Mental imagery scale: an application in the field of art didactics

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Abstract

Mental imagery is a quasi-perceptual experience, resembling perceptual experience, but occurring without appropriate external stimuli. In literature, most measurement tools for evaluating imagery capacity are self-report instruments focusing on differences in individuals. In the present work, we applied a Mental Imagery Scale (MIS) to mental images derived from verbal descriptions in order to assess the structural features of such mental representations. This is a key-theme in art didactics, given the constant need in this discipline to turn objects and representations into words. To this aim, an MIS questionnaire was administered to 262 participants. The questionnaire, originally consisting of a 33-item 5-step Likert scale, was reduced to 28 items covering 6 areas: 1) Image Formation Speed; 2) Permanence/Stability; 3) Dimensions; 4) Level of Detail/Grain; 5) Distance; 6) Depth of Field or Perspective. Factor analysis confirmed our 6-factor hypothesis underlying the 28 items.

Keywords: Mental imagery, verbal description, questionnaire, art didactics, structural qualities

1. Introduction

On The Concept of Mental Imagery. From a psychological point of view, mental imagery is a quasi-perceptual experience, resembling perceptual experience but occurring without appropriate external stimuli. Even though mental imagery is present in every sensory mode (e.g., auditory imagery, kinaesthetic or motor imagery, olfactory imagery, haptic or touch imagery, and so forth), most scholarly discussion on the subject, up to the present, has indeed focused mainly or exclusively upon the visual mode. Visual imagery is a form of mental representation and is often considered centrally involved in visuo-spatial reasoning and inventive or creative thought.

In our research, we adopted the concept of mental imagery according to two principal theoretical assumptions. First, a mental image has properties similar to those of perceptual image (Kosslyn, 1980) in that a mental image is projected on a mental screen with characteristics similar to those of the visual field (Dimensions, Perspective, etc…). Second, there are some interconnections between visual and verbal codes, so that verbal stimuli or descriptions referring to simple objects or complex images, respectively, can evoke a corresponding mental representation (Paivio, 1971). These apparently simple assumptions are based on a generally accepted paradigm of mental imagery supported by a wide range of experimental research and theoretical observations. As mentioned above, the two leading theories in this field are the ones put forward by Stephen Kosslyn and Allan Paivio.

Stephen Kosslyn (1980) produced experimental evidence showing that visual mental imagery has inherent spatial properties and represents things in an “analog” perspective which implies that the mental representations we experience are like pictures, with intrinsically spatial representational properties of the sort that pictures have. It is on this basis that the “quasi-pictorial” theory of Kosslyn (1980) is founded. This theory may explain various alleged “imagery effects”, such as mental rotation, selective interference, mental scanning and
size-inspection time effects. When one forms a mental image, a quasi-picture or surface representation is constructed, on the basis of stored information, on a functionally defined surface which Kosslyn calls the visual buffer, “mental screen” or “visuo-spatial sketchpad” - with specific features similar to those of the visual field. Once the quasi-picture is established on the buffer, it is available to the consciousness as an image, and a postulated mind’s eye function reads and interprets the buffer’s surface display.

Paivio’s work mainly analyses the relationship between verbal and visual codes through the study of the nature of memory conservation, thus developing the well-known “Dual Coding Theory” (1971). Paivio’s Dual Coding Theory postulates that visual and verbal information are processed differently and along distinct channels within the human mind, thus creating separate representations. Both visual and verbal codes for representing information are used to organize incoming information into knowledge that can be stored, and retrieved for subsequent use. According to Paivio (1971), mental images are analogue codes, while verbal representations of words are symbolic codes. Verbal and nonverbal systems interact through referential interconnections that link verbal and non verbal representations, permitting objects to be named and names to evoke images. Although imagery ability is assumed to be functionally independent of verbal systems, it is still considered to interact with verbal representations through referential interconnections.

