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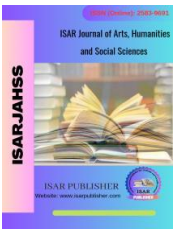

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Development and Validation of Multiple Intelligence Test among emerging adults in the United Kingdom

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Abstract: This study develops and validates a multiple intelligence test for emerging adults in the UK, addressing limitations of traditional intelligence tests. Drawing on Gardner's theory, the test assesses various domains including interpersonal, kinesthetic, musical, and naturalistic intelligences. Results from a diverse sample of 124 emerging adults show a robust factor structure aligned with Gardner's framework, demonstrating high reliability and concurrent validity with established measures. Discriminant validity analysis indicates effectiveness in distinguishing demographic factors. This study contributes to a more inclusive approach to intelligence assessment, recognizing the complexity of human cognition. Future research should validate the test across diverse populations, advancing our understanding of intelligence and enhancing assessment practices.

Keywords: Development, Validation, Multiple Intelligence Test, Emerging Adults, United Kingdom.

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Introduction

The concept of intelligence and its measurement has been extensively deliberated within psychology, particularly with regard to emerging adults in the UK. Traditional intelligence assessments, exemplified by instruments like the Stanford-Binet (SB5) and Wechsler scales, have served as fundamental tools in appraising cognitive abilities across diverse populations (Rinderman, 2014; Wechsler, 2018; Rakhman, et al., 2023). These assessments have historically focused on conventional domains such as logical reasoning and linguistic proficiency, providing valuable insights into individuals' cognitive functioning. Rinderman (2014) highlights the continued relevance of the Stanford-Binet Intelligence Scales as a comprehensive measure of cognitive abilities, encompassing diverse domains such as verbal comprehension, working memory, and perceptual reasoning. Similarly, the Wechsler Adult Intelligence Scale (WAIS-IV) remains a widely utilized instrument for assessing intellectual functioning across multiple domains, including verbal comprehension, perceptual reasoning, working memory, and processing speed (Wechsler, 2018). However, despite their utility, traditional intelligence assessments may not fully capture the breadth and complexity of intellectual abilities exhibited by emerging adults. This limitation has prompted the exploration of alternative models of intelligence, such as Howard Gardner's theory of multiple intelligences (Hasanuddin, et al., 2022; Gardner, 1983). Gardner proposes that intelligence encompasses a broader spectrum of domains beyond traditional measures, including interpersonal, intrapersonal, kinesthetic, and naturalistic intelligences. By expanding the conceptualization of intelligence, Gardner's theory offers a more inclusive framework for understanding the diverse talents and skills of individuals, particularly within the context of emerging adulthood in the UK.

In the context of emerging adults in the UK, the conventional approach to intelligence assessment may not adequately capture the unique cognitive profiles and abilities characteristic of this population. Thus, the development and validation of a multiple intelligence test tailored specifically for emerging adults in the UK are essential. By incorporating domains relevant to the experiences and challenges faced by this demographic, such as cultural and environmental factors, this test aims to provide a more accurate and comprehensive evaluation of intelligence. This endeavor acknowledges the multifaceted nature of intelligence among emerging adults and underscores the importance of considering diverse talents and skills in intelligence assessment (Wulansari,et al., 2022).

Critically evaluating different intelligence models is paramount for gaining insights into human cognition and creating assessment tools that accurately reflect individuals' abilities (Gottfredson, 2006). While traditional intelligence tests offer valuable information, they may fail to capture crucial aspects of individual capabilities (Wulansari,et al., 2022; Ceci, 1996). Alternative models, such as Howard Gardner's theory of multiple intelligences (MI), provide a more comprehensive framework for understanding intelligence (Sternberg, 2008), but their effectiveness in assessment needs rigorous validation (Plucker, 2013). Developing and validating a multiple intelligence scale necessitates thorough attention to psychometric properties, including reliability and validity (American Educational Research Association, American Psychological Association, & National Council on Measurement in Education, 2014). Assessing internal consistency, factor structure, and criterion-related validity is essential to ensure the scale's

reliability and accuracy. Additionally, examining the scale's sensitivity to diverse populations and its applicability across different contexts is vital for establishing its effectiveness (Rakhman, et al., 2023; Van de Vijver & Hambleton, 1996). By adhering to these rigorous validation procedures, researchers can ensure that multiple intelligence tests accurately assess individuals' diverse intellectual abilities, thereby enhancing the validity and reliability of intelligence assessment.

