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Research article

Exploring the vividness of mental imagery and eidetic imagery in people with intellectual disability (ID) in comparison with typically developing (TD) individuals

Akhtar Ali Syed [a,*], Shazia Neelofur [a], Aidan Moran [b], Gary O'Reilly [b]

[a] Brothers of Charity, Services, South East, Ireland
[b] University College Dublin, Ireland

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ABSTRACT

Background: Mental imagery (MI) has been described as the "ability to simulate in the mind information that is not currently being perceived by the sense organs" (Moran, 2012, p. 166). The vividness of mental imagery has been defined as the clarity, brightness, or intensity of an image as reported by the individual (Marks, 1973). There are many studies conducted on vividness in typically developing (TD) individuals, however, no attempt has been made either to assess the vividness of mental imagery in people with intellectual disability (ID) or compare it with that of typically developing (TD) adults.

Metods: A vividness of imagery test (comprising a modified version of the Vividness of Visual Imagery Questionnaire 2, (VVIQ-2; Marks, 1995), and two items of the Age Projection Test, (APT; Ahsen, 1988) were administered to participants with mild, moderate, and severe ID. Their performance on the vividness scale was compared with typically developing individuals. Measures for cognitive and adaptive functioning were administered to ascertain the ID level of participants.

Results: The results of this study reveal a non-significant group difference between people with mild ID, moderate ID, and TD on the vividness of mental imagery and eidetic imagery. People with severe ID performed significantly lower than the other three groups.

Conclusion: Despite their cognitive impairment, a non-significant difference between the performance of people with mild and moderate ID and typically developing individuals on imagery vividness scale is noteworthy.

What this paper adds

This is an empirical study conducted to investigate the ability of people with intellectual disability (ID) to experience the vividness of mental imagery (MI) and eidetic imagery (EI) in comparison with typically developing (TD) individuals. The results of this study indicated the potential of people with mild and moderate ID to experience the vividness of MI and EI, despite the cognitive impairment, without any significant difference from TD individuals. The findings of this study raise a question about the suggested role of cognition in experiencing the vividness of MI and EI.

1. Introduction

Mental imagery (MI) has been considered as a multisensory phenomenon (Lacey and Lawson, 2013; Pearson et al., 2013; Reber and Reber, 2001). That is the reason why phrases like 'seeing with the mind's eye', or 'hearing with the mind's ear' (Kosslyn et al., 2001, p. 635) have been commonly used to describe MI. However, in their efforts to define imagery, researchers and theorists have developed two different perspectives. The first perspective came from Paivio (1971), who suggested that imagery is one of the two major means (the other is language) to retrieve information from memory. Kosslyn et al. (1995) expanded the functioning of imagery and described it as the primary mode of cognitive

* Corresponding author.
E-mail addresses: akhtaralisyed@gmail.com, akhtaralisyed77@yahoo.com (A.A. Syed).

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functioning like memory, learning, information processing, and reasoning. The second theoretical perspective considered imagery as an ability to retain an accurate, detailed visual representation of a scene, pattern, or a personal experience. This definition came from researchers like Allport (1924), Jaensch et al. (1930), and Ahsen (2010). For Ahsen (2005), imagery is a consolidation of sensory, affective, and cognitive aspects of human consciousness. Ahsen defined it as eidetic imagery (EI).

The scientific study of imagery, its existence and measurement started in the 19th century. Galton (1883) was among the first psychology researchers to investigate imagery. Since then, the study of imagery as a phenomenon has gone through many phases (for details see Roeckelein, 2004). Now the existence of imagery as a mental phenomenon is an established scientific construct. However, the credit of current scientifically established status of imagery primarily goes to the attempts made to assess it. Galton (1883) pioneered the attempts to measure imagery; his breakfast-table questionnaire assessed three dimensions of imagery experiences – Illumination *(Is the image dim or fairly clear?),* Definition (*Are all objects pretty well defined?*) and Colouring (*Are the colours of all the objects quite distinct and natural?*) of the images (Roeckelein, 2004, p. 158). The next test was developed by Betts (1909), who developed a more refined questionnaire (Questionnaire Upon Mental Imagery; QMI) in which the participants were asked to assign a numerical value to the level of the vividness of evoked images. Other than vividness, this questionnaire assesses multiple modalities such as auditory and olfactory images, as well. A short version of this questionnaire was developed by Sheehan (Vividness of Imagery Scale, 1967). In the same vein, Gordon (1949) developed her Test of Visual Imagery Control, which is also known as the Gordon Test. This test was meant to measure an individual's execution of ability to control imagery. In another attempt, Marks (1973) defined imagery vividness in terms of clarity, brightness, or intensity of mental representation. It was described as a *phenomenological definition* of vividness by Ahsen (2005). Based on this definition, Marks developed the Vividness of Visual Imagery Questionnaire (VVIQ) in 1973; he made some changes in it and introduced the second version, VVIQ-2 in 1995. The VVIQ-2 was introduced with 16 more items and a different scoring method.

