



Short Communication

Einstein's jacket: Evidence for long-term perceptual specificity in mental imagery



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ABSTRACT

To what extent are visual fantasies constrained by our perceptual experience of the real world? Our study exploits the fact that people's knowledge of the appearance of individuals from the early 20th Century (e.g., Albert Einstein, Winston Churchill) derives predominantly from viewing black-and-white media images. An initial experiment shows that mental imagery for individuals from this period are experienced as significantly less colourful than imagery for individuals from the era of colour media. A second experiment manipulated whether participants were instructed to explicitly imagine using colour or not (i.e., "imagine Albert Einstein wearing a green jacket" vs. "imagine Albert Einstein wearing a jacket"). Results show that colour manipulation only influences imagery for black-and-white era individuals, with no comparable effect on imagery for colour era individuals. This finding is replicated in a third experiment that includes an additional control condition of imagining generic characters (i.e., "Imagine a knight wearing a cloak" vs. "imagine a knight wearing a red cloak"). Again, only imagery for black-and-white era individuals is affected by the colour manipulation. Overall these results provide evidence for long-term perceptual specificity effects in mental imagery. We argue that visual fantasies can be constrained by surface features of underlying representations in memory, even when imagining something we have never directly perceived.

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1. Introduction

Bring to your mind a mental image of George Clooney. Unless you have experienced seeing Mr. Clooney directly your knowledge of his appearance will derive entirely from depictions in visual media such as film and photography. Now imagine him wearing a red Santa Claus outfit. Experimental and anecdotal evidence from the literature suggests such imaginary scenes are easily created in consciousness even when they have never been externally perceived (Finke, 1990; Finke, Ward, & Smith, 1992). Our ability to transform and manipulate mental imagery has been linked to both everyday problem-solving (Kauffman, 1988) and creative discoveries in the sciences and arts (Miller, 2000; Pearson, 2007). But are such visual fantasies really boundless, or can they be constrained by the nature of the perceptual experiences on which they are based?

An influential perspective from the field of cognitive neuroscience is that the recollection of an event partially re-activates the same brain regions involved during the original experience (Buckner & Wheeler, 2001; Danker & Anderson, 2010). Evidence in support of this comes from the demonstration of perceptual specificity effects in memory. Recognition memory for scenes has been shown to be impaired by incongruent changes in viewing mode between presentation and recall (Ray & Reingold, 2003; Reingold, 2002). Recognition memory for colour and black and white photographs of natural scenes is also significantly worse when presentation at recall is incongruent with how the photograph was first presented (i.e., colour at

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presentation vs. black and white at recall, or vice versa; Wichmann, Sharpe, & Gegenfurtner, 2002). Findings such as these imply that visual memory representations incorporate surface perceptual information present during initial encoding.

If mental imagery is generated using the same memory representations it should be expected that similar perceptual specificity effects will occur. However, very few experimental studies have directly addressed this as an issue. Hitch, Brandimonte, and Walker (1995) examined participants' ability to mentally combine visual images of two line drawings that were presented using either white-on-black or black-on-white contrast. They found that performance of the imagery task was impaired following immediate presentation of drawings with incongruent contrast. The same impairment was also found following a retention period, provided that participants were prevented from verbally labelling the figures during their initial presentation. A follow-up study by Walker, Hitch, Dewhurst, Whiteley, and Brandimonte (1997) found the imagery impairment was specific to incongruence between the colour of the foreground figures rather than the background, implying that the underlying memory representations were object-based rather than purely pictorial in nature.

Together these findings support the hypothesis that the ability to manipulate mental imagery can be constrained by surface features of the original perceptual experiences. However, these studies are limited by only examining mental imagery for items that are first encountered by participants within an experimental setting. The retention interval for the long-term memory condition was defined by only a few minutes in the studies by Hitch et al. (1995) and Walker et al. (1997). Even in recognition memory paradigms the retention interval is seldom more than 48 h (Ray & Reingold, 2003). Hence these existing findings cannot establish whether perceptual specificity effects occur for mental imagery generated from representations naturalistically encoded outside of laboratory conditions.

The present study reports three experiments which directly address this issue. Our paradigm exploits the fact that during the first half of the 20th Century the visual media of cinema, still photography, and television all predominantly displayed black-and-white (monochromatic) images. Murzyn (2008) has used the prevalence of monochromatic media during this period to account for the widespread misconception that people only dream in black-and-white (e.g., Bentley, 1915). She notes that the tendency for participants to report black-and-white dream experiences disappears during the 1960s, during a period in which colour cinema, photography, and television became much more widely available to the general population (Murzyn, 2008, p. 1229). Rassin, van Rootseelaar, van der Heiden, Ugahary, and Wagener (2005) have also argued that individuals' lack of clarity in imagining scenes related to World War II is related to the viewing of poor quality monochromatic film footage. These findings imply that the phenomenology associated with mental imagery can be influenced by the experience of black-and-white media.

One consequence of the development of visual media is that representations of the appearance of well-known figures from the early 20th Century largely consist of black-and-white rather than colour depictions. Because we are examining naturalistically encoded representations we must recognise that it cannot be established whether knowledge of the visual appearance of individuals from this period *only* derives from perceptual experience of black-and-white images. Early colour photography processes were established during the mid-19th Century (Gernsheim, 1986), meaning it cannot be ruled out that participants at some point may have viewed colour (or colourized) images of famous faces from the first half of the 20th Century. Additionally because black-and-white media continues to enjoy contemporary usage (for example, in fashion and art photography, or through films such as *Schindler's List* or *Good Night, and Good Luck*), it cannot be established whether someone's visual knowledge of contemporary individuals such as George Clooney derives exclusively from viewing colour images either. However, taking into account these limitations we hypothesised that someone's ability to visualise the appearance of an individual such as Albert Einstein or Winston Churchill derives from encoding information present in black-and-white media depictions to a significantly greater extent than for modern individuals such as Stephen Hawking or George W Bush. If the laboratory-based findings of perceptual specificity do therefore generalise to naturalistic encoding of visual representations in long-term memory, it can be predicted that mental imagery under these circumstances should preserve surface perceptual information present during the encoding of the original perceptual experiences. To explore this hypothesis an initial experiment was conducted to establish whether mental imagery for famous faces from the black-and-white (B&W) media era differ significantly in terms of subjective experience from mental imagery for individuals from the colour media era.

2. Experiment one

2.1. Method

Because individuals from the B&W media era may simply be less well-known than more contemporary individuals, a pilot study was first conducted to select suitable test stimuli. Twelve participants from Aberdeen University (mean age = 19.83; $SD = 2.24$; nine female) were presented with a list of 20 famous names drawn from B&W and colour media eras. For each name they were asked to indicate if they recognised the person and were able to visualise their appearance. Based on the pilot data five B&W media (Humphrey Bogart, Charlie Chaplin, Winston Churchill, Albert Einstein, Adolf Hitler) and five colour media (Tony Blair, George W Bush, Johnny Depp, Stephen Hawking, Robbie Williams) stimuli were selected. All test items scored at least 90% recognition and were selected to ensure a variety of actors, scientists and politicians appeared in each group.

Fifty-four further participants (mean age = 19.62; $SD = 4.11$; 42 female) were then recruited for the main experiment. The test items were presented using a questionnaire completed in a classroom setting. Participants were told that the

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