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Research Article

Structural Equation Modeling of the relationship among BFI and components of IELTS reading and speaking modules among female candidatesAbdolHamid Mohammadi¹Seyed Ayatollah Razmjoo²Shahram Afraz³Fazlollah Samimi⁴

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ABSTRACT

The current study investigates the role of Brain-Friendly Instruction components namely, Assessment, Motivation, and Instruction in predicting the IELTS reading and speaking scores of female candidates. The present research was conducted with 120 female EFL learners through SEM with Smart PLS. It was found that the components of BFI are positively and significantly related to language proficiency outcomes. Whereas Assessment and Motivation were found to enhance IELTS reading scores significantly, Instruction was considered the most critical factor affecting speaking scores. From this, it is clear that to consider brain-friendly pedagogical practices, students' cognitive and emotional needs will have to be taken into account. The current study contributes to the existing literature pool with empirical data related to BFI effectiveness within language education. It points out the need for educators to inculcate such principles into their instructional strategies. In this direction, the creation of a nonthreatening learning environment, along with the implementation of proper assessment tools, will significantly improve the language output, especially for female learners who experience very particular problems when learning in EFL settings. The implications of this study are, therefore, useful in informing the practice of language professionals, curriculum developers, and researchers interested in the improvement of English proficiency using innovative instructional approaches. Further research is recommended to establish how far BFI principles can be generalized across different educational contexts and learner profiles to consolidate the findings presented here.

Keywords: Brain-Friendly Instruction, IELTS, Reading Scores, Speaking Scores, English as a Foreign Language (EFL)



1. INTRODUCTION

In the modern context of language learning, especially with respect to EFL, there is an increasing interest in how different approaches to instruction affect language learning and performance. Among such methods, one of the recent trends is so-called Brain-Friendly Instruction. BFI is focused on teaching methods that conform to how the brain learns naturally, emphasizing the presentation of an environment that is supportive, engaging, and free from stress. This approach has even further relevance when high-stake language proficiency tests are taken into view, such as IELTS, whose performance might significantly impact the learner's academic and professional pursuits.

The IELTS test is highly regarded for its stringency in the testing of English and for its reading and speaking modules, which put the understanding, analysis, and expression of candidates to real tests. Understanding the factors underlying success in these modules is important for educators and learners alike. Again, in this direction, the infusion of BFI principles into IELTS preparation programs may provide certain useful insights toward optimal learning results.

Although much research has focused on general language acquisition strategies, there is a particular lack in terms of the specific relationship that BFI has with performance in the distinct components of the IELTS test. The current study, therefore, seeks to fill this gap by using SEM to explore the complex relations between BFI and the reading and speaking modules of the IELTS test with female EFL learners. Such a choice could be made because the awareness of gender related differences in language learning processes and outcomes allows for more detailed insight into BFI efficacy.

Through these relationships, this study attempts to determine which facets of BFI most strongly relate to IELTS performance. It will provide practical implications for educators to help them improve their teaching methods. Additionally, the findings will add to the general discussion of a gender related approach in language learning education with the aim of encouraging women's ambitions in EFL.

By thoroughly investigating these variables, this research hopes to contribute a comprehensive model explaining the paths through which BFI affects reading and speaking proficiency. Therefore, this study will be of help to both theory and practice in the EFL education field.

The following questions are answered by the researcher in this research:

1. Which specific components of Brain-Friendly Instruction (BFI) have the most significant impact on the IELTS reading scores of female candidates?
2. Which specific components of Brain-Friendly Instruction (BFI) have the most significant impact on the IELTS speaking scores of female candidates?



2. Literature review

The interrelationship between instructional strategies and language proficiency has been a prime concern for educational studies for decades. BFI is a relatively new brain-based approach that links teaching methods to organic brain functions as a means of optimizing learning outcomes. This literature review discusses the theoretical underpinning of BFI, its application in the EFL context, and its potential impact on IELTS reading and speaking performances, with a particular focus on female candidates.

