EFFECTS OF LABELS ON PERCEPTION AND ITS RELATION TO VISUAL WORKING MEMORY, IMPLICIT BELIEFS, AND METACOGNITIVE ABILITY

A Senior Scholars Thesis

by

AMANDA CARINA HAHN

Submitted to the Office of Undergraduate Research
Texas A&M University
in partial fulfillment of the requirements for the designation as

UNDERGRADUATE RESEARCH SCHOLAR

April 2011

Major: Psychology

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ABSTRACT

Effects of Labels on Perception and its Relation to Visual Working Memory, Implicit Beliefs, and Metacognitive Ability. (April 2011)

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Labels hold a great amount of information and power, and they have been shown to affect perception and people's decisions when making categorical and similarity judgments. This study examines why reliance on labels found in previous studies is so common by exploring cognitive processes behind this labeling effect. We study how poor short-term visual memory, general assumptions, and an ability to think critically about one's own thinking relate to label use. Specifically, we investigated how visual working memory (VWM) ability, implicit beliefs, and metacognitive ability influence a participants' use of labels during a similarity judgment task. Participants were given a task to determine similarity between human faces. They were also given a VWM task and questionnaires to determine their implicit beliefs and metacognitive abilities. Our results indicate that VWM ability and implicit beliefs relate to the use of labels in certain conditions, with those having poor VWM ability using labels more and those whose implicit beliefs reflect an assumption that properties and traits in the world are fixed and intransient use labels more. Metacognitive abilities were not closely related to label use. These results suggest that the use of labels is not random or out of ease of use, but the result of certain cognitive processes.

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NOMENCLATURE

VWM	Visual Working Memory

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CHAPTER I

INTRODUCTION

The power of labels

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, according to color and shape, or by how the item is used. Language plays a key role in categorization through labeling because labels are one of the indicators people use to make categorical decisions. People make generalizations based on labels assigned to an object. For example, by knowing an object is called "oven", we make assumptions about the object (e.g. it is found in the kitchen; it is used for cooking or crafts; it can be dangerous, etc.). Likewise, giving labels such as "Hispanic" or "feminist" to people cause others to make generalizations about them, sometimes faulty ones. However, not everyone makes these generalizations to the same degree. What causes some people to use labels to generalize more than others?

Previous research has shown labels to be very powerful, and they affect a variety of categorical judgments in both adults and children (Goldstone, 1994, 1995; Livingston, Andrews, & Harnad, 1998; Rips, 1989; Yamauchi, Kohn, & Yu, 2007; Yamauchi & Yu,

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This thesis follows the style of *Memory and Cognition*.

2008). Even on something as complex as a human face, labels have been shown to affect categorical perception of both familiar and unfamiliar faces (Kikutani, Roberson, & Hanley, 2008). They can even go as far as to change people's actual perceptions of items as shown by participants' similarity judgments of images (Lara, 2009; Yu, Yamauchi, & Schumacher, 2008). For example, when two faces shared a label, subjects judged the two faces to be more similar than when the same faces were shown without labels in Lara (2009). Although much research has been done on the power of labels themselves, this present study seeks to find source of labels' power by exploring which cognitive processes are more closely related to a reliance on labels during a similarity judgment task of human faces.

The cognitive processes investigated in this study are short-term memory for visual information, general assumptions, and the ability to analyze one's own thinking and abilities. In what follows, previous research on these processes and how these factors relate to label use are explained. The experiments to test how these factors interact with label use and subsequent results are also explained.

Factors influencing label use

Visual working memory

One explanation for the strong effect of labels may be that some individuals have a smaller capacity for visual information. The evidence supporting the existence of a visual working memory (VWM) system is well established (Baddeley, 2003; Sternberg, 1966). Individuals differ in their ability to process this visual information (Luck & Vogel, 1997; Palmer, 1990; Vogel, Woodman, & Luck, 2001). The capacity to hold incoming information can be measured with a VWM task, which we use in this study (Luck & Vogel, 1997). Furthermore, research shows that there are different systems in the brain for visual and verbal information that interact and sometimes compete, such as when identifying labels is interrupted by processing visual information as demonstrated by the Stroop Test (Baddeley, 1992; Morey & Cowan, 2004; Stroop 1935). Thus, we suggest that individuals with a smaller capacity for visual information will rely on verbal information and therefore rely on labels during the similarity task more often. However, when testing these relationships, the order of the experiments needed to be presented carefully. Presenting the VWM task before the similarity judgment task may cause fatigue, resulting in an increased label use. This finding would suggest that labels are used as a result of conserving cognitive resources. Also, if the similarity judgment task is presented before the VWM task, this may cause fatigue as well and result in poor VWM performance, which may lead to misleading correlations. Therefore in Experiment 2 of this study, we manipulate the order in which materials are presented to test for any ordering effects.

Implicit beliefs

In addition to visual working memory, we tested people's general assumptions about traits and features. People believe surface features are representative of deep, stable, and innate properties of an item (Gelman, Heyman & Legare, 2007; Medin & Ortony, 1989).

Also, previous research suggests that labels themselves act as an important indicator in determining categorical membership and innate qualities of different items (Yamauchi & Yu, 2008; Yu et al., 2008). However, individuals do not all share the same beliefs and assumptions regarding innate, deeper properties of items, and those beliefs and assumptions can affect the way people remember and categorize items, including faces (Eberhardt, Dasgupta, & Banaszynski, 2003; Gelman & Diesendruck, 1999; Haslam, Bastian, Bain, Kashima, 2006). One way of describing these assumptions is in terms of a person's implicit beliefs. Social psychology studies have shown that some individuals view features in the world as being fixed and rigid while others view features as being more malleable and flexible (Dweck, Chiu, & Hong, 1995; Haslam, Rothschild, Ernst, 2000). How labels and these beliefs relate to and are perhaps influence each other is a topic of focus in this study. We believe that those who hold assumptions that properties are unchanging will be more influenced by labels during similarity judgments due to a belief that those labels reflect deep, innate properties.

