factors in the ANCOVAs, showed not only that both education and age had major effects on the performance of the I-BNT, but the latter effects were also found with regression analysis, but also that these demographic factors completely explained the type of bilingualism effects since the group differences disappeared in the ANCOVAs as well. Therefore, it can be concluded that the self-declared proficiency of the preferred language in Balinese bilinguals does not determine the performance on the I-BNT. The disappearance of the type of bilingualism group effect after controlling for age and education provides notions on the interplay between language spoken, age, and education. The cross-cultural neuropsychological literature mentioned that the bilingual culture of a society might be affected by educational experiences among test takers (Strutt & MacDonald, 2022). We also think that this is reasonable considering that education and age are the largest predictors for the BNT (Fernandez, 2022; Sulastri et al., 2018; Wahyuningrum et al., 2022) and that participating in Indonesia's education system is almost a guarantee for speaking Bahasa Indonesia on a good level, perhaps reinforced by its widespread use outside the field of education.

Our results, the presence of a significant length of education effect on I-BNT performances aligns with others for the BNT (Fernandez, 2022; Savoie et al., 2019) and with our previous studies with the I-BNT (Pesau et al., 2023; Sulastri, et al., 2018). Developing norms respecting the years of schooling should be taken into consideration, as is internationally done. Further studies investigating the performance of illiterate or low-educated individuals in Indonesia from various parts of the archipelago are necessary in case one needs reliable normative scores for all Indonesians, quite a challenge.

Our age-related effects on the I-BNT regarding the number of correct items and time to complete the test align with many previous studies of the BNT (Abrams & Davis, 2016; Ashaie & Obler, 2014; Karstens, et al., 2024; Oberle & James, 2013; Sulastri et al., 2019; Tombaugh & Hubley, 1997; Vanderploeg, 2014; Zec et al., 2007)), although this has not been found in all studies and is

less likely to occur in long educated persons. Cohort effects regarding general health status, intelligence, and years and quality of education might be the reason. The age-declining effect is also observed in longitudinal and normative studies on confrontation naming test ability (Fällman et al., 2022). Age-related changes in white matter tracts affected the phonological aspect of language production (Troutman & Diaz, 2020). The effect of aging on language production is usually explained by the Transmission Deficit Hypothesis. The often-reported tip-of-tongue (TOT) phenomenon, also described by this hypothesis, is a common response of older adults in providing the names of an object (MacKay & Burke, 1990). Inaccuracy in giving names increases as a function of age and weakens the linkage strengths of the connection between phonological and semantic nodes. Generally speaking, older adults tend to provide fewer correct answers in naming ability in comparison to younger adults (Oberle & James, 2013).

Sex effects, males needing fewer cues, were only observed in the number of phonemic cues: it regards the ability to give a correct response after receiving a phonemic cue. This variable is clinically not often used, However, there were no sex effects observed in the total number of correct answers, total time, spontaneous number of generated answers, and the number of a-phonemic/semantic cues. Sex effects were rarely found in BNT normative studies (Iñesta et al., 2022). Sometimes an interaction between sex, age, and education was reported: older than 71 years, well-educated women outperformed the age and education-matched males, while the sex difference was the opposite in poor-educated groups (Patricacou et al., 2007). A low effect size of sex on BNT performance is also more often reported, hence the corrections for normative scores are not required (Olabarrieta-Landa et al., 2015).

Differences between residents living in rural versus urban areas were described in a population of Han Chinese in the Montreal Cognitive Assessment scale, and urban people did better than rural residents even after controlling for age, sex, and education effects (Lu et al. 2011). A higher prevalence of mild cognitive impairment and dementia was found in rural versus urban areas as well, again after standardizing for age, sex, and level of education (Chuang et al., 2021; Jia et al., 2014). Others reported rural-urban differences in different cognitive domains, and these differences became more prevalent in older subjects (Saenz et al., 2018). We did not find the expected differences, a putative reason could be that the criteria for rural versus urban are different in the different countries. We used the definition of the Indonesian rural and urban areas by the Indonesian Bureau of Statistics (Badan Pusat Statistik, 2022) classifications that considered public facilities, i.e., schools, markets, shops, hospitals, entertainment, internet access, and electricity coverage.

Another reason is that the mean age of our participants was rather young, and that differences between urban vs rural, as reported in the literature, were primarily found for people older than 50 (Saenz et al., 2018). Nowadays it is common for children in rural areas to have more years of education than previously, therefore younger people have a longer education compared to older people, next, the quality of healthcare, living style, and access to mass and social media, are likely to have bridged the gap between rural and urban living millenniums.

Testing order did not affect the performance on the I-BNT: having seen the pictures and rating their familiarity a few minutes before does not seem to be critical for the performance of the test. It justifies our within-subject design; earlier others seeking a relationship between familiarity and BNT scores used a between-group design, and they also reported positive correlations between familiarity and correct names (Himmanen et al., 2003). There was an order effect on the familiarity data. The group that saw the pictures before taking the I-BNT indicated a higher familiarity than those who did the two tests in the opposite order. It can be speculated that the lower scores are due to people acknowledging ad-hoc that they were not able to generate the right word.

A limitation of our study is that the proficiencies in both languages were obtained through self-report, having an obvious subjective element. Measuring language performance might be a better option. On the other hand, we used a previously validated procedure to assess language proficiency by calculating z-score differences (Lai & O'Brien, 2020) of perceived language proficiency in two languages, in our case, Bahasa Indonesia and Bahasa Bali. A second limitation is that the mean age of the Balinese participants was rather young and that the number of years of education was above average. Therefore, it cannot be excluded that language proficiency remains a confounding factor for older people unless the I-BNT is adapted for Balinese, the assessments will be done in Bahasa Bali, and the effects of language proficiency will be objectively assessed.

CONCLUSION AND RECCOMENDATIONS

The I-BNT is sensitive to the commonly reported demographic factors. Also, language proficiency and familiarity with the items significantly influence the I-BNT. However, controlling for demographic factors age and education eliminated both the language proficiency and familiarity effect on the I-BNT. This implies that there is no need to adapt the normative scores for the Balinese for language proficiency beyond age and years of education. Only preliminary scores for the Javanese population have been published (Sulastri et al., 2018; Wahyuningrum et al., 2022), the current study provides again evidence for the necessity to come up with age and education-adapted normative scores to get a precise and fair interpretation of naming object proficiency.

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COMPLIANCE WITH ETHICAL STANDARD

Ethical Statement

All procedures performed in this study were in accordance with the 1964 Helsinki Declaration and its amendments or with comparable ethical standards. The ethical aspect of this study has been reviewed and approved by the Research Ethics Committee, Faculty of Medicine, Universitas Udayana (Approval number: 2879/UN14.2.2.VII.14/LT/2022 with Protocol number: 2022.02.1.1301). Written informed consent has been obtained from all participants in this study.

Conflict of Interest

The authors declare no competing interests.

Daya Availability

The datasets used in this study are available from the corresponding author through email at aimmanuel@umass.edu or immanuel.aria@outlook.com.

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