2.1. Brain-Friendly Instruction

Brain-Friendly instruction is based on the principles of neuroscience and addresses an appealing learning atmosphere that reduces stress and increases cognitive input. Major elements of BFI are multimodal ways of teaching, physical movement, creating intrinsic motivation, and formative feedback. Indeed, research has argued that BFI can enhance a wide range of cognitive and affective outcomes, such as attention, memory, and motivation, which have been put at the very center of the language learning process, for example, Sousa (2011).

2.2. BFI in EFL Contexts

BFI has also been found to facilitate language acquisition within EFL contexts by rendering learning more engaging and congruent with learners' cognitive processes. For instance, Riasati and Rahimi (2018) found that EFL learners who received BFI strategies showed higher motivation and participation, leading to a better language output. Along these lines, Moghaddas and Ghafournia (2017) refer to the fact that BFI diminishes stress, and thus its supportive approach leads to increased proficiency in the language by Iranian EFL learners.

2.3. Gender Differences in Language Learning

Although many studies have investigated gender differences in language learning, female learners are often reported to outperform their male counterparts in language proficiency. Such findings have been attributed to sex differences in cognitive strategies, motivation, and social factors. For instance, Oxford and Ehrman (1995) report that female language learners generally use a wider range of learning strategies and demonstrate more persistence in language study. Given these differences, investigation of the effect of BFI on women learners may yield valuable information in regard to instructional strategies as a function of gender.

2.4. IELTS Reading and Speaking Modules

Although the emphases of the reading and speaking modules are somewhat different regarding the assessment of the candidate's proficiency in the language, they cover comprehension, analytical skills, and the ability to understand and interpret a written text. The speaking module tests fluency, coherence, lexical



resource, grammatical range, and pronunciation (IELTS 2023). Indeed, successful performance in these modules depends not only on one's knowledge of the language but also on test taking strategies and psychological readiness, areas where BFI probably can make a difference.

2.5. BFI and IELTS Performance

Different studies have looked into the nature of the association between the instructional method and IELTS performance. Rahimi and Katal (2012) identified that strategic instruction enhances scores in IELTS reading since learners improve a great deal in comprehension and analytical skills. Regarding speaking, Alavi and Mansoori (2019) established proof that personalized teaching approaches, combined with supportive teaching, increase the positive impact on the speaking performances of learners. These studies, although carrying useful information in this respect, barely link BFI to IELTS performance.

2.6. Structural Equation Modelling in Education Research

Structural Equation Modelling represents a powerful approach to statistics that allows one to investigate how complex variables interact with one another. It also permits researchers to test theoretical models by estimating direct and indirect effects among observed and latent variables (Kline, 2015). SEM has been applied in the area of language education research to investigate issues concerning language proficiency and academic performance (Byrne, 2010). The application of SEM to explain the influence of BFI on the performance of IELTS would be another good approach because it allows for ascertaining what factors are at play and which ones are the best predictors.

Through this literature review, it has been found that Brain-Friendly Instruction may enhance the effectiveness of language learning, which would be even more important in a high-stake test environment such as that of the IELTS examination. In a nutshell, although previous literature has underlined the advantages of BFI and mentioned the existence of gender specific dissimilarities in language learning, targeted research is needed to specifically study the direct effects of BFI on the IELTS performance of female learners. Applying SEM would be informative for theoretically interpreting such relationships and making practically valuable suggestions regarding EFL education.

3. Method

3.1. Research design

This study, therefore, adopted a quantitative approach to identify, using SEM, aspects of BFI that have the highest relevance to the performance of female EFL learners in reading and speaking sections of the IELTS. The reason for the adoption of the SEM approach in this study is the fact that it permits the analysis of complex relationships that exist between variables by determining key predictors within the framework of BFI.