Metacognitive ability

In addition, we investigated how higher level cognitive processes could relate to label use. Subjects were given a questionnaire asking them to estimate their own performance on the VWM task following the format of Kruger & Dunning (1999). We theorize that one reason people rely on labels is their ease of use, and subjects may not be analyzing their own thought processes very thoroughly, and are therefore basing similarity not on physical features of complex human faces, but on the given label.

Overview of experiments

First, a pilot study was completed in which only the similarity judgment and VWM task were administered. This was done to determine whether labels in the judgment task in the present study would affect people's decisions as they had in previous studies. Also, the difficulty of the VWM task needed to be tested to ensure that the task was not so difficult or so easy that there was little variability within subjects and a poor test of VWM ability. After these measures were analyzed and results were found to be as expected, these two tasks were given along with the implicit beliefs and metacognitive questionnaires in Experiment 1. In Experiment 2, we tested how the order in which the tasks were presented affected label use. Explanation and results are explained further.

CHAPTER II

METHODS

General method

Overview

In the experiments reported, all subjects were undergraduate students participating for course credit. They were shown stimuli and made responses on Dell desktop computers. If they completed the similarity judgment task, they were assigned to one of two conditions: they were either told the labels signified diseases (disease condition) or last names (last name condition).

Materials

Participants viewed triads of human face pictures (Figure 1). To create stimuli, four pairs of photographed human face pictures were selected (Figure 2). Each pair of original faces was merged using MorphMan 4.0 (2003) software. Altogether, 80 morphed pictures were created from four sets of original pictures (18 degrees of morphed pictures for each of four pairs) (Figure 3). From the morphed pictures, three levels of physical difference—low-, medium-, and high-difference—were created based on the degree of merging of the two original pictures. In the low-difference condition, the two base pictures were not very different; in the medium-difference condition, the two base pictures were moderately different; and in the high-difference condition, the two base pictures were highly different. 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). In each trial, the target was always an original picture, and the two base pictures were morphed images of two original pictures.

Participants were also presented with a VWM task. For the task, 40 arrays were created that consisted of a gray square with eight smaller squares within (Figure 4). Each array had a corresponding "different" array (one square was a different color than the sample array) for a total of eighty arrays. Participants were shown all original squares that were made with a gray 4 in. by 4 in. template on PhotoDraw software with a 0.5 in. by 0.5 in. grid over it, creating sixty-four cells. This acted as a template to create the arrays. Eight colored 0.5 in. by 0.5 in. squares were placed randomly within the sixty-four cells. These squares were also created on PhotoDraw software using the RGB color model. Each square color was chosen at random on Microsoft Excel and was either red (255 Red), blue (255 Blue), green (255 Green), yellow (255 Red, 255 Green), violet (204 Red, 204 Blue), white (255 Red, 255 Blue, 255 Green), or black (0 Red, 0 Blue, 0 Green). The gray background was made up of 203 Red, 203 Blue, and 203 Green. After the square colors were determined, the location within the eight cell by eight cell grid on the template was selected at random on Microsoft Excel. Because no two squares could be directly adjacent to another, square assignments were manually adjusted to meet this condition after locations were randomly determined. The rules for adjustments were as follows: Each square was assigned a number, according to the order in which it was created. The lower square number has dominance. (e.g. if Square 1 and 2 were assigned next to each other, Square 2 was moved), and the decision to move a square or not is made in order of square number (e.g. if Square 2 and 3 are adjacent to two different squares, Square 2 would be moved first and then Square 3 would be moved and placed according to the new placement of Square 2). To move squares when manually adjusting, the square was first shifted one cell to the right. If it was still adjacent to a square, it was moved to the right again. If needed, the square continued to be moved one cell by one cell to the right, until either the square was no longer adjacent to other squares or until the end of the grid was reached. If no proper spot had been found, the square was moved down one by one with the same method. If needed, it was moved left one by one and finally up one by one if necessary. After colors and positions were assigned and placed onto the template, the grid was deleted. Using E-Prime software, the array was resized to have a width of 128 pixels and a height of 131 pixels so that it was 6.1 cm by 6.1 cm on each computer monitor.

Design

The similarity judgment task in the pilot study had a 2 (Label Condition; no-label vs. same-label conditions; within-subjects) × 2 (Label Type; Disease-label vs. Last Name-label; between-subjects) × 3 (Physical Difference; low-difference, medium-difference, high-difference; within-subjects) factorial design. The dependent measure was the proportion of participants selecting the dissimilar base pictures as more similar to the target than the other base pictures. The meaning for the labels was described only in the introductory instructions. The labels between each condition were physically the same, but expressed meaning of the labels was altered.

The VWM experiment had a within-subjects design. Each participant completed 80 trials with each trial consisting of an array being displayed followed by a second array. Subjects were to determine whether or not the two arrays were the same or different. The dependent measure was the subject's accuracy in this decision.

Procedure

During the similarity judgment task, forty-eight triads of pictures were presented to participants one at a time at the center of the computer screen. Participants 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 presenting stimuli was determined randomly. The dissimilar base picture was presented on the left or the right side an equal number of times. The experiment lasted about 10 minutes.

In the VWM task, each participant completed 80 trials after four practice trials. To begin each trial, participants were prompted to press the space bar to begin the trial when ready. After pressing the space bar, a gray screen with a black, cross mark fixation point was displayed for 500 ms. Then the first array was displayed for 100 ms. The presentation order was randomized for these arrays. A blank delay consisting of a gray square for 900 ms followed; then a second array was displayed for 2,000 ms (Figure 4).

In half of the trials, the second array was identical to the first; in the other half, the arrays were different (one square color was changed). If subjects did not make a decision during the time in which the second array was displayed, a blank, gray screen appeared for 5,000 ms during which subjects could still make a response. Finally, if the participant had yet to respond, a final screen instructing the participant to make a decision was displayed until the subject responded. 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.

Pilot study

In this experiment, we explored only the effects of labeling and its relationship to VWM.

Participants

A total of 106 undergraduate students participated. Of these students, 102 of them completed the similarity judgment task. There were 50 participants assigned to the disease condition and 52 were assigned to the last name condition. Fifty-nine of these students also completed a VWM task. A few students (*n* = 3) took only the VWM task.

Design

In this pilot study, the similarity judgment task preceded the VWM task.

