Mental Images in Human Cognition
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Chapter 20

The study of vividness of images

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This paper summarises some studies we have carried out on vividness of images. In a first series of experiments we examined which variables may affect vividness ratings. In a second series we used the vividness rating procedure to contrast different conditions and groups of subjects.

By focusing on vividness qualities of images we intend to suggest that the study of the structural properties of mental images is no less important than is the study of their functional properties. Furthermore, the phenomenological consideration of images appears to have the advantage that it does not require any legitimating proof concerning the existence of mental imagery, as the experience of having an image is central to the subjective mental life of the majority of people. Vividness, in particular, is one of the main qualities of such experience and has been the subject of research, especially in connection with the more or less explicit idea that those who have more vivid images are generally better at imaging and thus perform better in tasks requiring the use of imagery (Betts, 1909; Denis, 1982; Marks, 1972, etc).

Image vividness has been defined only intuitively as if the rating instructions given to subjects were based on a primitive dimension that is immediately comprehensible though not wholly definable. These intuitive definitions sometimes refer to two aspects defining image "vividness": a) the extent to which the image approaches actual visual experience; b) image luminosity-clarity. These two characteristics (a and b) are not necessarily present together. Furthermore, they do not seem to involve all the possible variables affecting ratings of vividness. Indeed, on the basis of a series of interviews we observed that other aspects were often mentioned as being related to vividness.

Our first study (Cornoldi et al., in press) was aimed at identifying factors influencing vividness judgements. We hypothesized that it is possible to identify some characteristics of an image which may play a critical role in determining the assessment of vividness.

In a small group of experts we explored the definitions of a vivid image given in an informal interview. Our re-analysis and discussion of their answers brought us to focus on the six following characteristics of an image: presence of colours, presence of a rich context, emergence of salient features, richness of details, well-defined shape and contour, generality of the represented object. For example an image of an house could be either coloured, or black and white (colour), within a landscape (context), with an emergent architectural element, such as an arch, (saliency), quite detailed in its elements, such as windows, doors, chimney etc. (details), well defined in its shape and contour, (shape and contour), and not referred to a particular example of a specific house (generality).

In the first experiment, we asked 18 University students to form images specifically related to one of the six above mentioned characteristics. For example, when based on colour, subjects had to create a good coloured image of a named object, and to concentrate on colours as a fundamental element. Thirty object names (five for each characteristic) were orally presented at a rate of one every 20 sec, during which time subjects heard the word, wrote it down, formed an image of the required kind (the six characteristics were randomly balanced within the list) and concentrated on it until they were asked to rate it in vividness by putting a mark at some point along a 20 cm line. After forming all 30 images and rating their vividness, subjects were asked to perform a 90 sec interpolated task (counting backwards) and then to write down all the words they remembered from the 30 item list.

The various types of image (i.e. the stimuli imagined with one of the six characteristics) produced significant differences in recall (coloured images were recalled better than detailed and generic ones) but not in vividness ratings.

Nevertheless, this failure to find differential effects on vividness ratings could have been due to the procedure adopted and, in particular, to the fact that the subjects' concentration had continuously to shift from one characteristic to another. It was surprising to find that the characteristic of generality (where the instructions requested subjects to form an image which did not represent any particular object, but a generic representation of the object) affected vividness ratings in the same way as the other characteristics. This is especially surprising when compared with the results of a previous study where generality

appeared to negatively influence vividness (Cornoldi, De Beni & Pra Baldi, 1989). It is possible that carry-over from one instruction to the next occurred, equalizing the effects of the different instructions.

For this reason we divided our second into six sessions, in each of which 45 subjects concentrated on only one of the six characteristics for the same thirty object names. Inviting subjects to form different images for the same objects minimized the influence of the stimuli and gave us the possibility of exploring which characteristic was more emergent when an image was retrieved from memory.

To examine the effects on the vividness ratings of groups of different imagery ability, tested on the basis of introspective reports, we administered the IDQ imagery test (Paivio & Harshman, 1983) to 88 University students. Of these, 23 with scores in the I scale (propensity to use images) higher than 31 were classified as high imagers, and 22 with scores lower than 23 as low imagers. High imagers gave significantly higher vividness ratings for all the six conditions. Correlations between IDQ-I scores and mean ratings in the six conditions were nevertheless significant only in the cases of detail, shape, and contour and generality (the correlations were respectively .298, .291, and .281). Furthermore, the object names that were recalled best proved to be those imaged with salient characteristics, while those imaged with the characteristic of details were recalled least well.

An Anova revealed a significant effect of characteristic: Post-hoc comparison revealed that saliency (mean recall = 3.84) was significantly recalled better (i.e. more frequently) than shape and contour (3.13), generality (3.07), and detail (2.60); context (3.57) and colour (3.33), too, obtained significantly higher recall than detail.