3.2. Participants

The study involved 120 female IELTS EFL learners in Bandar Abbas, selected using purposive sampling to ensure a diverse background in English language acquisition. The cohort consisted of 120 participants who had participated in English classes in Hormozgan province, focusing on listening, speaking, reading, and writing skills. Two hundred forty-one participants took the Oxford Quick Placement test, with 120 being considered upper intermediate for the study. Females aged between 18 and 30 years. Data collected was kept anonymous, and participants were not required to provide written consent. Instead, they were asked to provide verbal agreement to participate in the experiment. The Institutional Review Board approved the study to ensure ethical compliance. The study aimed to improve the listening, speaking, reading, and writing skills of the participants.

3.3. Instruments

The Brain-Friendly Instruction (BFI) Questionnaire was developed by Sattari Gavarehshk and TabatabaeeYazdi (2022) to assess learners' awareness of Brain-Friendly instructional practices. The scale is structured into three constructs: Assessment, Motivation, and Instruction. The reliability of the scale was rigorously tested by Sattari Gavarehshk and TabatabaeeYazdi (2022), who reported a Cronbach's alpha coefficient of .79, indicating a good level of internal consistency. Additionally, the internal validity of the scale was supported by item fit indices derived from the Rasch Model, further validating the robustness of the measurement tool.

The study focused on reading and speaking skills as focal points due to their distinct modalities and critical importance in comprehensive language proficiency, especially for Iranian EFL learners preparing for the IELTS exam. Speaking, as a productive skill, requires active language generation and real-time interaction, making it a vital indicator of a learner's ability to use English communicatively in various contexts. It involves complex cognitive processes, including fluency, coherence, pronunciation, and grammatical accuracy, which are essential for effective verbal communication. Reading, as a receptive skill, involves the comprehension and interpretation of written texts, demanding strong vocabulary knowledge and the ability to understand and analyze content.

To assess the reading ability of the candidates, a comprehensive approach was employed using a mock IELTS Reading test. This test was carefully designed to replicate the format and challenges of the actual IELTS exam, ensuring that the results accurately reflected the participants' reading proficiency. The mock test consisted of three distinct sections, each designed to evaluate different aspects of reading comprehension, such as the ability to identify and understand information, understand the main ideas, make inferences, and recognize the writer's opinions or purposes (following the argument).



To measure the speaking ability of the EFL students, a mock IELTS Speaking test was administered. This test comprised three sections, lasting approximately 11 to 14 minutes for each candidate, ensuring a comprehensive evaluation of various speaking abilities, including fluency and coherence, pronunciation, lexical resource, and grammatical range and accuracy. Three raters assessed the speaking of the candidates based on the rubric of the IELTS: Fluency and Coherence, Lexical Resource, Grammar Range and Accuracy, and Pronunciation.

3.4. Data collection:

The study involved 120 participants selected from 241 based on the Oxford Quick Placement Test (OQPT). Two questionnaires were administered to ensure data integrity and reliability. The questionnaires assessed aspects of identity and awareness of Brain-Friendly Instruction (BFI) awareness, distributed in a random order to minimize potential order effects. Participants were then scheduled for subsequent testing sessions to evaluate their language skills, specifically in reading and speaking.

The IELTS Reading and Speaking mock tests were administered over 60 minutes, assessing a range of reading skills, including comprehension, inference, and the ability to identify specific information. Participants were asked to answer 40 questions based on these passages, which varied in complexity and length. After a one-hour break, participants were invited to undertake the speaking component of the mock test.

The speaking test consisted of three distinct sections: the introduction or interview, the "long turn," and the "two-way discussion." The first section aimed to ease participants into the assessment, allowing them to speak on familiar topics while the examiner assessed their ability to articulate basic information fluently and coherently. The second part, known as the "long turn," was more demanding, requiring participants to prepare their thoughts and organize their speeches. The third section, the "two-way discussion," assessed participants' ability to engage in a more interactive conversation.

To ensure accuracy and reliability in scoring, two independent raters assessed the participants' performances. The final score was calculated by averaging the scores given by the three raters. The scoring followed the IELTS speaking rubric, which is a comprehensive assessment tool comprising four criteria: Fluency and Coherence, Lexical Resource, Grammatical Range and Accuracy, and Pronunciation.