Although the VVIQ and VVIQ-2 are subjective measures, however, their findings have been found to correlate with the activity of the early visual cortex as revealed on fMRI, and performance on the psychological colour-naming task (Cui et al., 2007).

This way, the VVIQ-2 potentially bridges the gap between self-rated subjective tools and the objective assessment of mental imagery. It is worth noting that right from Galton (1883), vividness is considered as one of the key features to assess imagery existence and function.

Assessment of imagery vividness was attempted to measure through other sensory domains than visual. Such attempts started with Betts (1909). Gilbert et al. (1998) developed the Vividness of Olfactory Imagery Questionnaire (VOIQ). Their findings correlated with another test of olfactory imagery and the Physical Anhedonia Scale. Similarly, vividness scales were developed to assess different types of imagery. In the domain of movement imagery, two scales have been introduced. The first one was the Revised Vividness of Movement Imagery Questionnaire (VMIQ-2) by Roberts et al. (2008). The second one was the Vividness of Haptic Movement Imagery Questionnaire, which was developed by Campos et al. (1998). The development of these scales and their use in studies confirm that vividness of imagery assessment has a legitimate empirical rationale.

As the vividness of imagery tests are subjective and based on self-report, this is the reason why some researchers raised issues and pointed at the possible intermingling of introspection with the imagery processes (Baddeley and Andrade, 2000; Kosslyn et al., 2001; Pearson et al., 2011; Pylyshyn, 2003). However, researchers provided evidence that participants' reports on image vividness were not only predictable but sometimes counter-intuitive (Andrade et al., 1997; Baddeley and Andrade, 2000) and without having an impact of social desirability (van de Mortel, 2008).

The attempts to assess imagery objectively, particularly through neurological tools started with Adrian and Mathews in 1934, Golla, Hutton, and Walter in 1943, and Short in 1953 (cf. Marks and Issac, 1995). The researchers "suggested that visual imagery was indicated by suppression of occipital EEG alpha rhythm" (Marks and Issac, 1995. p. 271). Marks and Issac (1995) tried to differentiate vivid imagers from non-vivid imagers through EEG recordings. They observed that different brain activity emerges on EEG records in the case of vivid and non-vivid imagers. The vividness was assessed through VVIQ. The vivid imagers produced a decrease and non-vivid imagers showed an increase in alpha rhythm. In another study, it was noted that the visual cortex, which has been identified as an area of the brain activated during imagery (Ganis et al., 2004), is also connected with the vividness of visual imagery (Amedi et al., 2005).

In Ahsen's (2005) view, the vividness of imagery tests do not only assess imagery ability. In his opinion, they can reveal useful pedagogic and clinical information. His assertion was that it is not important to assess vividness only; unvividness (lack of vividness) has its significance as well.

Ahsen proposed that for clinical reasons, both vividness and *unvividness* (a term coined by Ahsen, 2005) along with imagery behaviour should be taken into account by the therapist using imagery in psychotherapy. Ahsen (2010) differentiated his perspective of imagery by declaring image as not *information* but a *structure* (p. 133). In a series of experiments, he argued that the vividness of an image can alter if the subject is asked to keep the image of one of his/her parents in mind while visualizing items from QMI, VVIQ, and the Gordon Test (Ahsen, 2010). As he regards imagery as structure, instead of mere factual information from experience, which is why his definition of eidetic imagery has been described as *structural eidetics*. In Ahsen's definition the combination of ISM, where I (*image* as sensory input of an experience) S (*soma* as physiological/emotional response attached to the image) and M (*meaning* attached to a particular experiential image) is described as the structural eidetic image.