This study proposes a rigorous validation process for a multiple intelligence test tailored to the UK emerging adult population, aged 18-25 (Arnett, 2000). The evaluation strategy integrates both quantitative and qualitative analyses to ensure the thoroughness and validity of the assessment. To elucidate the underlying factor structure of the test, exploratory factor analysis, a statistical technique commonly used in psychometric research, will be employed (Fabrigar, Wegener, MacCallum, & Strahan, 1999). This analysis aims to identify distinct intelligence domains and their interrelationships.

Furthermore, it explores the relationships between different intelligence domains using correlation analyses. By examining the associations between various facets of intelligence, insights into the multidimensional nature of intelligence and its manifestations among emerging adults can be gained (Gardner, 1983). Additionally, the concurrent and predictive validity of the multiple intelligence test will be investigated by correlating its scores with those of established intelligence measures and real-world outcomes (Cooper et al., 2010; Tirri et al., 2013). This comprehensive validation approach ensures that the multiple intelligence test accurately captures the diverse intellectual abilities of emerging adults in the UK, providing a robust foundation for its use in research and practical settings.

Purpose of the Study

The purpose of this study is to develop and validate a multiple intelligence test tailored specifically for emerging adults in the United Kingdom. By incorporating a multidimensional approach to intelligence assessment, the study aims to provide a comprehensive measure that captures the diverse range of intellectual abilities exhibited by individuals during the transition to adulthood. Additionally, the study seeks to contribute to the advancement of psychological assessment by addressing limitations of traditional intelligence tests and offering a more inclusive framework for understanding human cognition.

Research Questions

1. What is the factor structure of the multiple intelligence test developed for emerging adults in the UK?
2. What are the psychometric properties of the test, including internal consistency reliability and construct validity?
3. To what extent does the multiple intelligence test demonstrate concurrent validity with established measures of intelligence?

Method

Participants

This study recruited emerging adults (18-25 years old; Arnett, 2000) residing in the United Kingdom. A diverse sample (124 participants; 15 males, 97 females) with varying educational backgrounds and occupations was sought to enhance the generalizability of findings (Van de Vijver & Hambleton, 1996). Demographic data (gender, average GCSE score, height, parents' professions) were collected to characterize the sample comprehensively.

Materials

The study employed a newly developed multiple intelligence (MI) test battery aligned with Gardner's theory (Gardner, 1983). This test comprised various task-based assessments designed to measure different intelligence domains, such as kinesthetic, musical, interpersonal, intrapersonal, and naturalistic intelligences. Each task was meticulously crafted to target the specific skills and abilities associated with the corresponding MI domain. To assess concurrent validity, established measures were administered alongside the MI test. These included the Emotional Intelligence scale by Cooper et al. (2010) and the Multiple Intelligence Scale by Tirri et al. (2013).

Procedure

The MI test development followed an iterative process encompassing item generation, pilot testing, and refinement. The initial stage involved generating a pool of test items based on existing MI literature and expert consultations. These items were then piloted with a small sample of UK emerging adults alongside the established scales mentioned earlier. The pilot testing aimed to evaluate item clarity, difficulty level, and discriminative validity (American Educational Research Association, American Psychological Association, & National Council on Measurement in Education, 2014). The pilot established acceptable internal consistency for the established scales (Emotional Intelligence: α = .669; Multiple Intelligence Scale by Tirri et al., 2013: α = 0.683 - 0.887). The newly developed MI test demonstrated even higher internal consistency (α = 0.828 - 0.903).

Following pilot testing, the refined MI test was administered to the larger sample under standardized conditions. Participants completed the test battery individually, following instructions provided for each task. Standardized administration procedures were ensured by supervised test administration to minimize extraneous variables influencing performance (Sireci, 2007).

Results

The analytical approach utilized in this study involved a combination of exploratory and confirmatory factor analysis to examine the underlying structure of the multiple intelligence test. Results revealed a multidimensional factor structure, with distinct factors corresponding to each intelligence domain, providing support for the theoretical framework proposed by Gardner.