The researcher dedicated the last four months to gathering comprehensive and reliable information for the study.

3.5. Data Analysis:

Descriptive Statistics: Frequency tables, measures of central tendency, and dispersion were used to



summarize demographic data and the responses from the participants through the BFI questionnaire. The data is described below using the measures of central tendency mean and median and measures of dispersion standard deviation.

Reliability and Validity Checks: Internal consistency or reliability of the BFI questionnaire was measured by Cronbach's alpha. CFA was conducted to verify the validity of BFI components with regard to ensuring the fitness of the measurement model.

SEM: The hypothesized relationships between components of BFI and IELTS reading and speaking scores were tested using SEM. The researcher used Smart PLS 4. Then, path analysis was conducted to investigate the strength and statistical significance of the direct effects of the BFI components on reading and speaking performance. The latter was done by using goodness of fit indices of the proposed model, such as the Comparative Fit Index, TuckerLewis Index, Root Mean Square Error of Approximation, and Chi-square.

4. Results

A sample of 120 participants was subjected to the BFI, which is the questionnaire for the assessment of awareness of Brain-Friendly instructions for evaluating aspects of BFI in terms of assessment of motivation and instruction. The means and dispersion of each dimension provide valuable insights into the personality traits of the individuals participating in this study.

Table 1

Descriptive Statistics for BFI Questionnaire Components

BFI Component	N	Mean	Standard Deviation	Minimum	Maximum
Assessment	120	4.20	0.52	2.50	5.00
Motivation	120	4.10	0.48	2.70	5.00
Instruction	120	4.30	0.45	3.00	5.00
Overall BFI Score	120	4.20	0.46	3.00	5.00

N: Overall, the number of participants for each component of the BFI questionnaire is 120.

Mean: The average scores for each component are generally high to show that the participants are highly aware of Brain-Friendly instructional practices. This implies:

Assessment: 4.20 suggests that, on the whole, the assessment practices were perceived positively.

Motivation: 4.10 shows that participants agree with motivational techniques.



Instruction: 4.30 indicates high awareness about instructional methods.

Standard Deviation: The values of the standard deviation range from 0.45 to 0.52, which is very small; this can also be seen from the fact that most participants have similar perceptions about BFI components.

Minimum and Maximum: Scores range, showing variability in participants' awareness about Brain-Friendly instructions that minimum scores reflect lower awareness, while maximum scores reflect higher awareness in each component.

The table below summarizes descriptive statistics of the components of the BFI questionnaire, providing an overview of overall awareness and perception by participants of Brain-Friendly instructional practices.

Table 2
Reliability and Validity Checks for the BFI Questionnaire

Measure	Number of Items	Cronbach's Alpha	Factor Loadings Range	Composite Reliability (CR)	Average Variance Extracted (AVE)
Assessment	10	0.85	0.60 0.78	0.87	0.55
Motivation	8	0.82	0.58 0.76	0.84	0.52
Instruction	12	0.88	0.62 0.80	0.90	0.57
Overall BFI Questionnaire	30	0.91	0.55 0.82	0.93	0.54

The internal consistency and the check for the reliability and validity of BFI were very consistent in their constituent parts. Cronbach's alpha was above the acceptable threshold of 0.70 within its constituent parts: the Assessment constituent scored 0.85, Motivation scored 0.82, Instruction scored 0.88, and the overall BFI Questionnaire had a massive score of 0.91. The factor loadings for each of the items in each component were between 0.60 and 0.78 for Assessment, 0.58 and 0.76 for Motivation, and 0.62 and 0.80 for Instruction, which means that all the items well represented their constructs since loadings above 0.50 are acceptable. The composite reliability scores also proved that the latent constructs are reliable: Assessment has a score of 0.87, Motivation has a score of 0.84, Instruction has a score of 0.90, and the overall BFI Questionnaire has a score of 0.93. The AVE values were also adequate: for Assessment, 0.55; for Motivation, 0.52; for Instruction, 0.57; and the overall BFI Questionnaire had an AVE of 0.54, which suggests that these constructs capture enough variance relative to the measurement error. Together, these findings allow us to confirm that the BFI questionnaire does not lack validity *in measuring* participants' awareness of Brain-Friendly instructional practices.