Most imagery tests developed to assess imagery are subjective and based on self-report. However, interest in imagery assessment brought researchers to a point where objective assessment was considered necessary. For this reason, the Test of Ability in Movement Imagery (TAMI) was developed as an objective test to assess motor imagery, which means "people's imagination of actions without engaging in actual physical movements involved or the mental rehearsal of voluntary movement without accompanying bodily movement" (Milton et al., 2008. cf. Moran, 2012, p. 197), by Madan and Singhal (2013).

Imagery vividness, as we outlined have been studied in multiple manners in varied domains. However, we could not find any study conducted to assess imagery vividness in people with ID in our literature review. Information about imagery vividness in people with intellectual disability (ID) in comparison with typically developing individuals has not been empirically established. In case of difference between people with ID and typically developing on vividness, no information is available about its possible reasons and effects on consciousness of both the groups.

1.1. Objective of the study and research questions

This study was conducted to explore the vividness of mental imagery and eidetic imagery in people with different levels of intellectual disability (ID) and to compare this vividness with that of people who typically pass through the developmental phases without any delay (TD). The purpose was to establish if cognitive impairment in people with ID has any effect on their performance on imagery vividness scales. There were two specific research questions that we tried to explore in this study.

- Do adults with an intellectual disability perform differently on the VVIQ-2 and/or APT compared to TD individuals?

- Does ability to experience mental and eidetic imagery as measured by VVIQ-2 and APT vary with the different cognitive levels of four groups of participants?

2. Method

This study was approved by the Research Ethics Committee of University College Dublin.

2.1. Participants

Four groups of participants were recruited for this study. The first group (n = 18) comprised those who have been assessed with a mild level of ID. The second group was recruited with matched gender and age groups. The second group (n = 18) comprised participants with a moderate level of ID. The third group of typically developing individuals (n = 18) was also matched on age range and gender. The fourth group (n = 18) comprised participants with a severe level of ID, and it was not matched on gender and age range. The participants with ID were recruited from services for intellectual disability in the South East of Ireland.

Power of calculation was used to determine the sample size. To determine the sample size we used Cohen's method and set alpha at 0.5 and power as 90% and effect size as moderate.

2.2. Recruitment and procedure

We recruited the participants following the inclusion and exclusion criteria given below.

2.2.1. Inclusion criteria

a) Participants were over the age of 18 years
b) The participants were typically developing (TD), people who were diagnosed with mild and moderate, and severe intellectual disability.
b) Participants who can give consent or (in case of people with severe ID) whose parents/guardians gave informed consent.
c) For the control group, participants were recruited who were functioning without any developmental delay.

2.2.2. Exclusion criteria

a) Individuals who had disorders such as Autism, ADHD, and Psychosis.
b) Individuals with degenerative diseases (i.e., dementia) and neurological disorders (i.e., epilepsy).
c) People who were on anti-psychotic medicines for mental health reasons.
d) Individuals who did/could not give informed consent due to the cognitive and verbal impairment.
e) Individuals with a profound intellectual disability.
f) Individuals with limited receptive and expressive speech to consent and participate in the study.
g) People who were currently engaged in a therapeutic interaction with the principal investigator (PI).

2.3. Measures

For this study, we developed a measure to assess the vividness of mental imagery and eidetic imagery. This measure consisted of 32 items of the Vividness of Visual Imagery Questionnaire-2 (VVIQ-2, Marks, 1995). Two items (and eight sub-items) derived from the Age Projection Test: Short-Term Imagery Treatment of Hysterias, Phobias & Other Themes (APT) has been developed by Ahsen (1988), Ahsen (1993) based on our findings of a pilot study. The Wechsler Abbreviated Scale of Intelligence, Second Edition (WASI-II; Wechsler, 2011) was used to measure the cognitive functioning of people with mild ID, moderate ID and typically developing individuals (TD). The Vineland Adaptive Behaviour Scale-II (VABS II; Sparrow et al. 2005). was used to determine ID level of people with severe ID.

