Influence of Implicit Beliefs and Visual Working Memory on Label Use

Amanda Hahn (achahn30@gmail.com)
Takashi Yamauchi (tya@psyc.tamu.edu)
Na-Yung Yu (nayungyu@gmail.com)
Department of Psychology, Mail Stop 4235
Texas A&M University, College Station, TX 77843 USA

Abstract

This study aims to examine the factors that influence the use of labels when making similarity decisions. We predict that a person's visual working memory (VWM) ability and implicit beliefs can predict the frequency in which a subject will rely on labels when making similarity decisions. To test this hypothesis, participants completed a VWM task along with a questionnaire to study how they relate to label use. We found a negative trend between VWM ability and use of labels, but a direct relationship between certain implicit beliefs and label use. Implications of these results in relation to label use are also discussed.

Keywords: Categorization; Reasoning; Decision Making; Labeling; Visual Working Memory; Implicit Beliefs

Introduction

When introduced to novel items, people use cues in order to assimilate those items into previously formed categories. We categorize items in a variety of ways: such as living or non-living, color and shape, or by how the item is used. When categorizing, language plays a key role through labeling because labels are one of the indicators people use to make categorical decisions and generalizations. For example, by knowing an object is called "oven", we make assumptions about the object (e.g. it is used for cooking or crafts, it has a timer, etc.) Likewise, labeling people as "Hispanic" or "feminist" leads others to make generalizations about them, sometimes faulty ones. However, not everyone influenced by labels to the same degree.

What influences some people to use labels to judge and generalize more than others? Previous studies have focused on label use itself, finding that participants tend to judge dissimilar looking pictures as more similar when the two pictures have the same label. Furthermore, labels have been shown to have an influence on several types of decisions. For example, children believe that the name of an animal will not change even if its surface features change to make it appear like another animal (Rips, 1989). The effect of labels goes beyond the superficial as category labels have been one factor that represents people's inner beliefs. Research shows that category membership, especially when it is denoted by verbal labels, influences the way people perceive attributes of stimuli (Goldstone, 1994, 1995; Livingston, Andrews, & Harnad, 1998; Yamauchi & Yu, 2008; Yamauchi, Kohn, & Yu, 2007). The category membership also affects subjects' perceptions of similarity between images (Yu, Yamauchi, & Schumacher, 2008; Yu & Yamauchi, 2008).

One source of labeling's power is that people believe surface features are representative of deeper properties of an item and that these properties are stable and innate (Medin & Ortony, 1989; Gelman, Heyman & Legare, 2007). In this regard, previous research has suggested that labels not only represent categorical membership (Yamauchi & Yu, 2008) but also evoke innate qualities of items, such differentiating between animate or inanimate objects (Yu et al., 2008). These research findings suggest that category labels are a part of people's assumptions. However, individuals have been shown to possess different belief systems which hold varying assumptions. Although there has been extensive research on how different types of labels influence decisions, there has been little illumination on how these individual differences and beliefs affect the tendency to rely on labels when making categorical and similarity judgments. Social cognition studies show that there are individual differences regarding how a person views the world in terms of the rigidity (fixed/rigid theory) or malleability of traits (flexible/entity theory) (Dweck, Chiu, & Hong, 1995). How these systems influence an individual's use of labels is unclear. We believe the extent to which a person believes that features and properties are unchanging and that those features are reflective of deep, innate properties will likely affect a person's tendency to view a label as a representation of the similarity between items.

Although the effect of labels is very strong, the effect is not absolute. Some people disregard labels and instead focus on physical appearance when making judgments. One influential factor may be an individual's visual working memory (VWM) span. Studies have shown that individuals differ in the ability to process visual information (Palmer, 1990; Luck & Vogel, 1997). This capacity for visual information can be measured by a visual working memory span task (Luck & Vogel, 1997). Research on working memory suggests that there are different systems for verbal and visual working memory and that the two interact (Baddeley, 1992; Morey & Cowan, 2004). Furthermore, identifying labels is interrupted by processing visual information at the same time as shown in task such as the Stroop Test (Stroop 1935). Thus, we suggest that having larger visual working memory can result in less use of

verbal information such as labels due to a greater focus and capacity for visual information.