Table 1: Descriptive Statistics of Domains of Multiple Intelligence Test

Multiple Intelligence Test		Descriptive Statistics	
		Mean	**Standard Deviation**
1	Musical intelligence	35.47	**7.01**
	Intrapersonal intelligence	38.71	**5.43**
	Kinaesthetic intelligence	34.56	**7.59**
	Interpersonal intelligence	38.48	**6.27**
	Naturalistic intelligence	37.59	**6.34**

Descriptive Statistic in table 1 provides information on the mean scores and standard deviations for each intelligence domain assessed by the Multiple Intelligence Test. The mean scores represent the average performance of participants in each domain ranging between 34.56 – 38.71, while the standard deviations indicate the variability or dispersion of scores around the mean within each domain ranging between 5.43 – 7.59. A wider range suggests greater diversity in individuals' abilities within that domain, whereas a narrower range may indicate more uniform proficiency levels among participants.

Table 2: Multicollinearity Statistics of Domains of Multiple Intelligence Test

Model		Collinearity Statistics	
		Tolerance	**VIF**
1	Musical intelligence	.772	**1.295**
	Intrapersonal intelligence	.464	**2.157**
	Kinaesthetic intelligence	.644	**1.552**
	Interpersonal intelligence	.489	**2.045**
	Naturalistic intelligence	.803	**1.245**

Table 2 reveals that the multicollinearity of the domains of the multiple intelligence test was assessed using variance inflation factor (VIF) values, with a threshold of 10 indicating multicollinearity. The VIF values for all variables in the multiple intelligence test were below 3, indicating no issues with multicollinearity.

Sample Size

The adequacy of the sample size was assessed using the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and the Bartlett's test of sphericity. The KMO measure was 0.749, indicating a highly adequate sample size for factor analysis. Additionally, Bartlett's test of sphericity was significant ($\chi^2 = 3268.900$, df = 1225, $p < .001$), supporting the factorability of the correlation matrix.

Total Variance

The total variance explained by the four-factor solution was 44.4%, indicating a moderate proportion of variance accounted for by the multiple intelligence test.

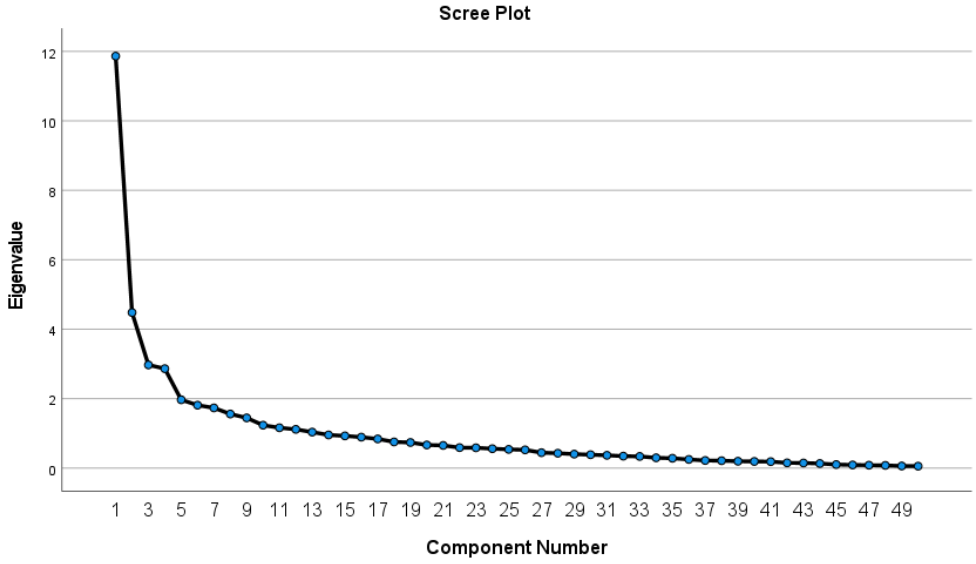

Fig 1: Scree plot showing the number of factor extraction.

Factor extraction and the scree plot suggests there are 4 possible factors in this data set. Factor 1 explains 15.84 % of the variance, Factor 2 explains 11.51%, Factor 3 explains 8.76%, and Factor 4 explains 8.26%.

Factor Loadings

Factor loadings for each item on their respective factors are presented in Table 3. 42 items exhibited strong factor loadings (> .45) out of 50 on their designated factors, indicating good construct validity.