2.3.1. Vividness of Visual Imagery Questionnaire-2 (VVIQ-2)

The Vividness of Visual Imagery Questionnaire-2 (VVIQ-2) was developed by David Marks (1995). The VVIQ-2 consists of 32 items. In our literature review we did not find any study in which VVIQ-2 or other tests developed by the same author VVIQ or VVIQ-RV has been used to assess the imagery performance of people with ID. However, for typically developing individuals (TD) , a large body of evidence confirms that the VVIQ is a valid and reliable psychometric measure for vividness of visual imagery (McKelvie, 1995). Morrison and Wallace (2001), Allbutt et al. (2008), and Campos and Pérez-Fabello (2009) found high internal consistency reliability in the VVIQ-2 (cf. Campos, 2011; p 458). Campos and Perez-Fabello (2009) reviewed the literature published on the reliability of the VVIQ. They found a number of studies conducted to assess the reliability of VVIQ. They reported Campos et al. (2002), who indicated internal consistency reliability of VVIQ as high as .96 after using the split-half method. Campos et al. (2002) reported Cronbach coefficient α of .88 for a sample of 850 secondary school students. Regarding the internal consistency of the VVIQ Burton (2003) and Burton and Fogarty (2003) reported Cronbach coefficient α of .95.

In another (pilot) study, we revised the language of the VVIQ-2 to make it comprehensible for people with ID.

A five point rating scale used to rate the vividness of images visualized by the participants. The rating scale was presented with four pictures having varied levels of clarity, and a totally dark picture to mark as if no picture was seen by the participant.

2.3.2. Age projection test (APT)

The Age Projection Test was developed by Ahsen (1988), Ahsen (1993). It has 25 items to guide the therapist in conducting a therapeutic session. As the full name, *Age Projection Test: Short-Term Imagery Treatment of Hysterias, Phobias & Other Themes,* suggests, this test is not a psychometric tool. Rather, it is a less formal tool for therapists using eidetic therapy to formulate interventions for conditions like anxiety, phobias, and hysterias. The APT is meant to help the therapist using eidetic therapy in gathering experiential information relevant to symptoms. The APT helps the therapist in tracing the experience which may be relevant to the presenting symptoms of the client (Dolan, 1997). The APT unlike other imagery tests (i.e., VVIQ-2) does not ask the participant to visualize a given picture or scene; rather it asks the participant to visualize real-life situations according to developmental themes. For example, item 11 of APT, which we used in this study the instruction is as follows.

> *Please look at the image* (of yourself) *and tell me what is most clear. Is it the clothes your image is wearing, the place where it appears? – What is your age in the image? —— Tell me any other details of the image which strike you in some way.* (Ahsen, 1988; Ahsen, 1993, p. 38)

From the APT, item 11 was selected due to its potential of being used for experimental reasons. The main purpose of using the items based on APT theory was to establish if people with ID can visualize the real-life situations, which they experience in daily routine, and to see how much detail related to an image they can describe. The vividness of tangible and palpable things is also noted as easy to develop (Paivio, Yuille, and Madigan, 1968).

To investigate the ability to experience eidetic images, two items (eight sub-items) were derived from item eleven of the Age Projection Test of Ahsen (1988), Ahsen (1993). Item eleven of APT is about seeing oneself and asking the person to describe about the place where the subject sees himself/herself. Following the response of participants in our pilot study, two items (and eight sub-items) were produced in our pilot study. These items were related to two places, which the participants

would experience as a matter of routine. Four items were related to residence and four were related to the day service/workplace. This way we have developed a set of items to ascertain a person's ability to experience eidetic (experiential) imagery.

The participants were asked to see different features of their residence and workplace and then to rate the vividness of the image formed in their minds. The same five-point rating scale has been used as we used for the VVIQ-2.

2.3.3. Wechsler Abbreviated Scale of Intelligence, second edition (WASI-II)

The third measure we used in this study was an IQ test, which belonged to the family of Wechsler Tests for intelligence. The Intelligence Quotient of participants was measured through the Wechsler Abbreviated Scale of Intelligence, Second Edition (WASI-II). The WASI-II is a measure of intelligence designed for individuals 6–90 years of age (Wechsler, 2011). In this study, WASI-II was used to determine the IQ level of TD individuals, people with mild and moderate ID to place them in the appropriate group of participants.

2.3.4. Vineland Adaptive Behaviour Scale: second edition (VABS II)

The Vineland Adaptive Behaviour Scale-II (VABS-II) was developed by Sparrow et al. (2005). It was a revision of Doll's (1953) Vineland Social Maturity Scale (cf. Price et al., 2018). The VABS-II is a scale to assess adaptive behavior of people from birth to 90 years old. It consists of five domains related to communication skills, daily living skills, socialization, motor skills, and maladaptive behaviour.

