Imagery and memory for color and the reported color of dreams

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Summary. The historical and individual differences in reporting color or greyscale dreams have been previously investigated as factors of age, color memory and experience with black and white media. The present study introduced visual imagery style as a potential factor (Kozhevnikov, Kosslyn and Shephard, 2005), using the Object Spatial Imagery Questionnaire and a custom color imagery task. It was found that individual imagery preferences – the tendency to visualise in pictorial detail or in spatial sketches – was related to questionnaire reported dream color, with object imagery skills being related to more frequent colored dreaming. Incidental memory for color was also examined, but neither recall nor recognition of color properties was related to dream color. Finally, age and childhood experience of black and white media were investigated, but were not found to be significant factors. The implications are discussed in the context of memory effects and continuity of cognitive functions.

Keywords: Continuity hypothesis, dream color, memory, visual imagery

1. Introduction

The question of whether people dream in color or greyscale has been of sporadic concern to the psychology of dreaming, and the few studies that did investigate this area came up with considerably different results depending on when and how they were carried out. Researchers in the early 20th century stated that people generally dream in greyscale (Middleton, 1941), and that color in dreams can be indicative of mental disturbance (Calef, 1954; Tapia, Werboff and Winokur, 1958). However, studies dating after 1960 document an increase of reported color in dreams, culminating when in 1968, Snyder, Karacan, Tharp and Scott concluded that almost all dreams contain color. This change in how people reported their dreams corresponded with the discovery of REM sleep and the introduction of REM awakenings as the method of obtaining dream reports, just as the rise and fall of greyscale dream reports was correlated with the rise and fall of black and white television in the US (Murzyn, 2008). This fluctuation in how people reported their dreams went mostly unnoticed until recently, when the interest in this issue was revived by several new studies. In 1998, a large scale survey of Austrian population revealed that older people tended to report more greyscale dreams than young people (Stepansky et al, 1998). In 2003, Schwitzgebel replicated the questionnaire study design used by Middleton (1941) and found that contemporary college students report that most of their dreams are in color (only 17% say they rarely or never see color in their dreams). A cross-cultural version of this study carried out with three different populations in China (Schwitzgebel, Huang and Zhou 2006) also found that rural populations with longer and earlier black and white TV access reported more greyscale dreams than urban populations with wider access to color media. More recently, Murzyn (2008) replicated the age differences in the reporting of greyscale dreams, and linked this effect to childhood experience with black and white media. Finally, Schredl, Fuchedzhieva, Hamid and Schindele (2008) indicated color memory as an additional factor in the recall of greyscale dreams and demonstrated that obtaining the dream reports close to awakening reduces the frequency of greyscale dream reports in a student population.

One of the major problems with dream research is the dreams are never the object of direct study – researchers only have access to dream reports, which can contain numerous distortions and omissions. What people say about how they dream is not necessarily a reliable reflection of how they actually experience dreams. Thus, one of the main areas of debate in dream color research is the question of whether people can actually have dreams without any colors. The evidence available so far lends itself to two possible interpretations. One is that people have always dreamt in color, and the historical differences can be explained by the effects of black and white media pressure and resulting generalised (but unfounded) belief that dreams ought to look just like the movies. This situation was compounded by the weaker research methodology which left a lot of time between the dream experience and the collection of reports in the early studies. The individual differences in modern rates of colored dreaming are explained through variability of memory abilities. The other interpretation states that dream imagery is malleable and while some aspects of how people report dream color can be attributed to memory problems and cultural context, there is a genuine possibility of having greyscale dreams. Exposure to black and white media is seen as the main factor behind the historical changes in dream color, and the current individual differences in the reporting of colored dreaming may be linked with individual differences in the ability to visualise colors.