Experiment 1

This experiment is identical to the pilot study except that an implicit beliefs questionnaire and a metacognitive survey were added to the experiment.

Participants

A total of 152 undergraduate students participated for course credit. In this experiment, 151 of these students completed the similarity judgment task; 77 were assigned to the disease condition and 74 were assigned to the last name condition. Of these participants who took the labeling task, 58 also completed a VWM task. Only one subject took only the VWM task without the similarity judgment task. Subjects also completed an implicit beliefs questionnaire (n=74) and a metacognitive survey (n=74).

Material and design

In experiment 1, the similarity judgment task came first, followed by the implicit beliefs questionnaire, the VWM task, and finally the metacognitive survey. All surveys and questionnaires were created and displayed using Microsoft Excel (Figure 5). The implicit beliefs questionnaire contained 9 items. The questions were a measure of implicit beliefs regarding world views, morality, and intelligence. Subjects read a statement and gave a rating between 1 (strongly disagree) and 7 (strongly agree). Higher ratings suggest stronger beliefs that traits and characteristics are flexible entities. The metacognitive survey consisted of three questions to measure the participant’s ability to judge their own capabilities on the VWM task.

Procedure

The procedures for the labeling and VWM tasks were identical to the pilot study. The implicit beliefs questionnaire was given after the similarity judgment task. Options to respond were given in a multiple choice format. Subjects chose one rating on a seven point scale ranging between 1 and 7. Each question was displayed one at a time. The order of these questions was randomized. Participants were not allowed to move on to the next question without responding. After completing this survey, subjects took the VWM task and finally the metacognitive questionnaire. This questionnaire consisted of three questions each displayed one at a time. Subjects were to type in their responses on the same screen.

Experiment 2

Potential effects of presentation order were tested in this experiment. There were two conditions. In the first, the order was identical to that of Experiment 1. In the second condition, the VWM task was presented before the labeling experiment.

Participants

In this experiment, 155 subjects completed the labeling task. Subjects were also assigned either the disease condition (n =76) or the last name condition (n =79). A total of 163 subjects took the VWM task. Of these subjects, 116 of them also took the similarity judgment task. Among these subjects, a total of 70 participants took the similarity judgment task before the VWM task, and 46 of them took the labeling experiment after the VWM task.

Materials and design

Materials and design were identical to those in Experiment 1. The only difference was that the order varied between participants. Some subjects (*n* = 96) completed the experiment in the following order: 1) Similarity judgment task 2) Implicit beliefs questionnaire, 3) VWM task, and 4) Metacognitive questionnaire, while others (*n* = 62) completed the experiment in the following order: 1) VWM task, 2) Metacognitive questionnaire 3) Implicit beliefs questionnaire, and 4) Similarity judgment task.

Procedure

The procedure in Experiment 2 is identical to Experiment 1, except for the variations in ordering.

CHAPTER III

RESULTS

Similarity judgment task

Pilot study

We measured the frequency in which a subject selected the dissimilar base face as being more similar to the target face as a proportion (Figure 6). Participants selected the dissimilar picture with a label in the disease condition ($M = .32$, $SD = .19$) significantly more frequently than when the dissimilar picture was shown with a label in the last name condition ($M = .23$, $SD = .11$). On trials shown with no labels, the difference between selecting the dissimilar picture in the disease condition ($M = .17$, $SD = .07$) was not significantly different than in the last name condition ($M = .18$, $SD = .07$). Label use was measured by subtracting the frequency of selecting the dissimilar face when there were labels present from the frequency of selecting the dissimilar face when there were no labels present. Overall, label use was higher when the faces were shown with labels than when they were shown without labels, $t\ (101) = -5.69$, $SE = 0.02$, $p < .01$. This was true across all levels of physical differences: low-difference, $t(101) = -4.65$, $SE = 0.03$, $p < .01$, medium- difference, $t(101) = -4.53$, $SE = 0.02$, $p < .01$, high- difference, $t(101) = -3.55$, $SE = 0.02$, $p < .01$. Also, although a labeling effect, as measured by label use, was found in both the disease ($M = .14$, $SD = .20$) and last name conditions ($M = .05$, $SD = .12$), labels were used in the disease condition was used significantly more than in the last name condition, $t(100) = 2.65$, $SE = 0.03$, $p < .01$.

Experiment 1

We measured the frequency in the same manner as in the pilot study, and label use was measured in the same way as well. When labels were given to the faces, similarity judgments changed significantly (Figure 6). In the disease condition, participants selected the dissimilar picture when the faces were labeled (M = .29, SD = .23) more frequently than when faces were shown without labels (M = .19, SD = .07). This was true in the last name condition as well, with subjects selecting the dissimilar picture as being more similar to the target when the faces were labeled (M = .27, SD = .13) more often than when they were not labeled (M = .19, SD = .05). Overall, subjects' label use was significantly higher when labels were present compared to when there were no labels, $t(150) = -5.70$, SE = 0.02, $p < .01$. This effect was significant in all levels of physical differences: low- difference, $t(150) = -4.85$, SE = 0.02, $p < .01$, medium-difference, $t(150)$, = -3.91, SE = 0.02, $p < .01$, high- difference, $t(150) = -4.09$, SE = 0.02, $p < .01$. This labeling effect as measured by label use (the difference in frequency of selecting the dissimilar face when there were labels and when there were no labels) was found in both the disease (M = 0.10, SD = 0.21) and last name (M = 0.08, SD = 0.18) conditions. Contrary to previous experiments, the difference of label use between the two conditions was indistinguishable: $t(149) = 0.59$, SE = 0.03, p = .55.