The Adaptive Behaviour Composite reliability was calculated from Nunnally's formula; correlations for this composite ranged from .93 to .97 across the age groups. Average correlations for test-retest reliability were found to be in the range between .76 and .92 across domains (with the exception of the Maladaptive Behaviour Subscales and Index), subdomains, and ages. The test-retest reliability correlations for Maladaptive Behaviour Subscales and Index was ranging from .74 to .98 (Sparrow et al., 2005).

The main focus of VABS is to help diagnose and evaluate the special needs of the individual. The VABS not only gives an idea of the current level of functioning but estimates the nature and amount of support the individual may need. We used VABS II to assess people with severe ID so that they can be placed in the appropriate study group.

2.4. Data collection

The data were collected from a selected sample of people with intellectual disability. The proposed participants were invited to participate in this study on the basis that they have sufficient verbal ability to comprehend and respond to test instructions and are capable of giving consent to participate. The first contact regarding their participation was made through the Manager of the service or the relevant KeyWorker in order to minimize any possible element of pressure to participate. If the willingness was expressed in the first contact, only then the researcher contacted this person to seek formal consent to participate. The information sheet and written consent form were presented (either in writing or by reading it out) to them.

The VVIQ-2 and APT based two imagery items (and eight sub-items) were administered to the participants, as described below.

The Vividness of Visual Imagery Questionnaire-2 (VVIQ-2; Marks (1995) was administered after making its language simple for people with ID to comprehend. The language was modified in a pilot study with the help of one frontline staff, one team leader, and a Manager of a day service for people with ID. To help the participants comprehend the concept of vividness, they were shown five pictures. The first one was a dark picture, which they were supposed to score as one, if they did not see any picture. In the rest of the four pictures, the clarity level was progressively raised. The last one was a very clear picture, where everything was clearly recognisable. This picture was supposed to be rated as five, which would mean the maximum vividness.

Two iems (eight sub-items) derived from Age Projection Test (APT; Ahsen, 1988; Ahsen, 1993) were administered with the 32 items of the VVIQ-2.

To establish the intellectual functioning of participants, the Wechsler Abbreviated Scale of Intelligence, Second Edition (WASI-II) was administered to people with mild ID, Moderate ID and TD. In order to establish the level of ID the Vineland Adaptive Behaviour Scale: Second Edition (VABS II) was administered to people with severe ID.

The instructions were given to the participants in a verbal form. All the tests were administered at their day activity centres.

3. Results

Table 1 shows that the total number of participants was 72 (18 TD and 54 ID). The intellectually disabled category comprised equal numbers of mild intellectually disabled, moderately and severely intellectually disabled individuals (18 in each category). The mean age of TD was 29.66 ($SD = 9.29263$). The mean age of participants with mild ID was 28.50 ($SD = 8.55$), the mean age of participants with moderate ID was 30.38 ($SD = 9.53$), and the mean age of participants with severe ID was 53.27 ($SD = 15.39$). We also calculated the mean and median of all the participants on VVIQ 2 ($M = 118.10$, $Md = 125.50$) and APT ($M = 33.11$, $Md = 36.00$).

Research question 1: Do adults with an intellectual disability perform differently from adults who are typically developing and from each other on the VVIQ-2 and APT.

Table 2 shows the results of ANCOVA while taking age as a covariate to control its effect on the differences on VVIQ-2 and APT in TD people, people with mild ID, moderate ID, and people with severe ID due to large difference of age between groups, although overall mean age calculated was 35.54 ($SD = 14.98$). Participants were divided into four groups according to their intellectual abilities. The findings indicated significant group differences on VVIQ-2 ($F = 8.17, p < .001$) and APT with respect to the level of intellectual disability ($F = 8.14$, $p < .001$). The effect size, calculated using eta squared, was .33, on VVIQ-2, which has been considered as small, while the effect size calculated on group differences on APT was 0.32 which is considered medium (Ellis, 2010), whereas the sample power calculated was significantly high as .99.

Furthermore, Post-hoc comparisons (using the Tukey HSD test) for VVIQ-2, indicated that the mean score of severely intellectually disabled individuals ($M = 89.67$, $SD = 41.45$) was significantly lower than that of TD people ($M = 135.61$, $SD = 16.19$), people with mild intellectual disability ($M = 122.11$, $SD = 30.44$) and people with moderate intellectual disability ($M = 125.00$, $SD = 18.72$) whereas, no other significant differences were found between groups.