The goal of this study is to identify factors that affect the extent of label use. In this study, we investigate two factors: implicit beliefs and VWM capacity. With respect to implicit beliefs, we predict that those who believe that traits cannot be changed will use labels more because previous research has shown that people believe labels reflect deeper properties. We also predict that those with larger VWM capacities will use labels less due to the greater focus on physical properties of stimuli.

To test this idea, we measured participants' label use, implicit beliefs, and VWM capacities. Label use was measured in the similarity judgment task (Sloutsky & Fisher, 2003; Yu et al., 2008; Yu, Yamauchi, Yang, Chen, & Gutierrez-Osuna, 2010) in which participants were shown three faces: a target picture displayed at the top of a triad with two base pictures at the bottom (Figure 1). Participants were instructed to select which of the base pictures was more similar to the target. We measured label use in two conditions: a no-label condition and a label condition. In the no-label condition, triads of pictures were shown without labels (Figure 1a). In the label condition, the base picture that was more dissimilar looking (i.e., *dissimilar base picture*) to the target was shown with the same label as the target and the more similar base picture was shown with a different label from the target (Figure 1b).

If people used labels in the similarity judgment task, the frequency of selecting the dissimilar base picture as more similar to the target would be higher in the label condition than the no-label condition (i.e., *label use*). To determine how implicit beliefs affect label use, participants were given an implicit belief questionnaire based on Dweck, Chiu, and Hong (1995) after the similarity judgment task. To measure the relationship between VWM and label use, subjects were tested for accuracy during a VWM task (Luck & Vogel, 1997).

Method

Participants

A total of 247 participants took part in the experiment. They were randomly assigned to one of two conditions: disease-label (n = 130) or last-name label (n = 117).

Materials

In the similarity judgment task, participants viewed triads of human face pictures (Figure 1). To create stimuli, four pairs of photographed human face pictures were selected. Each pair of original faces was merged in 18 degrees creating 72 morphed pictures (MorphMan 4.0, 2003). In each triad, one of the base pictures was always more dissimilar to the target than the other. The degree of dissimilarity varied from trial to trial. The trials were divided into three levels of physical difference— low-, medium-, and high-difference— based on the degree of merging of the two original pictures. In the low-difference condition, the target and the dissimilar base picture were not very different (Figure 2a); in the medium-difference condition, the target and the dissimilar base picture were moderately different (Figure 2b); and in the high-difference condition, the target and the dissimilar base picture were highly different (Figure 2c). Two sets of base pictures were randomly selected at each level of physical difference and were combined with two original pictures in each pair, yielding 12 triads for each pair (a total of 48 triads = 4 face pairs × 12 triads) altogether.

The labels themselves were pseudowords (Figure 1b) and were the same in both the disease and last name conditions. The meaning for the labels was described only in the instructions. Participants in the disease condition were told the labels represented a disease carried by each person in the triad, while those in the last name condition were told it signified the last name of each person.

In the VWM task, participants viewed an image (Figure 3) followed by a second image and were asked to decide whether two were identical or not. The images were created closely following procedures defined in Luck and Vogel (1997). Each one consisted of eight colored squares placed randomly on a gray background. We created 40 original

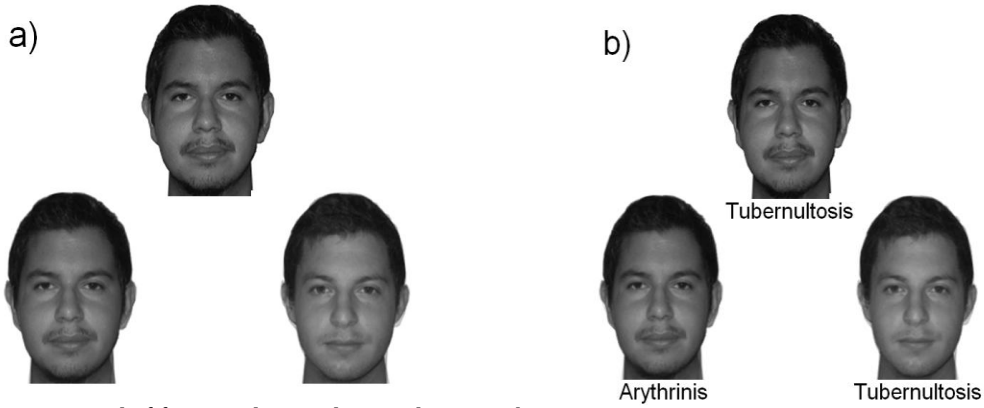

Figure 1: Triad of faces used in similarity judgment task. Pictures were shown without labels (a), or with labels (b)