Experiment 2

Label use was measured in the same manner as in the Pilot Experiment and Experiment 1. As in the former experiments, across all conditions, the frequency of selecting the dissimilar picture was higher with labels present than without, $t(157) = -4.30$, $SE = 0.01$, $p < .01$ (Figure 6). With labels present, in the Judgment 1st condition, the frequency of selecting the dissimilar picture in the disease condition ($M = .25$, $SD = .14$) was higher when there were labels than when there were not ($M = .18$, $SD = .09$). This was the case in the last name condition as well when comparing the selection of the dissimilar pictures with labels ($M = .23$, $SD = .12$) and without ($M = .20$, $SD = .06$). In the Judgment 2nd condition (the similarity judgment task was given after the VWM task), the difference in selecting the dissimilar picture when subjects were told the labels signified a disease carried was not as great as previous experiments when comparing the frequency of selecting the dissimilar picture when there were labels ($M = .22$, $SD = .10$) and when there were not ($M = .20$, $SD = .06$). In the last name condition subjects selected the dissimilar picture when there were labels more frequently than seen in previous experiments ($M = .27$, $SD = .13$), but the frequency of selecting the dissimilar picture when there were no labels was comparable to the previous experiments ($M = .19$, $SD = .09$). Similar to Experiment 1, in the Judgment 1st condition of Experiment 2 (the similarity judgment task was given before the VWM task), label use did not vary significantly in the disease condition ($M = 0.07$, $SD = 0.17$) as opposed to the last name condition ($M = 0.15$, $SD = 0.14$), $t(94) = 1.21$, $SE = 0.03$, $p = .23$. In the Judgment 2nd condition, label use did not vary significantly between the disease condition ($M = 0.01$, $SD = 0.10$) and last name condition ($M = 0.08$, $SD = 0.16$), $t(60)$, $SE = 0.04$, $p = .07$. However, unlike previous studies and the previous experiments within this study, in the Judgment 2nd condition, the label effect was greater in the last name condition than in the disease condition. Furthermore, label use in the disease condition was significantly greater in the Judgment 1st condition (*N* = 39, *M* = 0.10, *SD* = 0.19) than in the Judgment 2nd condition (*N* = 18, *M* = .01, *SD* = 0.12), *t*(55) = 1.97, *SE* = .05, *p* = .05. In the last name condition, the differences in label use between the Judgment 1st (*N* = 31, *M* = 0.01, *SD* = 0.14) and Judgment 2nd (*N* = 28, *M* = 0.08, *SD* = 0.16) conditions were not significant, *t*(57) = -1.64, *SE* = 0.04, *p* = .11.

Visual working memory (VWM) task

Pilot study

A total of 59 participants took the VWM task along with the labeling task in the pilot study. Analysis was done on these individuals. In the pilot study, VWM ability determined by measuring the percent of trials answered correctly (*M* = 68.28, *SD* = 11.82). There were no differences in VWM ability between disease and last name conditions, *t*(57) = -0.98, *SE* = 0.03, *p* = .33. Correlations between VWM ability and label use were found (Figure 7a). Overall, there was not a significant correlation between the two, *r*(59) = .04, *p* = .77. The relationship between VWM ability and label use in the disease condition, *r*(59) = -.07, *p* = .72, was weaker than the relationship between VWM ability and label use in the last name condition, *r*(59) = .28, *p* = .13. However, the correlation between VWM ability and label use was still not significant in the latter condition.

Experiment 1

As in the pilot study, the VWM task followed the similarity judgment task in Experiment 1. A total of 57 participants took both the VWM Additional measures were taken in this portion of the study however. VWM ability was measured by analyzing the percent of trials answered correctly as well as a measure of Hits – False Alarms (*H – FA*), *d'*, and *K.* In all of these, higher values within each measure indicate better performance.

We will discuss percent correct first. This is the percent of trials in which the subject answered correctly, meaning they correctly identified the two arrays as being the same (a Hit or *H*) or correctly identified the two arrays as being different (a Correct Rejection, or *C*). On average, participants answered 71.12 percent of the trials correctly. The correlation between overall label use and percent correct was calculated, $r(58) = -.14$, $p = .30$. The correlation between the percent correct and the disease condition was also not significant, $r(30) = -.03$, $p = .88$. Although the correlation was stronger between percent correct and last name label use, it was not significant, $r(28) = -.18$, $p = .35$ (Figure 7b).

The second measure taken was *H – FA*. This measure is the number of Hits (the number of times a participant correctly identified the two arrays in the VWM task as being the same) minus the False Alarms (the number of times a participant judged the two arrays to be the same when they actually differed). The highest obtainable score is 40 because there are 40 trials in which the two arrays are the same. A score of 40 would mean the participant correctly spotted every trial in which the two arrays were the same and never obtained any false alarms, meaning the participant correctly determined every trial in which the two arrays were different. On average, the H – FA value was 16.90 with a standard deviation of 5.01. Correlations were taken between H – FA and label use. Overall, there was not a significant correlation between the two, $r(58) = -.14$, $p = .30$. As in comparisons with percent correct, further analysis was done by comparing VWM ability with specific labels. When comparing H – FA results with only the disease condition, there was no correlation, $r(30) = -.03$, $p = .88$. The correlation between H – FA and label use was stronger in the last name condition, but not significant, $r(28) = -.18$, $p = .36$.

A *d'* measure was taken as well. This value is the probability of a participant obtaining a hit based on his or her performance, *HP*, minus the probability of a participant getting false alarm, *FP*. This is a measure intended to account for a participant's tendency or bias to, when unsure, judge the arrays as being the same more often than judging them to be different or vice versa. The highest possible *d'* score is 4.65. In Experiment 1, the average *d'* score was 1.30, Overall, a correlation of $r(58) = -.14$, $p = .30$ between label use and *d'* was found. Correlations between *d'* and label use were also taken for specific labels: disease condition: $r(30) = -.02$, $p = .91$, last name condition: $r(28) = -.18$, $p = .35$.

The final measure taken was *K*, which is the number of items a participant can hold in memory. The formula for *K* as explained in Vogel, Woodman, and Luck (2006) is $K = CR \times [S \times (HR - FR) / (1 - FR)]$, where CR is the correct rejection rate of a participant (proportion of correctly determining the two arrays are different), S is the set size (or the number of squares in the array. In the case of this experiment, there were always eight colored squares), HR is the hit rate and FR is the false alarm rate. This formula is intended to account for guessing. The average number of items subjects were able to hold was 3.38 items with a standard deviation of 1.00. Previous studies have found the capacity of items held in short term visual memory to be 4 (Luck & Vogel, 1997; Cowan 2000; Vogel, Woodman, & Luck, 2006) so this result is not unexpected. As with previous measures, the correlation between *K* and label use was found: overall, $r(58)= -.137$, $p = .30$, disease condition, $r(30) = -0.03$, $p = .88$, last name condition, $r(28) = -.18$, $p = .36$.