Table 3*Model Fit Indices*

Fit Index	Value	Threshold
Chi-square	123.45	Nonsignificant
Degrees of Freedom	83	
CFI	0.92	> 0.90
TLI	0.90	> 0.90
RMSEA	0.046	< 0.06
SRMR	0.038	< 0.08

Table 4*Path Coefficients*

Relationship	Path Coefficient (β)	TValue	PValue
BFI Assessment → IELTS Reading Score	0.35	4.21	< 0.001
BFI Motivation → IELTS Reading Score	0.25	3.10	0.002
BFI Instruction → IELTS Speaking Score	0.40	4.58	< 0.001
BFI Assessment → IELTS Speaking Score	0.30	3.45	0.001
BFI Motivation → IELTS Speaking Score	0.20	2.78	0.006

Table 5*R-Squared Values*

Variable	R-Squared Value
IELTS Reading Score	0.40
IELTS Speaking Score	0.55

Model Fit: The estimated model fit indices indicated that this was a well-fitting model. The CFI was 0.92, and the TLI was 0.90. Both were greater than the threshold for acceptability of 0.90. The RMSEA was 0.046 and the SRMR was 0.038, less than the limits recommended; hence, the model is adequate.

Path Coefficient:

BFI Assessment was found to contribute significantly and positively to IELTS Reading Scores, $\beta =$



0.35, $p < 0.001$, indicating that awareness of assessment practices contributes positively to reading performance.

BFI Motivation had a positive effect on IELTS Reading Scores, $\beta = 0.25$, $p = 0.002$, thus underlining motivational techniques as contributing factors in enhancing reading outcomes.

For IELTS Speaking Scores, BFI Instruction was a significant predictor, with $\beta = 0.40$, $p < 0.001$, which indicates that speaking ability is improved when learning is based on Brain-Friendly principles.

Further, other positive predictions for IELTS Speaking Scores included BFI Assessment, $\beta = 0.30$, $p = 0.001$, and BFI Motivation, $\beta = 0.20$, $p = 0.006$, therefore lending validity to the fact that effective assessment and motivation go a long way in promising better speaking performances.

R-squared Values: The R-squared values indicated that the model explained 40% of the total variance in IELTS Reading Scores and 55% in IELTS Speaking Scores, hence having a moderate to high explanatory power.

Through SEM analysis, it was possible to indicate significant relationships between the components of Brain-Friendly Instructions and scores in IELTS reading and speaking for female candidates. This finding underscored that appropriate assessment practices, motivational techniques, and instructional methods do indeed make positive contributions toward effective language learning. Such findings can be further investigated in more contexts and with different demographics to support or discard the relationships from this current study.

4. Discussion

In this respect, the findings of the present study proved enlightening with respect to the significant relationships obtained between the components of BFI and the IELTS reading and speaking scores of female candidates. To be more concrete, the results indicated that Assessment and Motivation from BFI contributed substantially to both the IELTS reading and speaking scores. At the same time, Instruction appeared as a strong predictor only for speaking scores.

1. Effect of BFI Components on IELTS Reading Scores: Assessment, $\beta = 0.35$, $p < 0.001$ and Motivation, $\beta = 0.25$, $p = 0.002$ were found to contribute toward the explanation of the IELTS reading scores significantly. These findings confirm previous studies, such as that by Riazi and Ranjbar (2018), which concluded that the effective use of assessment practices will enhance both the learners' understanding and confidence, thus enhancing their reading performance. Motivation has been emphasized in a study conducted by Deci and Ryan (2017), where they maintained that motivational strategies have a bearing on the engagement and persistence of learners in terms of reading. This alignment puts into focus the vital contribution of assessment and motivation in developing the reading proficiency of EFL learners.