The main aim of experiment 3 was to assess which characteristics have greater relevance in producing vividness ratings when images are spontaneously generated and immediately rated for vividness. For this purpose subjects were asked only to create an image of the presented noun. After giving the vividness ratings, they were asked to rate to what extent the six characteristics (examined in the preceding experiments) were present in the image by putting a mark along a line.

Stepwise multiple regression analysis revealed that the dependent variable represented by the vividness ratings was significantly influenced first by shape-and-contour ($B = .42$ $p < .001$), then by detail ($B = .20$, $p < .001$), context ($B = .08$, $p = .022$), and generality ($B = .08$, $p = .024$).

We should add that items recalled at a following memory test were rated as significantly more vivid than non-recalled items.

In our opinion, it was in this experiment that the procedure adopted most closely mirrored the situation in which a person creates an image

and immediately experiences its degree of vividness. However, the successive rating with regard to the presence of the six characteristics could have been influenced by the preceding overall vividness rating.

To examine the effects of the order of ratings, we carried out a fourth experiment in which the procedure for experiment 3 was slightly modified; our subjects were now required to rate, first, the presence of each of the six characteristics, and then the overall vividness of the image generated.

In this way we expected to find a still greater weight of the six characteristics on overall vividness ratings, as in fact happened. The characteristics entered the stepwise multiple regression analysis in the following order: shape-and-contour ($B = .24$, $p < .001$), colour ($B = .20$, $p < .001$), detail ($B = .16$, $p < .001$), generality ($B = -.13$, $p < .001$), and saliency ($B = .14$, $p < .001$). Only context did not significantly enter the final equation. Before processing the overall image, context probably has no influence on overall vividness ratings, since subjects base their final ratings on the properties of the critical item rather than on those of the context. The negative sign concerning generality, found in both experiments 3 and 4, was due to the fact that low values in generality (i.e. high in specificity) contributed to the high vividness ratings.

The main result concerning vividness found in this series of experiments was that all of the six identified characteristics contributed in some way to the vividness of an image. When images are generated using only one characteristic for different stimuli (experiment 1) or for the same stimuli (experiment 2), any of the six characteristics of the image (shape-and-outline, detail, context, colour, generality and salience) influences vividness ratings to a similar extent. Further, when an image generated and rated in vividness, either immediately (experiment 3) or as the outcome of a progressive construction (experiment 4), is considered at the same time for all the six characteristics, then all the characteristics seem to influence the vividness ratings in a specific way; however, some of them (first of all shape-and-contour) are more likely to influence vividness than others whose influence changes depending on the procedure adopted (see for a discussion Cornoldi et al, in press).

The second series of experiments illustrates how the consideration of the different vividness properties of the images may help in studying critical problems concerning visual imagery. In particular we focused on the relationship between visual perception and visual imagery. If we consider that vividness ratings are related to the extent to which the image approaches actual visual experience, our goal of comparing vividness ratings for perceived and for the corresponding imaged patterns could appear trivial and circular.

Therefore our hypothesis that vividness ratings may be used to demonstrate some differences between perception and imagery may be particularly challenging. Indeed, our preceding study had shown that other characteristics also influenced vividness ratings. Moreover we reasoned that the reference to visual perception which can be used during vividness ratings may be based on the extent to which properties which render a perceived object vivid are also present in the image. In this case the same properties (or others related to the specific medium) could be active in a different manner for a perceived object and for a corresponding imaged object. We formed this expectation on the basis of the idea that an image is the result of constructive cognitive processes, whereas some forms of perceptual activity are immediate and do not require the use of attention and cognition.

In particular, studies on visual perception (see e.g. Treisman, 1986) have shown that some properties of objects such as rotation, colour and movement are immediately processed by the perceiver, and that some modalities of these properties (such as high colour contrast vs low colour contrast) emerge more clearly and probably more vividly (pop-out effect). In our opinion this effect is specific to perception; in imagery, given its different psychological processes, it should tend to disappear.