Experiment 2

A total of 116 participants took the VWM task along with the similarity judgment task. Of these, 70 participants took the similarity judgment task before the VWM task, and 46 participants took the similarity judgment task after the VWM task. VWM ability was measured using the same means as Experiment 1, and correlations were found in the same manner as well. Average values for VWM ability were lower overall than in Experiment 1 and were the following: percent correct, $M = 68.44$, $SD = 8.52$; *H – FA, M* = 14.74, $SD = 6.81$; *d', M* = 1.11, $SD = 0.56$; *K, M* = 2.95, $SD = 1.36$. Overall, within Experiment 2, no significant correlations were found between VWM ability and label use: percent correct, H – FA, *d*', and *K* each resulted in the following correlation with label use: $r(116) = -.s13$, $p = .17$. However, it is noteworthy that the all correlations between VWM ability and label use in the Judgment 1st disease condition were weaker than with those in the Judgment 1st last name condition (Figure 7). Correlations between disease label use and VWM ability were as follows: label use– vs. percent correct, $r(39) = -.18$, $p = .28$, vs. H – FA, $r(39) = -.18$, $p = .28$, vs. d', $r(39) = -.15$, $p = .36$, vs. K, $r(39) = -.18$, $p = .28$. These are weaker correlations than those found between last name label use and VWM ability: last name label use– vs. percent correct, $r(31) = -.21$, $p = .26$, vs. H – FA, $r(31) = -.21$, $p = .26$, vs. d', $r(31) = -.27$, $p = .14$, vs. K, $r(31) = -.21$, $p = .26$.

Implicit beliefs

Experiment 1

Along with label use and VWM ability, we measured the extent to which people believe that one's intelligence, one's sense of morality, or traits in the world can be changed (fixed/flexible implicit belief) using a questionnaire with a 7 point scale. Higher values for these measurements indicated more flexible implicit beliefs than low values.

A total of 69 participants completed the implicit beliefs questionnaire along with the similarity judgment task, and these were the participants used in the analysis. The average ratings for the fixed nature of different qualities were measured: intelligence, $M = 4.16$, $SD = 1.09$, morality, $M = 3.96$, $SD = 1.14$, world, $M = 3.43$, $SD = 0.90$. Correlations between the different beliefs were significant. Overall, correlations between label use and implicit beliefs were significant between intelligence beliefs and label use, $r(69) = .28$, $p < .05$, and between world beliefs and label use, $r(69) = .44$, $p < .01$.

However beliefs regarding morality were not closely correlated with label use, $r(69) = .14$, $p = .25$. Correlations were also taken between implicit beliefs and each label condition (Figure 8): disease label use vs.– intelligence, $r(36) = .28$, $p = .10$, morality, $r(36) = .21$, $p = .22$, world = .49, $p < .01$. Here, the correlation between the disease label and implicit beliefs were only significant within world beliefs. This was also the case in the last name condition: last name label use vs.– intelligence, $r(33) = .25$, $p = .17$, morality, $r(33) = .06$, $p = .75$, world, $r(33) = .42$, $p < .05$. Although correlations with label use varied between label conditions, there were not significant differences between the disease and last name conditions regarding beliefs pertaining to intelligence, $t(67) = -1.09$, $SE = 0.26$, $p = .28$, morality, $t(67) = -0.48$, $SE = 0.28$, $p = .63$, or the world $t(67) = 0.81$, $SE = 0.22$, $p = .42$.

Experiment 2

A total of 155 participants completed both the similarity judgment task and the implicit beliefs questionnaire, and only these are used in the analysis. The averages for beliefs regarding intelligence ($M = 4.06$, $SD = 1.14$), morality ($M = 3.71$, $SD = 1.04$), and the world ($M = 3.28$, $SD = 0.90$) are comparable to those in Experiment 1. These beliefs were also significantly correlated. Overall, unlike in Experiment 1, correlations between label use and implicit beliefs were not closely correlated: Label use vs.– intelligence $r(155) = .09$, $p = .28$, morality, $r(155) = .08$, $p = .33$, and the world $r(155) = .06$, $p = .45$. Further analysis was performed to compare implicit beliefs with each labeling condition (Figure 8). When comparing the use of labels in the disease condition of the Judgment

1st task, there were not significant correlations between label use and beliefs regarding intelligence, $r(53) = -.10$, $p = .49$, morality $r(53) = -.17$, $p = .24$, or the world, $r(53) = .02$, $p = .87$. However, significant correlations between use of last name labels in the Judgment 1st condition and implicit beliefs were found regarding assumptions about intelligence, $r(42) = .37$, $p = .02$, and morality, $r(42) = .36$, $p = .02$, but not the world, $r(42) = .21$, $p = .18$. In the disease condition of the Judgment 2nd condition, there were not significant correlations between label use and beliefs pertaining to intelligence, $r(24) = .18$, $p = .41$, morality, $r(24) = .37$, $p = .08$, or the world, $r(24) = .15$, $p = .50$. The absence of significant correlations was also found in the between last name label use and implicit beliefs in the Judgment 2nd condition: label use vs.– intelligence, $r(36) = .02$, $p = .91$, morality $r(36) = .13$, $p = .44$, and the world, $r(36) = -.08$, $p = .65$.

Metacognitive ability

Experiment 1

Metacognitive ability was measured by determining the differences between a participant's actual percentile ranking on the VWM task from the estimated percentile ranking of the participant. Percentiles were determined based on the participant's *d'* score. The absolute value of the difference between actual and estimated percentiles was obtained, the *percentile accuracy*. Lower values indicate a closer prediction to actual results and therefore better metacognitive ability. The same was done for the actual and estimated number of trials answered correctly on the VWM task, the *number accuracy*. Those with close estimations were said to have better metacognitive ability. The average percentile accuracy was 27.91 with a standard deviation of 17.22. The average number accuracy was 10.11 with a standard deviation of 9.87. Overall, correlations between label use and metacognitive ability were not significant: label use vs. percentile accuracy, $r(55) = .13$, $p = .33$, label use vs. number accuracy, $r(55) = -.09$, $p = .54$. This was the case when analyzing metacognitive ability compared to only the disease condition as well: percentile accuracy, $r(28) = -.02$, $p = .93$, number accuracy, $r(28) = -.01$, $p = .95$ (Figure 9a). Also, although correlations were stronger between metacognitive abilities and label use in the last name condition, correlations were not significant: percentile accuracy, $r(27) = .25$, $p = .21$, number accuracy, $r(27) = -.11$, $p = .60$ (Figure 9b).