Similarly, for the APT, post-hoc comparisons revealed that the mean score of severely intellectually disabled individuals ($M = 25.44$, $SD = 12.48$) was significantly lower than that of TD people ($M = 38.94$, $SD = 1.55$), people with mild intellectual disability ($M = 34.28$, $SD = 8.73$) and people with moderate intellectual disability ($M = 33.78$, $SD = 5.60$) whereas, no other significant differences were found between groups.

Table 2 shows that the participants with severe ID scored significantly lower on VVIQ-2 and APT than the rest of the three groups. Other than that there was no significant group difference. In a nut shell, the results indicate that there is no significant group difference in the performance of TD individuals and people with mild and moderate ID on VVIQ 2 and APT. However, people with severe ID performed significantly lower than rest of the three study groups on both VVIQ 2 and APT.

Research question 2: Does ability to experience mental and eidetic imagery, as measured by VVIQ-2 and APT, vary with the different cognitive level of four groups of participants?

Data from participants in the mild ID, moderate ID, and TD groups, who completed the WASI II, were used in this analysis. The severe ID

Table 1. Descriptive characteristics of sample (N = 72).

	N	Min	Max	M	SD
TD Age	18	19.0	51.0	29.6	9.2
VVIQ-2		101.0	157.0	135.6	16.1
APT		35.0	40.0	38.9	1.5
IQ		91.0	137.0	111.6	14.3
Mild ID Age	18	19.0	46.0	28.5	8.5
VVIQ-2		32.0	160.0	122.1	30.4
APT		8.0	40.0	34.2	8.7
IQ		55.0	69.0	59.3	4.6
Mod ID Age	18	19.0	49.0	30.3	9.5
VVIQ-2		88.0	156.0	125.0	18.7
APT		20.0	40.0	33.7	5.5
IQ		40.0	54.0	46.0	4.1
Sev. ID Age	18	23.0	73.0	53.2	15.3
VVIQ-2		32.0	147.0	89.6	41.4
APT		8.0	45.0	25.4	12.4
Adapt. Beh Score		20.0	63.0	28.7	9.9

Note. ID = Intellectual Disability, Mod ID = moderate ID, Sev. ID = Severe ID, TD = Typically developing, IQ = Intelligence Quotient, VVIQ-2 = Vividness of Visual Imagery Questionnaire-2, APT = Age Projection Test. Adap. Beh Score = Scores on Vineland Adaptive Behavior Scale II.

Table 2. ANCOVA comparing Vividness of Visual Imagery-2 and Age Projection Test in typically developing people, people with mild, and moderate intellectual disability, people with moderate intellectual disability and people with severe intellectual disability (N = 72).

Variables	Typically developing People (TD) (n = 18)		People with mild intellectual disability (MiID) (n = 18)		People with moderate intellectual disability (MoID) (n = 18)		People with severe intellectual disability (SeID) (n = 18)		*F(df1, df2)*	Partial $\acute{\eta}^2$	Sample Power	Post-hoc
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*				
VVIQ-2	135.61	16.19	122.11	30.44	125.00	18.72	89.67	41.45	8.17***(3,71)	.33	.99	TD > SeID***, MiID > SeID**, MoID > SeID**
APT	38.94	1.55	34.28	8.73	33.78	5.60	25.44	12.48	8.14***(3, 71)	.32	.99	TD > SeID***, MiID > SeID**, MoID > SeID*

Note. VVIQ-2 = Vividness of Visual Imagery Questionnaire 2; APT = Age Projection Test; Partial $\acute{\eta}^2$ = Ratio of variance.
***$p < .001$.

group was omitted, as the participants in this group were not assessed with the WASI II. The purpose of using WASI II for people with mild, moderate ID and TD individuals, and VABS II for people with severe ID was to assess their category related to ID.

Table 3 shows that age has a significant correlation with IQ level, VVIQ- 2, and APT, whereas gender didn't show any significant relationship with any of the study variables.

Table 3. Correlation between scores of people with mild ID, moderate ID and typically developing on VVIQ-2, APT and WASI II (N = 54).

Variables	1	2	3	4	5
1. Age	-	.06	.55***	-.51***	-.50***
2. Gender	-	-	.07	.04	.03
3. IQ	-		.	.50***	.51***
4. VVIQ-2		-		-	.87***
5. APT			-		

Note. IQ = Intelligence Quotient, VVIQ-2 = Vividness of Visual Imagery Questionnaire-2.
APT = Age Projection Test.
***p < .001.