The research carried out so far addressed three potential factors for the historical and individual in reported dream color: the methodology that was used, the cultural context of the reports (presence of black and white media) and the

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individual differences in memory. Very little has been said about the potential impact of other individual differences, for example the ability to visualise detailed colored scenes. In 2005, Kozhevnikov, Kosslyn and Shephard proposed that there are two different modes of visual imagery that people employ. Spatial imagery is focused on visualising objects in space and their relationships; people who are good spatial imagers can easily solve tasks requiring mental rotation or creating mental blueprints. Object imagery refers to the ability to visualise detailed, picture-like scenes that preserve the color, shape and relative size of objects. Object imagers tend to have good color memory and fare better at object recognition tasks, such as the degraded picture test. The individual differences in imagery style seem to be stable and linked with haptic processing (Lacey, Lin and Sathian, 2011), suggesting that they reflect a deeper underlying processing style. It is possible that these abilities could be reflected in how the visual aspects of dreaming are created, resulting in dreams that vary in terms of color presence, which should be reflected in individual dream reports.

The present study was carried out to examine how individual factors interact with historical media access when dream color is investigated. The first major aim of this study was to find out if individual differences in memory for color play any role in the reported dream color. The previous studies that looked at visual memory and dreaming used explicit memorising tasks (Schredl et al, 2008), which might not be adequate for the context of dream recall. A narrative task was thus constructed, in which the participants saw series of thematically linked images for which they invented titles – and after a short delay they had to recall which slideshow was presented in color, and which was black and white. The hypothesis was that memory for color would be positively correlated with the reported frequency of colored dreaming.

The second objective of the study was to find out whether the color properties of dreams, as reported with a questionnaire, can be linked to the individuals' visual imagery preferences. The main hypothesis was that there would be a positive relationship between object imagery abilities and reporting of colored dreams. A secondary hypothesis was that spatial imagery abilities would be positively correlated with greyscale or mixed dreams. To complement the self-report measure of visual imagery preferences a separate measure of purely color imagery was developed and introduced, basing on the grain size task used in the Kozhevnikov et al. (2005) paper investigating the OSIQ questionnaire properties. The original grain size task required the ability to visualise and compare sizes of various common objects, such as pepper and poppy seeds. The color version of this task measured the participants' ability to accurately visualise colors of common objects without external input. It was hypothesised that people with better accuracy in color visualisations should report more colored dreams.

Additionally, the relationship between age, media experience and dream color was once again investigated, following on the results obtained by Murzyn (2008). It was hypothesised that the older age group would report more greyscale dreams than the young group and that there would be a link between measures of black and white media access and the frequency of greyscale dreaming.

2. Method

2.1. Design

This study was based on a correlational and between groups design. The main variables investigated were age, experience with black and white media and color of dreams as reported in a questionnaire. Additional factors included memory for the presence of color and visual imagery style preferences and color imagery ability.

2.2. Participants

Thirty nine people took part in the study, 19 aged 20 or less and 20 people aged over 50. There were 12 men and 27 women in the group. The participants were recruited through the University of Dundee and local newspaper advertisements. Since the study involved a surprise memory task, the participants were not informed that they were taking part in a study of color in dreams, but were instead told that the research concerns age differences in picture description.

2.3. Instruments

2.3.1 Dream color and media experience questionnaire

The participants were given a questionnaire which asked a series of questions related to dreaming in full color, greyscale and in mixed color: whether they experienced these types of dreams at all, how certain they were of their answer, what percentage of their dreams was in that color type and whether they could remember a particular dream in that color type at the moment of testing. Thus, this instrument could gather information on the predominant color of dreams as well as confidence ratings and the recall of particular dream types. The questionnaire also included items that estimated the participants' experience with black and white media, including the age of first access and the length of access to color and black and white media.