Experiment 2

Metacognitive ability was determined using the same methods as Experiment 1. The percentile accuracy ($N = 119$, $M = 27.27$, $SD = 19.77$) and number accuracy ($N = 119$, $M = 13.72$, $SD = 11.32$) were calculated. As in Experiment 1, correlations between these values and label use were found (Figure 9). Overall, neither the correlation between label use and percentile accuracy, $r(119) = .04$, $p = .66$, nor the correlation between label use and number accuracy, $r(119) = -.02$, $p = .83$, resulted in significant correlations. An analysis of disease label use in the Judgment 1st condition did not result in significant correlations when compared with percentile accuracy, $r(41) = .15$, $p = .34$, or number accuracy, $r(41) = .07$, $p = .66$. This was also the case when comparing last name label use in the Judgment 1st condition with percentile accuracy, $r(31) = .15$, $p = .43$ and number accuracy, $r(31) = .26$, $p = .22$. Correlations were stronger between the use of the disease label in the Judgment 2nd condition and percentile accuracy, $r(19) = -.39$, $p = .10$, and number accuracy, $r(19) = -.27$, $p = .26$, however neither were significant. Correlations between last name label use in the Judgment 2nd condition were weaker than disease label use in the same condition compared to both percentile accuracy, $r(28) = -.01$, $p = .97$, and number accuracy $r(28) = -.19$, $p = .34$.

Additional analysis

The experimental method for Experiment 1 and the Judgment 1st condition of Experiment 2 were identical. Therefore, in order to increase the amount of participants in the analysis for increased accuracy, we grouped together the results of these two experimental conditions. The results are described below.

Similarity judgment task

As found in the individual experiments, the effect of labels is clearly seen. From Experiment 1 and Experiment 2, a total of 247 participants completed the similarity judgment task before the VWM task. Overall, when labels were present, subjects' label use were significantly higher than when no labels were present, t (246) = 6.48, $SE = .01$, $p < .01$. This labeling effect was significant in all levels of physical differences: low-difference, $t(246) = 5.23$, $SE = .01$, $p < .01$, medium-difference, $t(246) = 4.73$, $SE = .01$, $p < .01$, high-difference, $t(246) = 4.64$, $SE = .01$, $p < .01$, $F(1, 245) = 1.21$, $MSE = .03$, $p = .27$, $\eta^2 = .004$.

Visual working memory task

A total of 133 participants took the VWM task along with the labeling task and analysis on VWM ability was done only on these participants for this section. VWM ability was not different between the disease condition compared to those in the last name condition in H – FA, $t(131) = 1.08$, $SE = .09$, $p = .28$, *d’,* $t(131) = 0.53$, $SE = 1.11$, $p = .60$, , or *K*, $t(131) = 0.55$, $SE = 0.22$, $p = .68$, however it was for percent correct, $t(131) = 2.24$, $SE = 1.41$, $p = .03$.

With the results from Experiment 1 and Experiment 2 combined, as predicted, participants with smaller visual working memory spans tended to use category labels more in the similarity judgment task. VWM ability (percent correct, H – FA*, d’* and *K*) and label use showed a significantly negative correlation (Figure 10): percent correct and label use $r(133) = -.17$, $p = .06$, H – FA and label use: $r(133) = -.17$, $p = .06$, *d’* and label use: $r(133) = -.17$, $p =.06$, *K* and label use: $r(133) = -.165$, $p < .06$. The negative correlation was found in both the disease and last name condition.

Implicit beliefs

The values on intelligence, morality, and world were highly correlated to each other: intelligence and morality, $r(164) = .25$, $p <.01$, intelligence and world, $r(164) = .38$, $p <.01$, and morality and world, $r(164) = .33$, $p <.01$. 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 beliefs (Figure 11). 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, $r(75) = .33$, $p < .01$, 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 $r(89) = .18$, $p = .10$. It was our hypothesis that those with more fixed beliefs would use labels more, so these findings were not as predicted.

Metacognitive ability

A total of 127 participants' metacognitive abilities were also measured with a questionnaire. Those with closer estimations of their own performance on the VWM task suggest higher metacognitive abilities. As described, we asked subjects to estimate in which percentile they belong (*M* = 57.51, *SD* = 18.95) on the VWM task compared to other participants who completed the same task. We also asked them to estimate their how many trials they believed they answered correctly on the VWM task, *M* = 55.84, *SD* = 14.38. In order to measure metacognitive ability, we found the absolute value of the difference between subjects' estimated percentiles and actual percentiles, *M* = 27.17, *SD* =18.63. We also found the absolute value of the difference between their estimated number of trials answered correctly and the actual number of trials answered correctly, *M* =11.82, *SD* = 10.06. Metacognitive ability was not significantly correlated with label use in both estimations of percentile rankings: $r(127) = .13$, $p = .14$, and number of trials answered correctly: $r(127) = .03$, $p = .73$ (Figure 12).

CHAPTER IV

SUMMARY AND CONCLUSIONS

Summary

As discussed, labels have shown to have large effects on decisions, and some labels tend to have a greater affect than others. Based on the results of the pilot study, it seemed as though the disease label would be a stronger, more powerful label throughout the experiment. It was used with greater frequency in this study which was consistent with previous findings by Lara (2009), and we hypothesized that the disease label would continue to have a larger effect on judgments because people feel it is more meaningful and constant than a last name. However, unexpectedly, as we continued to administer the experiment, this difference between the two labels began to disappear. Label use was nearly equivalent between the disease and last name conditions in Experiment 1, and in Experiment 2, the use of the last name label actually surpassed that of the disease label. When the results of Experiment 1 are combined with the 1st Judgment condition of Experiment 2, the disease label is seen to be used more frequently, but this difference is not significant. So was there an effect on label use by reordering the experiment? It seems that this is a possibility. When the VWM task preceded the similarity judgment task, the last name label was used with greater frequency, which was not the result in any other experimental condition. However, with only 46 participants completing the Judgment 2nd condition of Experiment 2, no sound conclusions can be made regarding this finding; further experimentation with a larger amount of subjects would be required for a more accurate analysis.

