Interpretations of imagery-induced McCollough effects

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I would like to comment on two articles, recently published in this journal (Broerse & Crassini, 1980; Kunen & May, 1980), which explored the finding that mental images can be used to establish the McCollough effect, reported by M. J. Schmidt and myself several years ago (Finke & Schmidt, 1977, 1978). In particular, I would like to examine the evidence provided in these recent studies pertaining to the proposal that imagined and observed patterns are functionally equivalent.

In their first experiment, Broerse and Crassini found no effect of imagery vividness on the size of the McCollough effect produced when bar patterns and colors were actually observed during adaptation procedures. Since Finke and Schmidt (1978) had found that vivid imagers show larger McCollough effects than nonvivid imagers when bar patterns are imagined, Broerse and Crassini took the results of their experiment as evidence against this functional equivalence hypothesis. They presumed that vivid and nonvivid imagers should differ on the size of their perceptual McCollough effects as well as on their imagery McCollough effects, if imagery and perception really do involve the same neural processes.

What is the rationale for making this claim? Surely it does not come from previous work comparing the effects of imagery vividness on corresponding imagery and perceptual tasks. This work has shown, in general *support* of functional equivalences in imagery and perception, that, while vivid and nonvivid imagers often differ on the magnitude of a variety of imagery effects, they do not differ on analogous perceptual effects (for a recent review, see Finke, 1980). Furthermore, whenever imagery and perceptual effects are of the same kind, the imagery effects are usually smaller. The most sensible account of these findings seems to be that imagery vividness is a measure of the extent to which the visual system can be activated during imagery. Were the visual systems of vivid imagers somehow more sensitive than those of nonvivid imagers, one would expect to find imagery vividness predicting performance differences on perceptual tasks as well, but there is no evidence to suggest

that individual visual systems differ in this way. Indeed, the fact that imagery vividness does not predict variations in the size of perceptual effects rules out the further possibility that subjects rating their imagery as more vivid are merely less conservative in making judgments of any kind, whether they be in imagery or perception conditions.

In their second experiment, Broerse and Crassini attempted to measure the strength of the McCollough effect for vivid and nonvivid imagers when bar patterns were imaged onto actual fields of color. Here, they found virtually no evidence for pattern-contingent color aftereffects in any of their imagery groups. While part of the reason for this failure might have been due to their use of the Betts scale, which is not specifically designed to measure vividness of *visual* imagery (see Marks, 1973), I think it more likely that the failure was due to the particular method they employed during their testing procedures. Instead of using a pure forced-choice method, which had been used in previous demonstrations of imagery McCollough effects, they permitted subjects to indicate at first whether they thought they saw colors on the test slides. If so, a forced-choice judgment was then given for the particular color seen; if not, their responses were scored as "0." Although this procedure was successful in resolving the McCollough effect established under perceptual conditions, it should be pointed out that the perceptual McCollough effect is fairly weak to begin with and that the imagery McCollough effect is weaker still (Finke & Schmidt, 1977). Hence, many of the subjects who reported not seeing colors on the test patterns in the imagery condition might yet have shown a McCollough effect had more stringent judgment methods been used. This possibility was considered briefly by Broerse and Crassini in their discussion section.

Another problem with their experimental procedures is that no attempt was made to insure that subjects were following the imagery or testing instructions properly. As Schmidt and I have reported, there is a strong tendency in this type of experiment for subjects to think that they are supposed to give as responses the same colors, in association with pattern orientation, that had been presented (or imagined) during adaptation procedures. It is not sufficient merely to take baseline testing measures prior to adaptation as a control for this source of bias, as Broerse and Crassini have done, because subjects may not decide upon a response strategy until after the adaptation procedures have begun. Thus, obtaining subject reports on their response strategies at the end of the experiment is not, as Broerse and Crassini contend, "unnecessarily ad hoc" but would seem to be a sensible measure for discovering whether or not

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subjects really based their judgments on the color appearances of the test patterns. As a further note, one might also wonder whether subjects in this study were ever reminded during adaptation procedures of the proper pattern to image onto the color fields—for, if they became confused and forgot which pattern images went with which colors, the failure to find an imagery McCollough effect would not be at all surprising.

Fortunately, problems involving response bias in forced-choice methods are avoided in the study by Kunen and May, which demonstrated imagery McCollough effects using color-cancellation testing procedures. Specifically, they showed that when subjects imagine checkerboard patterns onto alternating fields of color, the direction of the McCollough effect is determined by the orientation of the edges of squares composing the patterns and not by the orientation of the low-spatial-frequency components of the patterns. However, when subjects imagined blurred versions of these patterns during adaptation, in which case the low-spatial-frequency components became noticeable, the resulting McCollough effects were reversed, now being in the same direction as those found in perception.

These findings led Kunen and May to conclude that only when people are aware of specific spatial frequency information do they incorporate that information into the formation of their visual images. Although their results do provide support for a functional equivalence interpretation, I am forced to disagree with this particular conclusion, since it is well established that there are limitations on how much information can be contained in any single mental image (e.g., Kosslyn, 1975). I would think, therefore, that their subjects might have had considerable difficulty keeping all of the hundreds of squares on the checkerboard patterns “displayed” in their mental images at once. If so, one would expect the direction of the imagery McCollough effect to be determined by the local edge information in the unblurred patterns, just as it would have been in a perceptual condition in which only a handful of the squares are displayed. Accordingly, blurring the pat-

terns permits their lower spatial frequency components to be included in the image, because now the patterns are much less complex and can be imaged in their entirety. This “limited-capacity” account of their findings could be tested by comparing McCollough effects obtained in corresponding imagery and perception adaptation conditions in which the area of the exposed (or imagined) region of the checkerboard patterns is systematically varied.

To conclude, I have argued that the results of the study by Broerse and Crassini do not provide serious evidence against the functional equivalence of imagined and observed patterns and that the results of the study by Kunen and May do not show convincingly that spatial frequency components must first be recognized before they may enter into an image, thereupon producing effects that are functionally equivalent to those in perception. These examples should illustrate the importance of proper assessment and interpretation of individual differences in imagery vividness, as well as the importance of considering limitations on image complexity, when conducting experiments on the relationship between imagery and perception.

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