2.3.2 Memory for color

The majority of color memory tasks used in the literature are explicit memory tasks which look into the ability to recall the particular color of an item presented in a picture. This does not correspond well with the task that the dreamer undertakes when trying to recall the presence of color in a dream, especially that typically no conscious effort to remember dream details is made during the encoding phase. The task used in the present study was constructed to imitate the context of natural dream recall as much as possible. 18 slideshows, each consisting of 7 photographs were created using freely available photos. The photos were assigned to the slideshows according to a theme, such as 'holidays' or 'sports'. A color and a greyscale version of each slideshow was prepared, and the participants were randomly shown half of the slideshows in color, and half in greyscale. Each slide was shown for 3 seconds, and the participants were asked to say a word in response to the stimuli (either name the object or the situation presented). After each slideshow, they were asked to think of and write down a title for the sequence of photos, and rate how difficult it was for them to create that title. After seeing all the slideshows, they were given a series of questionnaires and filler tasks to complete. After 20 minutes, they were given a surprise recall task – they were presented with the list of titles they had gener-

ated, and were asked to recall which slideshows were in color and which ones were in greyscale. The participants were encouraged to guess, if they could not recall anything. Lastly, a recognition task was presented. Two photographs from each of the slideshows were picked, for a total of 36 pictures shown. Each photograph was shown in color and greyscale side by side, and the participants decided which one they remembered seeing. The participants were asked to respond as quickly and accurately as they could.

2.3.3 Color imagery instrument

A novel task was designed to measure color imagery abilities, basing on the perceptual grain size task developed by Kozhevnikov et al. (2005), and analogous to the color imagery task used by Goldberg et al. (1989). A list of color comparison questions for various objects with a relatively stable and yet not too characteristic color was generated. Example items would be 'Which item is darker: a pound coin or a penny coin?' or 'Which one has more red in its color: carrot or butternut squash?'. This list was presented to 10 native English speakers who answered the questions and provided any feedback regarding any possible problems with the items and the color comparison. 22 items with highest agreement rates were picked out for the final instrument. There were 2 items concerning light-dark judgements, 4 items concerning greenness, 6 items concerning redness, and 5 items concerning whiteness and yellowness each. A forced choice task was created from these items using Superlab software. First, the question for each item (for example 'which item is darker') would be displayed on a white screen for the participants to read in their own time. After they felt they had read and understood the question, the two comparison items could be brought up by clicking any mouse button. This allowed for a separation of question reading time from item reading and response time. The two items to compare were then displayed below the question, and the participants would respond by pressing the corresponding mouse button to indicate which item fit the criteria – the one presented on the left or on the right. Additionally, 5 semantic decision tasks were included in order to have a measure of general decision and reaction speed, without the visual imagery component.

2.3.4 Visual imagery style

The Object Spatial Imagery Questionnaire (as developed by Blajenkova, Kozhevnikov and Motes, 2006) was used to estimate individual preferences in visual imagery style. This instrument was selected because it does not simply assess visual imagery ability, but also separates it into two components that have been shown to be neurologically and functionally separate – spatial and object imagery. Additionally Marks' Vividness of Visual Imagery Questionnaire (Marks, 1973) was used as a secondary imagery assessment tool that would provide a more general overview of visual imagery abilities.

2.4. Procedure

The participants were tested at the University of Dundee by the experimenter. After reading the study description and signing the informed consent form, the participants were given the color memory task disguised as a picture naming task. Then, they were given two visual imagery questionnaires to fill out – the OSIQ and the VVIQ. Afterwards, they carried out the color imagery task, and the experimenter made sure that the time since finishing the color memory task was 20 minutes for each participant. At this point, the participants were informed about the true purpose of the study and were given the option to withdraw if they wished to. All participants decided to go ahead, and they were then given the recall and recognition tasks, followed by the dream color questionnaire. The participants were fully debriefed at the end of the study and received £4 for their time.

3. Results

3.1. Potential sex differences

Both dream recall frequency and detail (Giambra, Jung and Grodsky, 1996) and visual imagery preferences (Casey, Winner, Brabeck and Sullivan, 1990) typically show sex differences that might impact the analysis. However, in this sample no such sex differences were found in the frequency of experiencing the three dream color types. There were also no sex differences in the OSIQ variables in this sample or in the VVIQ score, although the difference in Spatial Imagery was approaching significance ($t(37)=-1.651$, $p=.107$).