Measuring Mental Imagery Ability. Most research focused on the attempt to measure different aspects of inner visualization in single subjects by using introspective reports. In literature, most measurement tools for evaluating imagery capacity are self-report instruments, focusing on individual differences in the ability to: 1) clearly and vividly visualise static images (VVIQ – Vividness of Visual Imagery Questionnaire, Marks, 1973); 2) visualise moving images (VMIQ – Vividness of Movement Imagery Questionnaire, Isaac set al., 1986); 3) control and transform images (TVIC - Test of Visual Imagery Control, Gordon, 1949); 4) preferentially visualise spatial relations or object configurations (OSIQ – Object-Spatial Imagery Questionnaire; Blazhenkova et al., 2006). A later development of the OSIQ is the OSIVQ – Object-Spatial Imagery and Verbal Questionnaire (Blazhenkova & Kozhevnikov, 2008), designed and validated to assess individual differences in object imagery, spatial imagery and verbal cognitive style. This instrument is the most recent development of a former and well-known questionnaire: the IDQ – Individual Differences Questionnaire (Paivio, 1971). Those instruments try to measure:

- the general ability to visualize different types of mental images (i.e., static versus dynamic images);
- the preference of the subject to focus on different aspects of the information (e.g., spatial relations versus object configurations);
- the specific ability manipulate images (e.g. to control, transform, etc.).

In short, these all are instruments that measure an ability or a cognitive style internal to the respondent.

Study Objectives. The purpose of this research was to develop and evaluate the factorial structure of a multi-dimensional scale to assess structural qualities of a mental image and its process of generation. This scale was applied to mental images generated by verbal descriptions in order to assess the relationship between images and words. As mentioned above, the way an mental image is created on the basis of description has been studied at length over the last few decades in Psychology, and relevant findings led to the knowledge that mental representations have measurable characteristics. The possibility of turning verbal descriptions into mental images and vice-versa is also a key theme in art didactics, given the constant need in this discipline to turn objects and representations of artworks into words. In addition, the opportunity of exploring mental images and turning inner representations into words, may also be applicable to other disciplines (e.g., when architectural or engineering
projects have to be conceived and explained without drawing). Finally, as mentioned before, the existing questionnaires are focused on a general ability internal to the respondents. No measuring tools can be found in literature to assess the structural qualities of a mental representation deriving from a verbal description of an object or a scene. This scale can, therefore, apply to a wide range of different stimuli and cannot be used without them, and it may also be useful to test the consistency between the original description and the resulting mental representation.

Specific Hypotheses. Scale construction and psychometric assessment were guided by two assumptions. The first was that we anticipated that items would load on a six-factor model representing six distinct components of the image structural qualities and generation process: 1) Image Formation Speed; 2) Permanence/Stability; 3) Dimensions; 4) Level of Detail/Grain; 5) Distance, 6) Depth of Field or Perspective. By Image Formation Speed we mean the time required to generate and complete the image. Mental representation is a voluntary act, in which the more complex the image is, the more time it will take to form (Kosslyn, 1984). Since formation is a process that involves the assemblage of simple units into a whole, we considered the hypothesis that single words might act as triggers for single components of the mental image. Stability is the ability to maintain the image once it has been formed, by refreshing it every now and then, which is necessary in order to examine a mental image or use it for problem solving. It has been empirically demonstrated (Kosslyn, 1977) that mental images have their Dimensions, i.e. they can be visualized in a smaller or in a larger scale on the mental screen. Dimensions can be assessed by comparing mental images with either their equivalent in the real word or in proportion to the “observer”. The Level of Detail and Grain of mental images depends on the dimensions, i.e. the degree of elaboration of single parts of the image and of its texture, and the sharpness of object contours. Distance can be described as the gap between the image visualized and the virtual observer. By Depth of Field we mean the presence of perspective and of a three-dimensional distribution of objects in space (Kosslyn, 1978).

The second assumption was that some subscales loaded on these factors would be significantly associated with each other: more specifically, according to Kosslyn (1977, 1978, 1984), the variables Dimensions, Level of Detail, and Distance should exhibit the same trend of the data.