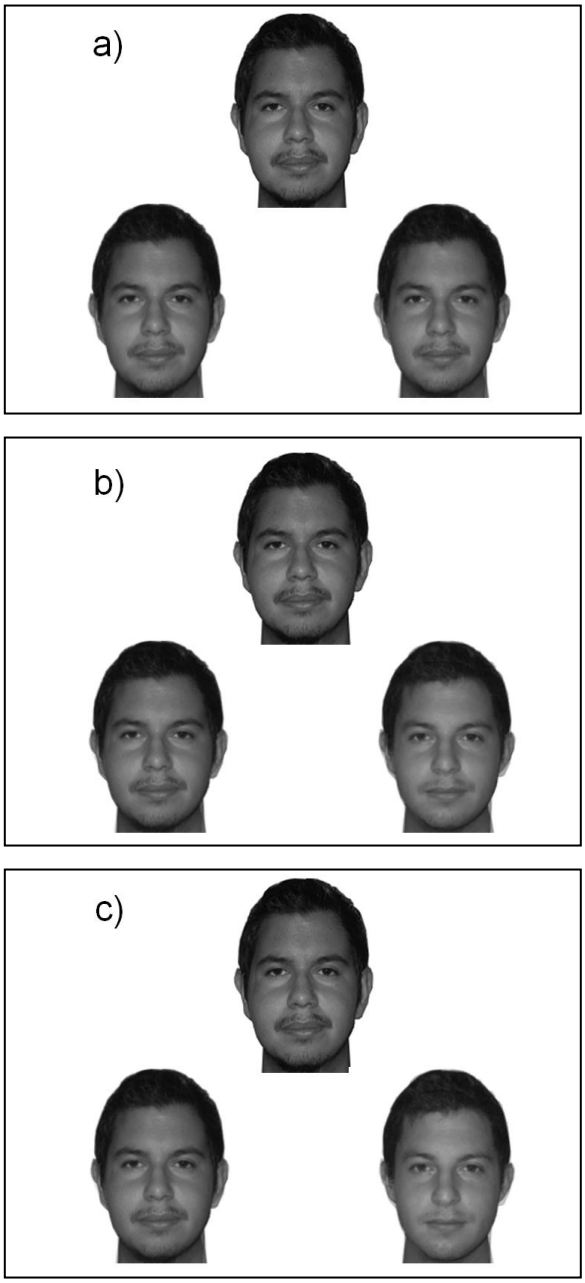

Figure 2: The three levels of physical difference—low (a), medium (b), and high (c) used in the similarity judgment task. In this example, the dissimilar picture is seen on the right.

images in which the color of each square was chosen randomly from red, blue, green, yellow, violet, white, or black. From these, we created 40 more images in which we changed the color of one square in each to create a total of 80 images.

In the implicit beliefs questionnaire (Dweck, Chiu, & Hong, 1995), participants received nine statements to determine the degree to which a participant believes intelligence, morals, and the characteristics in the world in general are fixed traits or malleable.

Design

The similarity judgment task had a 2 (Label Condition; no-label vs. label conditions; within-subjects) × 2 (Label Type; Disease vs. Last Name; between-subjects) × 3 (Physical Difference; low-difference, medium-difference, high-difference; within-subjects) factorial design. The dependent measure was the frequency in which participants selected the dissimilar base pictures as more similar to the target than the other base pictures as measured by a proportion.

Procedure

Participants carried out the similarity judgment task, VWM task, and the implicit belief questionnaire. In the similarity judgment task, participants completed 48 trials where they were asked to select the base picture that they judged to be more similar to the target than the other base picture. They indicated their responses by pressing the left or right arrow key on the keyboard. The order of presented stimuli was random. The dissimilar base picture was presented on the left or the right side an equal number of times.