3.2. Age and media experience

The questionnaire data revealed that the older group reported less colored and more greyscale dreams than the younger group, however none of these differences was statistically significant. Figure 1 shows the details for the dream type frequencies for the two age groups.

In order to assess the relationship between media access and dream color independently of age, it is vital that at least one age group includes people who had childhood access to only black and white media as well as people who started off with access to colored media. Unfortunately, this was not the case in this sample, since all of the younger participants had only color media access, and all of the older participants had started with black and white media. Therefore, a different approach was taken, and the length of sole black and white movie access and the age of first access to color media were used as measures of black and white media exposure within the older age group. There were no significant correlations between length of black and white media access and the frequency of colored ($r=.347$, $p=.134$) or the frequency of greyscale dreams ($r=-.304$, $p=.192$). The first age of access to color media was also not related with either color dreaming ($r=.166$, $p=.485$) or greyscale dreaming ($r=-.204$, $p=.388$).

3.3. Memory for color

The data was analysed for possible age differences that could obscure the relationships between color memory and dream color. There were no age differences in the overall percentage of slideshows with correctly recalled color ($t(35)=1.400$, $p=.170$), with the older group correctly recalling the color of 75% of the 18 slideshows, and the younger group recalling 72% correctly. The only interesting difference was that the older group recalled greyscale slideshows as having been presented in color more often than the younger group ($t(35)=2.541$, $p=.016$). When the recognition task was analysed, predictable significant age differences appeared ($t(37)=2.06$, $p=.047$), with the younger