Table 4. Descriptive Statistics of scores of people with severe ID on VVIQ-2, APT, and VABS II (N = 18).

Tests	M	SD	n
VVIQ-2	89.6667	41.45	18
APT	25.4444	12.48	18
VABS II	28.72	9.92	18

Note. VVIQ-2 = Vividness of Visual Imagery Questionnaire-2, APT = Age Projection Test, VABS II = Vineland Adaptive Behaviour Scale-II.

Table 5. Correlation between scores of people with severe ID on VVIQ-2, APT and VABS II (N = 18).

Variables	1	2	3
1. VVIQ-2	-	.845***	.12
2. APT		-	.08
3. VABS II			-

Note. VVIQ-2 = Questionnaire 2, APT = Age Projection Test, VABS II = Vineland Adaptive Behaviour Scales-II.
***p < .001.

Table 3 further shows IQ had a significant positive correlation with the VVIQ-2 ($r = .50$, $p < .001$) and Age Projection Test ($r = 0.51$; $p < .001$). VVIQ-2 also showed strong significant relationship with APT ($r = .87$. $p < .001$).

Table 4 shows the mean scores of participants on VVIQ-2, APT, and VABS II.

Table 5 shows the results of a Pearson product moment correlation analysis which revealed that the VVIQ-2 has a significant positive relationship with APT ($r = .84$, $p = .001$) whereas no significant correlation was found between VVIQ-2 and VABS II ($r = .11$). Similarly, VABS II was not found to be correlated with APT ($r = .07$). There is no significant correlation except between VVIQ-2 and APT ($r = .84$, $p = .001$), which is similar to what we have seen in Table 3. Unlike the significant positive correlation of people with mild and moderate ID with APT (Table 5) we did not see any correlation between APT and VABS II in case of people with severe ID. Here the notable point is that there is a positive correlation between WASI-II and VABS II (Minguez and Milh, 2018).

4. Discussion

The results of this study confirm the ability of all the three groups of ID and TD to experience the vividness of mental and eidetic imagery.

The results indicate that individuals with mild and moderate intellectual disability can have vivid imagery not significantly different from TD individuals. People with severe ID performed significantly lower than the other three study groups. Their mean scores on Vividness of Visual Imagery Questionnaire 2 (VVIQ 2) ($M = 89.67$, $SD = 41.45$) was lower than the mean score of all the participants ($M = 117.10$). Similarly, their mean score on Age Projection Test (APT) ($M = 25.44$, $SD = 12.48$) was also lower than the mean score of all the participants ($M = 36.00$). However, their scores still indicative of their ability to experience mental imagery and eidetic imagery though lower than rest of the three experimental groups. It is evident from the findings of the current study that the role of cognitive abilities in experiencing imagery is not as significant as it has always been thought by the cognitivists (Sack and Schumann, 2012). As we know now better than before that vividness of imagery is not based on individual ability rather on the object or situation, which is being visualized (Runge et al., 2017; Dijkstra et al., 2017). These studies used fMRI and found that *trial-by-trial* vividness rating (VR) is better than the VVIQ, which suggests that vividness is a neurological construct rather than merely a psychological phenomenon. That is why they concluded that vividness can be better assessed through fMRI and trial by trial method than the VVIQ type of measures (Runge et al., 2017). The reason behind this conclusion was the complexity of imagery vividness. According to Dijkstra et al. (2017) different imagery stimuli (for example items of VVIQ-2) generate different levels of vividness for different individuals. Different stimuli for imagery get different areas of the brain involved (more than the visual cortex) and vividness depends on the category of stimulus. It might be sufficient to conclude the outcome of these studies from the domain of neuroscience that the variation in vividness is more related to the categories of stimuli instead of the ability of participants.

The results of these studies suggest that vividness is modulated not by ability but by the way simple stimuli were experienced by the participants at a particular moment in time.