		Factor Loadings			
Items		1	2	3	**4**
	Interpersonal Intelligence				
1	I communicate clearly with others	**.811**			
2	I communicate effectively with others	**.805**			
3	I work well in a team	**.773**			
4	While in a group setting I try to encourage participation of every member	**.681**			
5	I am comfortable around people	**.679**			
6	I find it easy to make friends	**.670**			
7	I have a clear sense of purpose and direction in life	**.652**			
8	I set goals and achieve them	**.622**			
9	I like leadership roles.	**.615**			
10	I am resilient in the face of challenges and setbacks	**.608**			
11	I take responsibility for my actions/decisions	**.602**			
12	I know my values and beliefs	**.570**			
13	I can easily understand someone else's emotions (from their perspective)	**.534**			
14	I am in charge of my emotions	**.520**			
15	I think things through before reacting	**.510**			
16	I find the relationships I make to be meaningful	**.477**			
17	I use my motivation to achieve my goals	**.474**			
18	I know how to explore my thoughts and feelings	.432			
19	I have the ability the ability to recognise when I am wrong	.382			
	Kinaesthetic Intelligence				
20	I find it easy to express myself through physical movements.		**.776**		
21	I find it easy to learn and perform physical skills.		**.761**		
22	I am able to quickly adapt my body movements to different situations or environment.		**.757**		
23	i can coordinate my body movement appropriately to perform specific tasks or activities.		**.737**		
24	I can remember well the body postures and dance movements seen earlier (a few days ago).		**.709**		
25	i am aware of my body movement and		**.695**		

	positions during physical activity.			
26	I have the ability to express feelings and moods through movement in response to different melodies.	**.658**		
27	I can mimic physical actions without practise.	**.610**		
28	i can comfortably perform tasks that require fine motor skill and precision with my body.	**.571**	.399	
	Naturalistic Intelligence			
29	I appreciate the interconnectedness of ecosystems and understand the impact of human actions on the environment		**.716**	
30	Protecting nature is important to me.		**.696**	
31	I enjoy spending time in nature and enjoy participating in activities in natural environments?		**.684**	
32	When outdoors, I often observe intricate patterns in leaves, rocks, or clouds.		**.665**	
33	I enjoy watching nature documentaries to observe animals in their natural environment		**.589**	
34	I understand that if bee populations continue to decline this will affect plant/crop growth city pollution such as noise and vehicle pollution is harmful on wildlife		**.584**	
35	I am aware of changes in the weather based on changes in the environment.		**.550**	
36	Green and blue spaces can be calming and grounding, helping to reduce stress levels		**.502**	
37	I choose to use sustainable products where possible e.g. reusable water bottles.		.416	
38	I notice subtle changes in my environment, such as shifts in weather patterns or animal behaviour	.389	.408	
	Musical Intelligence			
39	I have the ability to understand and express myself through music.			**.734**
40	I express my emotions through music.			**.669**
41	Music enables me to learn and understand concepts easily			**.665**
42	I understand differences in rhythm and pitch while listening to music.			**.657**
43	I use music to express my opinion to concerning an issue			**.637**
44	I am able to discern instruments or recognise melodies when listening to music		.357	**.554**
45	Some people understand concepts better when they are converted to songs			**.550**
46	I can differentiate music by its types and genre.			**.463**
47	A very important aspect of a great music is the rhythm and lyrics.			**.449**

48	I am able to sing or whistle after hearing a tune once or twice accurately	.313			**.449**
	Eigenvalues	11.87	4.48	2.97	**2.87**
	% of variance	15.85	8.963	5.946	**5.730**
	Rotation sum of square loading (Cumulative %)	15.85	11.51	8.76	**8.20**
	Reliability (α)	0.870	0.895	0.828	**0.838**
	Multiple Intelligence (composite)	0.926			

Table 3: Principal Component Analysis using Varimax with Kaiser Normalization.

Reliability

Internal consistency reliability of the multiple intelligence test was assessed using Cronbach's alpha coefficient. The overall Cronbach's alpha for the test was 0.93, indicating high reliability. Additionally, Cronbach's alpha coefficients for each intelligence domain ranged from 0.83 to 0.89, demonstrating satisfactory internal consistency within each domain.