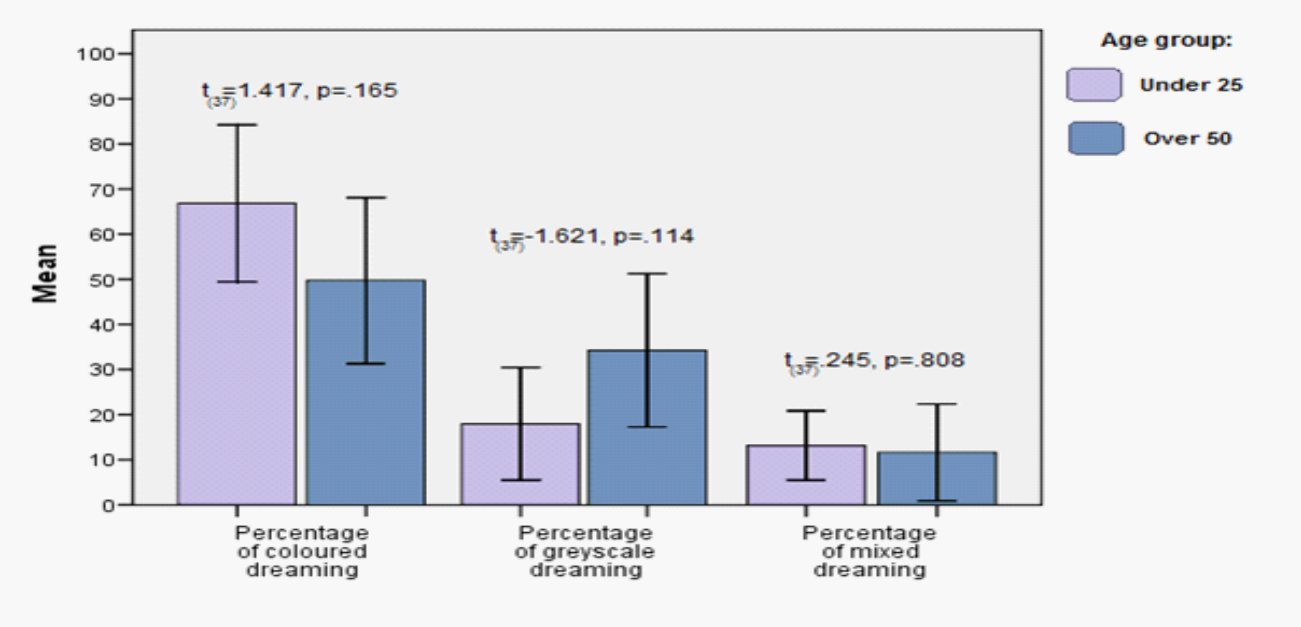

Figure 1. Comparison of the reported frequencies of different types of dreaming for the older and younger age groups

group correctly choosing the previously presented version in 83% of the trials, as compared to 76% rate for the older group.

Despite the interesting pattern of age differences in recall errors, there were no significant relationships between recall ability and either frequency of colored dreams (r=.163, p=.334) or greyscale dreams (r=-.270, p=.105).

When recognition was analysed, there were no significant correlations between the percentage of reported color dreaming and recognition (r=.550, p=.783), and the percentage of greyscale dreaming (r=-.045, p=.784) in the whole sample. Separate analysis of the two age groups did not yield any different results.

3.4. Visual Imagery

There were no age differences in the score for the Marks' Vividness of Visual Imagery Questionnaire (VVIQ) instrument (t(37)=0.263, p=.794), so a simple correlation between the score and frequency of different types of dreaming was calculated. However, there was no relationship between the VVIQ score and either colored dreaming (r=.096, p=.561), greyscale dreaming (r=.017, p=.919) or mixed dreaming (r=.143, p=.386).

Age differences in the Kozhevnikov's OSIQ object and spatial scores were computed and it was found that the object score differences approached significance (t(37)=1.68, p=.100) with the younger group scoring 3.6 on the object scale as compared to 3.3 in the older group. There were no significant differences in the spatial imagery scores (t(37)=0.384, p=.703).

When the data from both age groups was analysed together, significant positive correlations were found between object imagery score and frequency of colored dreaming (r=.361, p=.024) and between frequency of mixed dreaming and spatial imagery score (r=.410, p=.010). Separate analysis of the age groups did not yield any different results.

3.5. Color imagery

There were no significant age difference in the percentage of items correct (t(37)=-1.80 p=.080), with the older group correctly answering 80% of items, as compared to 74% in the young group. There were also surprisingly no significant age difference in the reaction times, with the older group averaging a 2515ms reaction time and the younger group responding in 2153ms (t(37)=-1.46, p=.152).

Pearson's correlations were computed for the color imagery score and the two imagery variables from OSIQ. It was found that both the average reaction time and the reaction time with the semantic decision time subtracted were negatively correlated with Object Imagery (r=-.402, p=.011 and r=-.369, p=.021 respectively). At the same time, the percentage of items correct was strongly negatively correlated with Spatial imagery score (r=-.414, p=.009). These results suggest that the color imagery instrument behaves according to expectations and does tap into color imagery abilities.

When the reaction times and accuracy in the color imagery task were compared with the types of dreams experienced, no clear links were found. The table below presents the correlations between the dream type proportions experienced and the results of the color imagery task. It is

Table 1. Correlation coefficients between imagery preferences and dream color

	Proportion of colored dreaming	Proportion of greyscale dreaming	Proportion of mixed dreaming
Object imagery score	r=.361* p=.024	r=-.224 p=.132	r=-.191 p=.245
Spatial imagery score	r=-.126 p=.445	r=-.083 p=.616	r=.410* p=.010

Table 2. Correlation coefficients between imagery preferences and dream color

	Proportion of colored dreaming	Proportion of greyscale dreaming	Proportion of mixed dreaming
Reaction time	r=-.306 p=.058	r=.043 p=.797	r=-.024 p=.886
Percentage of items correct	r=-.064 p=.697	r=.154 p=.349	r=-.173 p=.292

possible that with a larger group size a significant relationship between the reaction time to items and color dreaming could emerge.