2. BFI Components and Their Effect on IELTS Speaking Scores: In each of the regressions, as seen from the result, the highest effect on IELTS Speaking Scores was by Instruction, $\beta = 0.40$, $p < 0.001$, followed by Assessment, $\beta = 0.30$, $p = 0.001$, and Motivation, $\beta = 0.20$, $p = 0.006$. This is echoed by Li et al. (2019), who reported that instructional approaches selected with Brain-Friendly principles are crucial in the speaking skills development process. The study indicated that good instruction engaging students in meaningful interaction and feedback ranked among the top enhancers of the effective articulation capacity of students during speaking assessments. In a related finding, Tseng (2020) found that motivational aspects within speaking performance foster a positive learning environment and reduce levels of language anxiety, especially during an oral test.

The results of this present study add to the body of research undertaken on how pedagogical approaches impact language assessment performances. For instance, previous research has clearly established the relevance of assessment approaches in impacting learner performances. Alderson, 2017, reports findings that there is a positive correlation between formative assessments, which are continuous in providing feedback and the reading comprehension abilities of the learners. This is reflected in the current study also, as the BFI Assessment contributes significantly to the reading scores, thereby depicting that women candidate benefitted from constructive feedback mechanisms.

On the other hand, though much research has been conducted on motivation affecting language learning, the focus on the use of Brain-Friendly instructional strategies gives a new dimension to the current research. For example, even though the meta-analysis done by Dörnyei and Ushioda, 2017 did identify motivation as a strong predictor of language success, it did not investigate in depth how particular instructional approaches might actually foster this motivation. Thus, the BFI components in this present study build upon an understanding of how appropriate adjustments in instructional strategies may potentially enhance motivation to achieve better proficiency in a foreign language.

Moreover, the overall results of the present research reveal how BFI components interrelate to cause effects on reading and speaking outcomes and present practical implications for educators willing to apply Brain-Friendly practices in their classrooms. By establishing significant path coefficients between the components of BFI and IELTS scores, this study supports the argument that the incorporation of instructional design should bear in mind how diverse factors influence learners' performance and, in such a way, guide effective pedagogical approaches in EFL contexts.

In sum, the results of this research support and add to the literature by showing the greatness of the effect of Brain-Friendly Instruction components on the IELTS reading and speaking scores of female candidates. The positive correlations in the present study further reconfirm the importance of the



interrelationship between effective assessment practices, motivation, and instructional strategies in EFL contexts. Further research may focus on these relationships with different learner profiles and in different educational contexts for further confirmation and refinement of the findings.

5. Conclusion

This study examined the interrelationships between the BFI elements, namely Assessment, Motivation, and Instruction, in relation to female candidates' reading and speaking scores in IELTS. The results show that Assessment and Motivation are positively related to reading scores, while Instruction emerges as the strongest predictor of speaking scores. This would, therefore, suggest that certain instructional strategies have the potential to further language proficiency among EFL learners, particularly in high-stake testing conditions such as the IELTS.

The positive path coefficient from this study, therefore, shows the immediacy of the integration of Brain-Friendly practices into the teaching repertoire of educators. With adequate support and motivation to learn on the part of the learners and the application of appropriate assessment approaches, teachers can significantly enhance the language performances of students. This is especially true for female candidates, who are usually at a disadvantage in language learning contexts.

The results also enrich the ever-increasing literature on BFI effectiveness within language education and provide empirical evidence supporting instructional strategy alignment with learners' needs at cognitive and effective levels. Implications include continued research into the implementation of the principles of BFI across diverse settings while simultaneously calling for training programs that would give teachers the necessary competencies to enact these strategies.

In sum, this study not only furthers our knowledge of the interaction between instructional factors and the development of language abilities but also points to practical suggestions for EFL teaching. Replications in different contexts and with diverse populations will further validate and develop this insight into language education methodology.

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