In the VWM task, participants from both of the label conditions (disease & last name condition) were asked to judge whether two images were identical. They completed a total of 80 trials: in half of the trials, the two images were identical; in the other half, they were different. At the beginning of each trial, a gray screen with a black fixation point was displayed for 500 ms; the first image that consisted of colored squares (Figure 3) was displayed for 100 ms. Following the first image, a gray screen was displayed for 900 ms; then a second image was displayed for 2,000 ms. Participants were asked to determine whether the two images were identical during the time in which the second image was displayed. Although the second image was only displayed for 2,000 ms, participants were given an unlimited amount of time to respond. The order of trials was randomized. Decisions were made by selecting the 'S' key on the keyboard if the arrays believed to be the same, and the 'D' key if different.

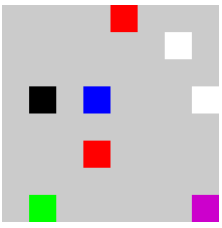

Figure 3: Example of stimuli used in the VWM task.

After the VWM task, participants were presented with an implicit belief questionnaire using Visual Basic software. They read 9 statements one at a time and rated the sentences in 6 point scale (1: strongly agree, 6: strongly disagree). Participants rated how strongly they agreed or disagreed to statements such as, "Your intelligence is something about you that you can't change very much," and "Though we can

change some phenomena, it is unlikely that we can alter the core dispositions of our world." Participants who agreed with these statements hold beliefs that traits are fixed, while those who disagreed are determined to have beliefs that traits are flexible. The statement order was randomized.

Results

Similarity Judgment Task The overall results are shown in Table 1. We measured the frequency in which a subject selected the dissimilar base face as being most similar to the target face as a proportion.

Table 1: Frequency of choosing the dissimilar picture in the similarity judgment task, measured as a proportion

Label type	No label	Label
Overall	0.19	0.26
Disease	0.19	0.27
Last Name	0.19	0.26

Label use was measured by subtracting the frequency of choosing the dissimilar picture when a label was present from the frequency of choosing the dissimilar picture when a label was not present. When labels were attached to the pictures, similarity judgment of human faces changed considerably. Overall, significant label use (i.e., difference in the proportion of participants selecting the dissimilar base picture between the label and no-label conditions) was found, t (246) = 6.48, SE = .01, p < .001. The labeling effect was significant in all levels of physical differences: low-difference, t(246) = 5.23, SE = .01, p <.001, medium-difference, t(246) = 4.73, SE = .01, p <.001, high-difference, t(246) = 4.64, SE = .01, p <.001.

Participants used the labels in their similarity judgments regardless of what the label indicated. The difference in label use was also indistinguishable between the disease condition (M = .09, SD = .19) and the last name condition (M = .06, SD = .17), F(1, 245) = 1.18, MSE = .10, p = .28, η^2 = .005. There was no interaction between the label condition (disease vs. last name) and the physical difference, F (2, 262) = .41, MSE = 0.04, p = .26, η^2 = .007.

Visual Working Memory (VWM) Task A total of 133 participants took the VWM task along with the labeling task. This difference is because the similarity judgment task was administered for a period of time before the VWM task and implicit belief questionnaires were administered to determine whether or not labels were found to be effective in the similarity judgment task before using it as a measure of labeling effects. After this task was found to be effective, the VWM task and implicit beliefs questionnaire was given along with the similarity judgment task. Analysis on VWM ability was done only on participants that took both the similarity judgment and VWM tasks. VWM ability was measured by two ways: 1) a subject's d-prime (*d'*) score based on the average number of *hits* (correctly recognizing the two arrays were identical) and *false alarms* (falsely identifying the arrays as identical when they were actually different) obtained (Macmillan & Creelman, 1991) and by 2) subtracting the number of hits from the number of false alarms, hereafter denoted by *hits minus false alarms*. Higher values for these measurements indicated better VWM ability than low values. VWM ability was not different between the disease condition compared to those in the last name condition in *d'*, t(131) = .53, SE = 1.11, p = .60, and hits minus false alarms, t(131) = 1.08, SE = .09, p = .28.

For further analysis, subjects were divided into three groups: low- (n = 44), medium- (n = 45), and high- (n = 44) VWM ability according to participants' *d'* scores. This was done to determine if there were any significant differences between the different groups and label use, which there were not between low and medium ability, t(87) = 1.34, SE = 0.04, p = .18, low and high ability, t(86) = 1.43, SE = 0.03, p = .16, or medium and high ability, t(87) = 0.03, SE = 0.03, p = .98. Although there were not significant differences between these ability groups, there was an overall trend that participants with small visual working memory span tended to use category labels more in the similarity judgment task (Figure 4). VWM ability (*d'* and *hits minus false alarms*) and label use showed a significantly negative correlation, *d'* and label use: r(133) = -.17, p =.05, hits minus false alarms and label use: r(133) = -.17, p = .06.