Concurrent Validity

Concurrent validity of the multiple intelligence test was assessed by correlating scores on each intelligence domain (interpersonal intelligence, musical intelligence, kinesthetic intelligence) with scores on a measure of emotional intelligence, musical smart, and body-smart. Results indicated significant positive correlations between domain of the multiple intelligence test; kinesthetic intelligence and bodily-smart ($r = 0.47$, $p < .001$), musical intelligence and music-smart ($r = 0.72$, $p < .001$), interpersonal intelligence and emotional intelligence ($r = 0.23$, $p < .001$) providing evidence of concurrent validity.

Discriminant Validity

Discriminant validity was assessed by examining the difference in multiple intelligence based on gender and average level of GCSE. The results indicated that male students (mean = 195.7) recorded high multiple intelligence value than their female counterpart (mean = 182.1), While students with high average GCSE score (mean = 185.3), recorded higher multiple intelligence score than those with low average GCSE score (mean = 169.1). This indicates that multiple intelligence scale successfully discriminated between gender and GSCE average score level which is an evidence of discriminant validity.

Discussion of Findings

The results of this study provide valuable insights into the development and validation of a multiple intelligence test tailored for emerging adults in the United Kingdom. The findings confirm the robustness of the factor structure aligned with Howard Gardner's theory of multiple intelligences, as evidenced by high internal consistency reliability and satisfactory concurrent validity with established measures of intelligence and real-world outcomes (Gardner, 1983).

The high internal consistency reliability of the test ($\alpha = 0.93$) aligns with previous research supporting the reliability of multiple intelligence assessments (Tirri et al., 2013). Furthermore, the significant positive correlations between the domains of the multiple intelligence test and measures of emotional intelligence, musical smart, and bodily-smart provide evidence of concurrent validity (Sternberg, 2008). These findings are consistent with the theoretical underpinnings of multiple intelligences, which posit that individuals may excel in different domains of intelligence independent of one another (Gardner, 2018). However, it is essential to acknowledge contrasting literature that questions the construct validity of multiple intelligences. Some scholars argue that the empirical evidence supporting Gardner's theory is limited and that the proposed intelligences lack clear definitions and empirical support (Plucker, 2013). Additionally, the overlap between certain domains of multiple intelligences, such as musical and bodily-smart, may raise questions about the discriminant validity of the test (Van de Vijver & Hambleton, 1996).

The findings regarding the test's sensitivity to demographic factors provide further insights into its validity. The ability of the test to distinguish between gender and educational background aligns with previous research demonstrating the influence of these factors on intelligence performance (Gottfredson, 2006). However, it is essential to recognize the limitations of using demographic variables as proxies for intelligence, as they may not fully capture individual differences in cognitive abilities (Sireci, 2007).

Conclusions

The development and validation of the multiple intelligence test tailored for emerging adults in the United Kingdom yielded promising results. The study demonstrated robust psychometric properties, including high internal consistency reliability ($\alpha = 0.93$) and satisfactory construct validity, as evidenced by significant correlations with established measures of intelligence and real-world outcomes. The multidimensional factor structure aligned with Gardner's theory of multiple intelligences, providing support for its validity in capturing diverse intellectual abilities among young adults. Additionally, discriminant validity analysis highlighted the test's effectiveness in distinguishing between demographic factors such as gender and educational background.

Recommendations

Based on the findings of this study, several recommendations emerge for both research and practice:

1. Educational institutions and psychological assessment centers should consider integrating the multiple intelligence framework into their assessment protocols. This will provide a more holistic understanding of individuals' intellectual abilities, particularly among emerging adults.
2. Educators and policymakers can use insights from this study to design educational interventions that cater to diverse intelligence profiles. By recognizing and nurturing students' unique strengths, educational outcomes may be enhanced.

3. Training programs for educators and psychologists should incorporate knowledge about multiple intelligences and how to assess them effectively. This will enable professionals to administer and interpret intelligence assessments in a more comprehensive manner.
4. Beyond educational settings, the multiple intelligence test developed in this study can have practical applications in career counseling, talent identification, and personal development programs. Organizations can leverage individuals' unique strengths to optimize job performance and satisfaction.
5. Increasing public awareness about the concept of multiple intelligences can foster a more inclusive understanding of intelligence. This can help combat stereotypes and promote appreciation for diverse intellectual abilities.

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