The results of our study, which tried to assess the ability of people with different cognitive levels to experience the vividness of mental and eidetic imagery, confirm one outcome of the above mentioned neurological studies - the role of cognitive ability in experiencing vividness of imagery is not as important as it was considered. We have seen the evidence; people with mild and moderate ID performed no differently from those with TD on the VVIQ-2 and APT based items, despite their cognitive impairment. Looking at the results of the current study, one can ponder that the use of other modes of assessing the vividness than VVIQ-2 may produce different results. However, it can be safely suggested that despite its limitations, evaluation of the role of cognition in experiencing mental and eidetic imagery and related constructs, like vividness may be a valuable step for future research in psychology, imagery and ID.

4.1. Limitations

Based on our literature review we can safely suggest that the current study was the first attempt which assessed the vividness of mental imagery and eidetic imagery in people with different levels of ID in comparison with typically developing individuals. This study revealed the potential of people with mild ID, moderate ID to experience the vividness of mental imagery and eidetic imagery without any significant difference with TD individuals despite their cognitive deficit. Similarly, the ability of people with severe ID to experience the vividness of mental and eidetic imagery has been assessed for the first time. The outcome suggested a noticeable potential of people with ID to experience the vividness of mental and eidetic imagery. In spite of this strength, we acknowledge the following limitations of the current study.

4.1.1. Measures

As we have discussed that none of the imagery assessment tools we used was developed for people with ID. Although, people with ID showed a noticeable performance on VVIQ-2 and APT but both the tests needed modification for this study. After reviewing the recent advances in the study of the vividness of imagery made by neuroscientific studies, it sounds prudent to believe that the trial-by-trial vividness assessment tools would be better than anything such as VVIQ-2. We have discussed that APT is not a vividness assessment tool; rather it is an assessment mechanism for clinically significant features. For future studies, its current use may suggest the phenomenological potential of APT.

4.1.2. Sample and sample size

We had 18 participants in each of the four study groups, with the total number of participants was 72, which is an adequate size for comparing the within group difference (Table 2).

4.2. Practical implications

The results showed a noticeable ability of people with ID to experience mental imagery and eidetic imagery comparing with typically developing. The outcomes indicate that for learning and therapy, people with ID may benefit from imagery in a similar manner typically developing individuals do.

In the efforts of Schalock et al. (2007), and DSM 5 (APA, 2013) to redefine ID and suggest new mechanisms to bring the lives of people with ID as close to typically developing, results of the current study may contribute positively. The results of the current study successfully identified the overlapping areas of ability and skill between people with ID and TD.

4.3. Suggestions for future research

The results of the current study are indicative of two noteworthy outcomes. One, people with ID *do* experience the vividness of mental

imagery and eidetic imagery. Two, as the existence of mental and eidetic imagery, has been established substantially, it is important to develop an assessment tool, which should have comprehensible instructions for people with ID. Furthermore, the assessment tool may be based on the type of imagery, people with ID can experience readily, i.e., experiential imagery. Our literature review suggests that a trial-by-trial vividness assessment might be a better option because vividness changes from moment-to-moment and from object to object. In the light of our findings that vividness of imagery exists in people with ID, it may be worth suggesting that the value of phenomenological approaches to therapy need to be evaluated, as suggested by Syed et al. (2020). Such therapeutic approaches focus on the "client's process of self-discovery as opposed to an interpretive focus" (VandenBos, 2002. p. 432). The evaluation of a form of psychotherapy based on experiential imagery, which does not need learning and education of client rather encourages the re-examining of experiences and reviewing the environment without any pre-conceived theoretical notion (phenomenology) would open new avenues of understanding of and support for people with ID.

5. Conclusion

The results on the Vividness of Visual Imagery Questionnaire 2 (VVIQ-2) indicate that people with mild and moderate intellectual disability (ID) can experience vividness of mental imagery without any significant difference between them and typically developing (TD) individuals. There was a significant difference found between people with severe ID and the other three study groups (i.e., people with ID, moderate ID and TD). Nevertheless, the findings still significantly confirm the ability of people with severe ID to experience and report the vividness of mental and eidetic imagery on tools that were meant for TD. The results confirmed that people with ID can experience the vividness of imagery. Furthermore, the results indicate the existence of imagery and the potential of using it as a tool to achieve several other objectives for the betterment of people with ID. Those objectives may include learning enhancement and therapeutic support.

Declarations

Author contribution statement

A. A. Syed: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

S. Neelofur: Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data.

A. Moran, G. O'Reilly: Conceived and designed the experiments; Wrote the paper.

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The authors declare no conflict of interest.

Additional information

No additional information is available for this paper.

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