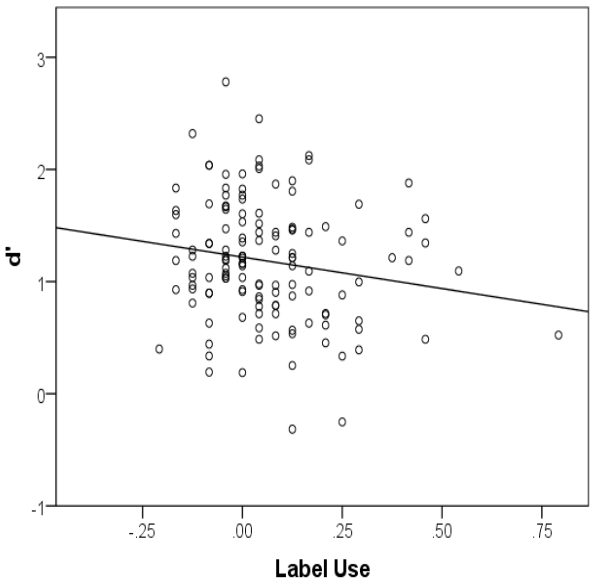

Figure 4: Relationship between VWM ability and label use showing both individual data and general trend

Implicit Belief Questionnaire We measured the extent to which people believe that one's intelligence, one's sense of morality, or how much our world can be changed

(fixed/flexible implicit belief). Higher values for these measurements indicated more flexible implicit belief than low values. The values on intelligence, morality, and world were highly correlated to each other (Figure 5): intelligence and morality, $r(164) = .25$, $p < .001$, intelligence and world, $r(164) = .38$, $p < .001$, and morality and world, $r(164) = .33$, $p < .001$. Participants in the disease condition did not differ from those in the last name condition in their implicit belief about one's intelligence (t (162) = .13, SE = .18, p = .89), one's morality (t (162) = -.27, SE = .17, p = .79), and our world, t (162) = .95, SE = .14, p = .34.

Participants with flexible implicit beliefs tended to use labels more than participants with fixed belief (Figure 5). The more a participant thought one's intelligence can be changed rather than being fixed, the tendency to use labels increased $r(164) = .17$, $p < .05$. This was also true among those who think our world can be changed $r(164) = .23$, $p < .005$. There was no correlation between beliefs on one's morality and label use, $r(164) = .08$, $p = .30$.

The positive relationship between label use and flexible implicit beliefs was stronger when the label indicated diseases compared to when the labels indicated last names. When labels indicated last names, label use increased as participants believed that one's intelligence can be changed, $r(75) = .33$, $p < .005$, that one's morality can be changed, $r(75) = .24$, $p < .05$, and that our world can be changed, $r(75) = .30$, $p < .01$. However, when labels indicated diseases, label use was not related to people's beliefs about intelligence and morality: label use and intelligence scores, $r(89) = .04$, $p = .70$, label use and morality scores, $r(89) = -.03$, $p = .75$, and label use and world scores $r(89) = .18$, $p = .10$.