There were both expected and unexpected results found regarding the relationship between label use and VWM ability. A weak positive correlation was found between VWM ability and label use in the last name condition of the pilot study. This indicated that those with better VWM ability use labels more, not less as expected. However this is the only condition in which this occurred. In other conditions, it was typical that, in the last name condition, those with poor VWM used labels more, which was expected. The effect was not robust, however. The most significant correlations between VWM ability and label use were found when grouping Experiment 1 and the Judgment 1st condition of Experiment 2 together. However, in this final analysis, the correlations were not stronger than those found in the other experiments. This suggests that the lack of significance in the correlations may be due to a small sample size.

Throughout the experiment, a participant's implicit beliefs were the measures that most closely related to label use consistently. Like in the VWM task, this was especially the case with the last name label. The relationship found between label use and implicit beliefs was unexpected, however. We predicted that participants with beliefs that traits in the world are fixed would use labels more because labels have been shown to affect decisions so strongly and because a large amount of information about the properties of an item can be given with a label. However, the opposite was found. The general trend was that those with more flexible beliefs tended to use labels more, especially in the last name condition.

Correlations between metacognitive ability and label use were not found to be significant. There was a weak, positive relationship between a participant's percentile estimations and label use; however this was not strong enough to be considered significant. In this study, metacognitive ability was not found to be strongly related to label use.

Conclusions

Across several measures, results for the Judgment 2^{nd} condition varied from the other experiments in which the similarity judgment task was presented first. This suggests that label use or VWM ability may be affected by the previous task. After taking the VWM task in the Judgment 2^{nd} condition of Experiment 2, subjects label use was less than that of other experiments for the most part, suggesting the VWM task results in a decreased use of labels in the future. This may be due to subjects being forced to think only visually during the VWM task, so when they begin the similarity judgment task, they are primed to think visually and therefore use labels less. However, due to the small number of participants in the Experiment 2 condition, further studies will need to be done to support this theory.

Both VWM ability and implicit beliefs can potentially predict label use, however metacognitive ability does not. Furthermore, VWM ability and implicit beliefs were more closely related to the last name label use in general. In the case of those with low VWM ability, people tended to use labels more in the last name condition. Those with more flexible beliefs regarding traits and characteristics tend to use last names labels more. The frequency of the disease label use is steadier across these conditions. This suggests that people find the disease label more meaningful than the last name label because no matter what implicit beliefs are held, disease label use is frequent. While a last name can be changed quickly with the proper signatures, a disease can change the biological aspects of an organism. A disease can affect functioning, health, and even appearance. Although a last name can suggest a familiar relationship, it is very common to come across several people with the same last name that are unrelated and dissimilar. However, a disease tends to behave the same no matter which person it infects. Because the last name label holds less power, it is more susceptible to outside influences, such as implicit beliefs, resulting in the trend found.

The interaction between label use and cognitive factors is not straight-forward. Many cognitive processes interact simultaneously during decisions. In order to have a better understanding of how people judge similarity and categorize items, further research needs to be done, channeling more specific aspects of cognition. This study serves as a launching point for future developments in determining how abilities and assumptions affect people’s vulnerability to believe that a label is a reflection of meaningful information.

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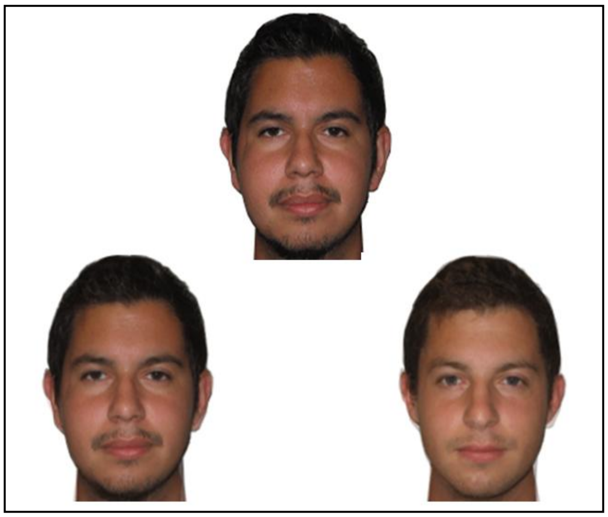
APPENDIX

FIGURES

A)



B)

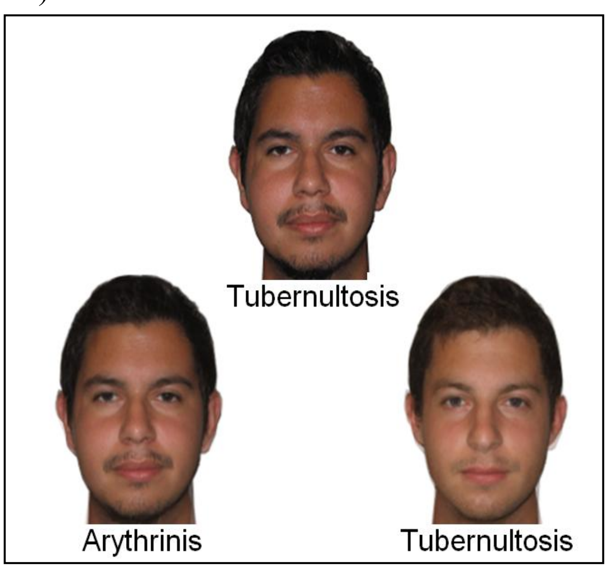


Figure 1. An example of stimuli used in the similarity judgment task shown A) without labels, and B) with labels.