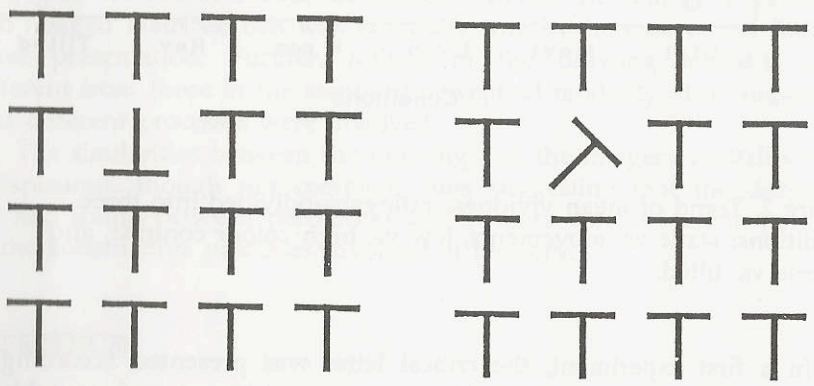

Figure 1. Example of letter matrix

To explore this hypothesis, Giusberti, Cornoldi, De Beni and Massironi (in press) (see also Rocchi, Cornoldi & Massironi, 1990) invited

different groups of adult subjects to rate (giving a number between 0 and 99) the vividness of perceived patterns or of the corresponding imaged patterns. The patterns presented consisted of matrices of letters. In each matrix four rows of 4 letters each were included with the letter in the position 2,2 in a particular condition (see Figure 1 for an example).

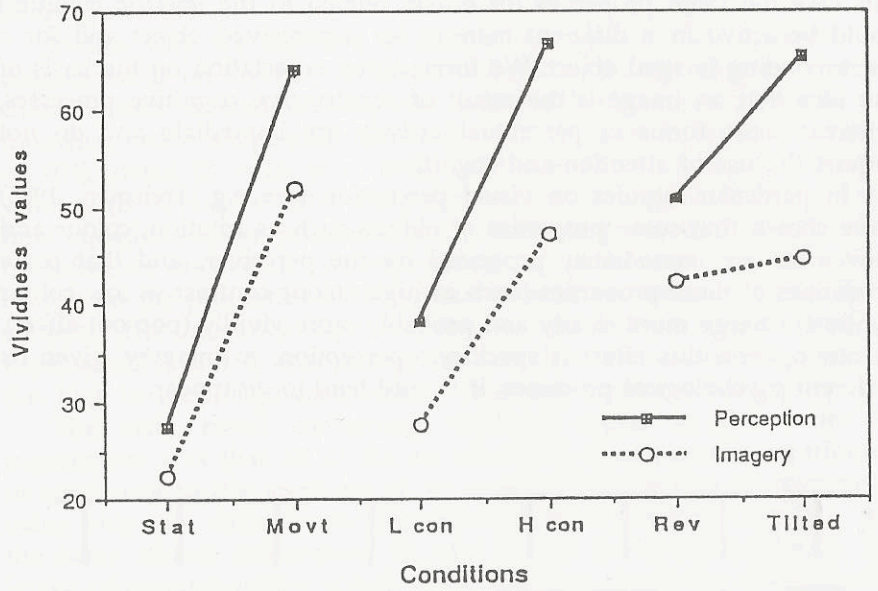

Figure 2. Trend of mean vividness ratings subdivided into three conditions: static vs. movements, low vs. high colour contrast, and reverse vs. tilted.

In a first experiment, the critical letter was presented according to three conditions. For each of these one presentation was favourable to the emergence of a perceptual pop-out effect and the other one was unfavourable. For the movement condition (actual movement of the letter during the experiment), the favourable presentation was represented by the movement of the letter along the second row from left to right and the unfavourable presentation was due to the absence of any movement (static). For the colour condition high and low contrasts were, respectively, the favourable and the unfavourable

presentations. Finally, for the rotation conditions the favourable presentation was determined, for the series of the Roman alphabet letters we had selected (F, L, Q, R, T, U), by a 45° inclination of the letter, whereas the unfavourable one was determined by its rotation through 180° (reversed presentation). Subjects were asked either to observe or to imagine different matrices and to rate the phenomenological quality of the critical letter in the 2,2 position with respect to the overall matrix, giving vividness ratings.

The results obtained confirmed our expectations (see figure 2). In particular, the far greater vividness of inclined vs reversed letters in the perceptual modality tended to disappear in the imagery modality, determining a highly significant interaction between modalities and patterns.

In a follow-up experiment we tested the hypothesis that the difference between perception and imagery was due to the immediacy of the perceptual activity involved. In fact, in this experiment we introduced a third condition in which the perceptual vividness rating followed a constructive attentional phase involving drawing the required patterns (drawing modality). Due to the complications involved in the drawing modality, we limited the task to three different presentations of the critical letter: static, inclined and reversed. In all other respects the procedure was identical to that of the preceding experiment.

Again we found a clear difference between the ratings of perceived and imaged matrices; this was especially true in the case of the inclined letter presentation. Further, ratings in the drawing modality were different from those in the standard perceptual modality, thus suggesting that different processes were involved.

The similarities between the drawing and the imagery modality were conspicuous, though not complete, thus suggesting that the difference we had found between perception and imagery was at least in part due to the constructive processes involved in imagery.

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