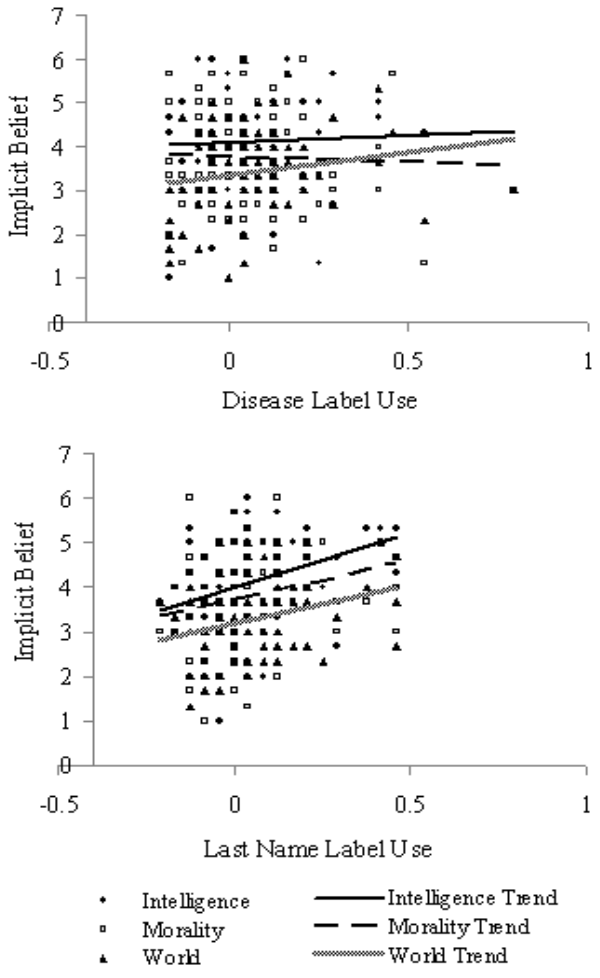

Figure 5: Relationship between implicit beliefs and label use

Discussion

The results suggest that individual differences and beliefs are related to the tendency to rely on labels when making similarity judgments. In the experiment, participants judged dissimilar faces as being most similar to a target face when those faces have same labels, and this tendency to use labels in similarity judgment is related to VWM capacity and implicit belief. People with low VWM spans tend to use labels more often than those with high VWM spans. Among participants who completed the last name condition in the similarity judgment task, those who believe that intelligence and phenomena in the world can be changed tend to use labels more than those who held fixed beliefs. These results show that individual differences can affect label use. When making judgments, people are limited by their VWM ability and influenced by their implicit beliefs.

We found that those with low VWM ability used labels more. This trend may reflect the costs of competing visual and verbal information. Research has found that there is a tradeoff when people process both visual and verbal working memory together (Morey & Cowan, 2004). We believe that those with low VWM performance likely lack the capacity to process visual information compared to those with medium and high levels of VWM ability; therefore, people with low VWM rely on labels when performing the similarity judgment task. In contrast, those with high and medium VWM abilities can process the visual complexities of morphed human faces in making judgments and do not rely on labels as often as those with low VWM spans.

However, results regarding implicit beliefs suggest that people are not simply using labels due to a lack of cognitive resources, such as low levels of ability to hold visual information. We found that in some cases, people use labels depending on their beliefs, suggesting that assumptions and beliefs are a factor in determining the importance of labels in similarity judgments. Overall, people who hold the belief that traits are flexible tended to use labels more. This finding is unexpected, especially because in previous studies, it has been found that those who hold beliefs that traits are flexible tend to disregard racial labels in making judgments of similarity between faces, while those with beliefs that traits are fixed are more influence by racial

labels when making judgments (Eberhardt, Dasgupta, & Banaszynski, 2003).

However, the finding that there was a strong relationship between label use and implicit beliefs mainly applied to the relationship with the last name condition of the similarity judgment, not the disease condition. This result implies that not only do the individual differences of the participants affect label use, but the type of label itself can play a significant role in how people will respond and react to it. When it comes to making judgments based on a label said to be a disease, participants holding implicit beliefs across the spectrum use labels with nearly equal frequency. In previous studies, disease labels were more commonly believed to be a powerful indicator of shared category membership than other labels, such as last names (Yu et al., 2008). Therefore, the findings in the present study serve to provide evidence that the disease label is so powerful that the label will be "believed" and therefore used with equal frequency regardless of one's beliefs. The frequency of label use with last names, however, may be more susceptible to being influenced by a person's beliefs. Last name labels are typically used less in general, suggesting that participants do not believe there is as much categorical information provided from last name as other labels. This may be due to the ease in which a person can change their last name through legal means, marriage, etc. Therefore, those with beliefs that traits are fixed may not believe that the last name label provides useful categorical or similarity information, and therefore use labels less than others.

The goal of this study was to expand on previous research that have found labels to be important in categorical and similarity judgments and identify some of the factors that play a role in the tendency for people to use labels. In this experiment, we found that although they are not perfect predictors of label use, both VWM ability and implicit beliefs do relate to the use of labels when making similarity judgments, signifying that both limitations of cognitive resources and implicit beliefs can explain why people use labels as opposed to other cues when making similarity judgments.

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