4. Discussion

The present study set out to investigate the contributions of age, visual memory and visual imagery preferences on how people recall dream color. The most interesting result obtained in this study was the discovered relationship between visual imagery abilities and reported dream color. Firstly, high object imagery score was correlated with reporting a larger proportion of colored dreams. This is consistent with the idea that a tendency to visualise detailed, colored images should be expressed in dreaming as colored dreams. Moreover, there was a positive correlation between spatial imagery score and the tendency to report more dreams that mix color and greyscale imagery. Since strong spatial imagers tend to omit color from their visualisations (unless it is particularly important), greyscale dreams with elements of color can also be a direct result of the imagery preferences. Both of these correlations are in line with the hypothesis that the waking visual imagery style is preserved when dream visual content is generated. However, as compelling as this interpretation is, the current findings are not sufficient to fully support it. This is because the visual imagery style as measured in the present study encompasses memory and attention mechanisms in addition to pure image generation. Thus, when spatial imagers report a greyscale dream with one central colored object, there is no way to assess whether this is because they actually experienced such a dream, or they only paid attention to that one object (ignoring the color information in the rest of the dream scenery) or if they simply failed to remember the color information they needed to identify their dreams as fully colored. In the present study, object imagery score was correlated with the recall of color in the slideshow task (r=.406, p=.013), which supports the idea that the imagery style (as measured through OSIQ) and memory are closely connected. A larger scale study would be necessary to disentangle the effects of memory and visual imagery preferences on reported dream color.

The second line of investigation did not find any significant relationships between individual memory abilities and dream color. This is surprising, especially in the light of previous research (Schredl et al, 2008) and since it was expected that the use of a memory task specifically designed to mimic dream color recall should increase the likelihood of detecting the predicted influence. It is possible that a larger sample (or the use of dream diary based data) could still find the predicted relationship. Stepping aside from the results directly related to dream color, this part of the investigation did uncover an interesting caveat of age-driven memory changes. When age differences in dream color are invoked, one explanation usually points at age changes in memory as an explanation for the increased incidence of greyscale dream reports. The reasoning is that because older people have worse memory abilities, they might not recall enough visual details from the dream and they thus label it as greyscale. In the present study, however, the older group exhibited the exact opposite tendencies when completing the recall task. While the overall accuracy rates were similar across both age groups, the older group's mistakes tended to involve incorrectly attributing color to slideshows they saw in black and white (the younger group had no bias in error making). This suggests that the assumption that older people default to labelling their memories as greyscale when they have insufficient visual recall needs to be revisited. It would be interesting to explore whether this effect appears for image sets that are not equally divided into color and greyscale elements, but are set on a continuum from purely black and white to only in color.

Finally, the proposed relationship between age, media experience and reported dream color did not materialise in this study, in contrast to the findings of Murzyn's previous research (2008), where a clear effect of media experience on the reported dream color was found. This could be attributed to a number of reasons. Firstly, the limited sample size and the high variability within the age groups analysed could have obscured any actual age differences in reported dream color in the populations investigated. Secondly, the lack of media use variety within the groups precluded the use of the most sensitive analysis method, in which the effects of media access could be analysed within both age groups separately. Finally, this study used a questionnaire method of assessing dream color proportions (as opposed to a dream diary used by Murzyn, 2008), introducing another level between the visual experience of dreaming and the data gathered. It could be argued that the self-assessment method that was employed in this study should be better for uncovering the prevalence rare dream color types: for example, one or two greyscale dreams a person could have had in their lifetime that would not be picked up by the time-limited journal approach. However, people are not very good at putting their experiences into numbers and between this issue and individual variability in estimation skills, the data obtained through such a questionnaire could lack reliability necessary for correlational analysis. Overall, a larger scale study would be necessary to replicate the results of Murzyn (2008), and address whether age and the associated cognitive changes or media experience are the key determinant of age differences in the reported dream color.

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