2. Method

Item Construction and Selection. The initial set of items was based both on a literature review of the most important structural qualities of mental images, and on a previous pilot research conducted by the same authors about relevant characteristics of mental images (Castelli et al., 2008). Using this material, 33 items were generated to represent six components of the aforementioned image structural qualities: Image Formation Speed, Permanence/Stability, Dimensions, Level of Detail and Grain, Distance, Depth of Field or Perspective. The Image Formation Speed subscale was comprised of 5 items (e.g., “I began to visualize images while reading”); the Permanence subscale included 6 items (e.g., “Now and then, while reading, I lost the image”); the Dimensions subscale contained 5 items (e.g., “I visualize a small image”); the Level of Detail subscale was comprised of 6 items (e.g., “The image was a whole in which I could not distinguish the single components”); the Distance subscale included 5 items (e.g., “The elements of the image were very distant from me”); the Perspective subscale contained 6 items (e.g., “I could distinguish objects in the foreground from those in the background”). Participants responded to each item on a 5-point Likert-type scale ranging from 1 (totally false) to 5 (totally true). A separate page for verbal description was attached to the questionnaire. On top of that page, participants were asked to fill in their demographics (birth date, degree, field of education, occupation).
Sample and Procedure. The 33 items of Mental Imagery Scale (MIS) were administered to 262 people, 170 female and 92 male, with an age range of 18 to 60 with a mean age of 29. A wide variety of educational background (ranging from high school diploma, 49% of the sample, to PhD degree, 6% of the sample) and occupation (ranging from self-employed to public employee) was reported. After answering demographic questions, participants were asked to read a verbal description of an artwork (The Pink Nude by Henri Matisse) and to fill out the MIS questionnaire.

Analytic Plan and Analysis. We used a multi-step process to analyze the psychometric properties of the MIS. First, we conducted a factor analysis to examine whether items would cluster into conceptually and statistically distinct subscales. The factor analysis supported the six-factor model and subscales for each factor were assessed for internal consistency. Next, using correlational analyses, we evaluated the hypothesized associations between subscales.

3. Results and discussions

Factor Analysis and Internal Consistency of Resultant Subscales. The primary objective of this study was to develop and generally test a theoretically grounded, multifactor scale of the structural qualities of mental images. To this end, we conducted an exploratory factor analysis using a principle component analysis (Oblimin rotation with Kaiser Normalization and mean replacements for missing data). Items were maintained if: 1. they yielded a factor loading of at least .55, 2. they did not score to this criterion on any other factor and 3. they loaded by at least .40 less on any other factor.

Five items did not meet the criteria listed above and, therefore, were not included in the final scale. As hypothesized, factor analysis on MIS items produced a six-factor solution (Kaiser–Meyer–Olkin Measure of Sampling Adequacy = .793; Bartlett’s Test of Sphericity, \( p < .0001 \)). Total variance explained was 54.6%, with Factor 1 accounting for 19.3%, Factor 2 accounting for 10%, Factors 3 accounting for 8.9%, Factors 4 accounting for 6.6%, and Factors 5 and 6 accounting for 5.4% and 4.4%, respectively.

Factor 1 was labelled Stability. The five items loading on this factor reflect the idea that the mental representation image is quite stable and permanent in the mind of the respondent. The second factor, labelled Depth of field, contains five items reflecting the presence of perspective in the field of the image. Factor 3, labelled Distance, contains five items that express the distance of the “observer” from the virtual image; Factor 4, named Level of Details, includes four items that give information on the grain of the objects and the sharpness of contours. Factor 5, named Dimensions, contains four items in its group regarding how small or large the scale of the image projected on the mental screen is. Finally, Factor 6, labelled Rapidity, includes 5 items regarding the speed with which the image is formed.

Based on the subscales derived from the factor analysis, inter-item analyses were performed. The degree of internal consistency for Stability, Distance, Level of Details, and Rapidity was acceptable, yielding internal consistency scores of .77, .80, .76, .73 and .72, respectively. The Depth of Field and Dimensions scales yielded a lower internal consistency score of .69 and .62.

Inter-subscale Correlations. Correlations between the six MIS subscales ranged from .13 (\( p = .05 \)) to .23 (\( p < .001 \)), demonstrating the overlapping but distinct conceptual properties of the subscale. Contrary to what had been hypothesized, results showed that variable Level of Detail is not correlated with Dimensions, and that the explained variance from the significant association between Level of Detail and Distance is only 1%.

4. Conclusion

The primary goal of this study was to develop a theoretically and empirically grounded multi-dimensional scale measuring structural qualities of mental images. This goal was met
through the construction and validation of the Mental Imagery Scale. The construct validity of MIS drew support from the emergence of six distinct theoretically driven subscales derived from factor analysis. The resulting MIS scale adds to the study of mental images and to research examining the relationship between these images and verbal descriptions. The challenge and psychological work required for the future will be to verify correlations between MIS and other questionnaires conceived to measure internal abilities in generating mental images.

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References