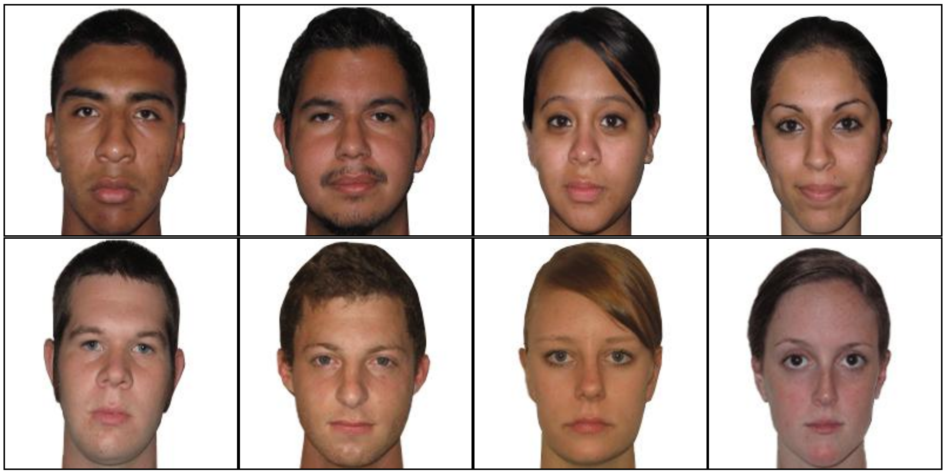


Figure 2. Original, un-morphed face pairs used in similarity judgment task. The two faces within the same box were morphed together.

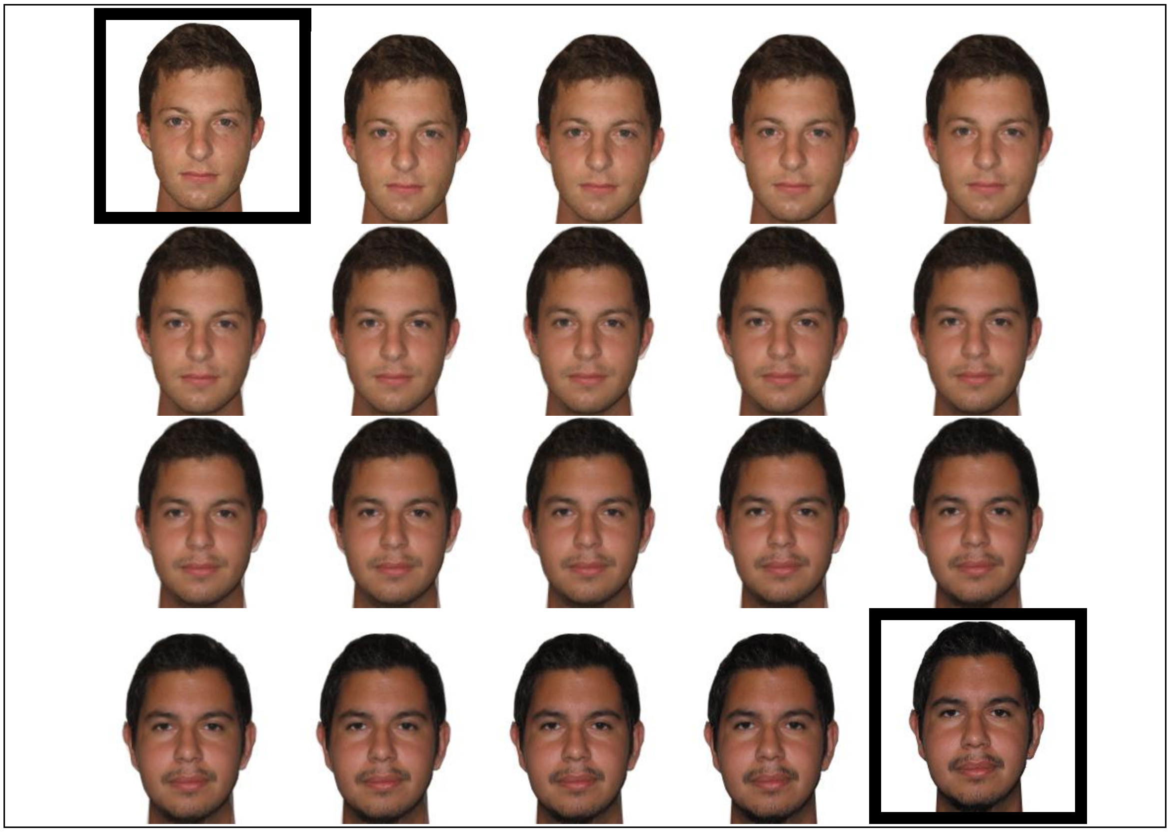


Figure 3. Two original, target faces emphasized and all morphed steps shown for the pair.

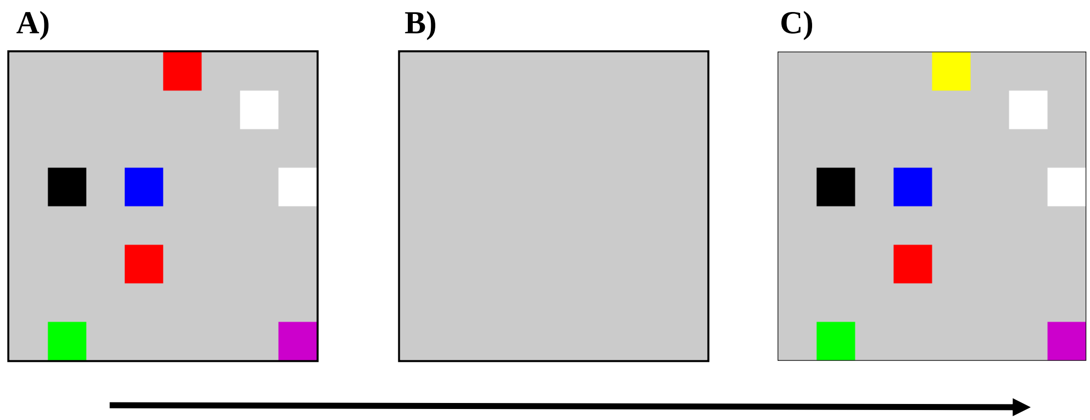


Figure 4. Sequence of stimuli shown in VWM task starting with A) the sample array, followed by B) a blank delay, then C) the test array. An example of an array used in the visual working memory task.

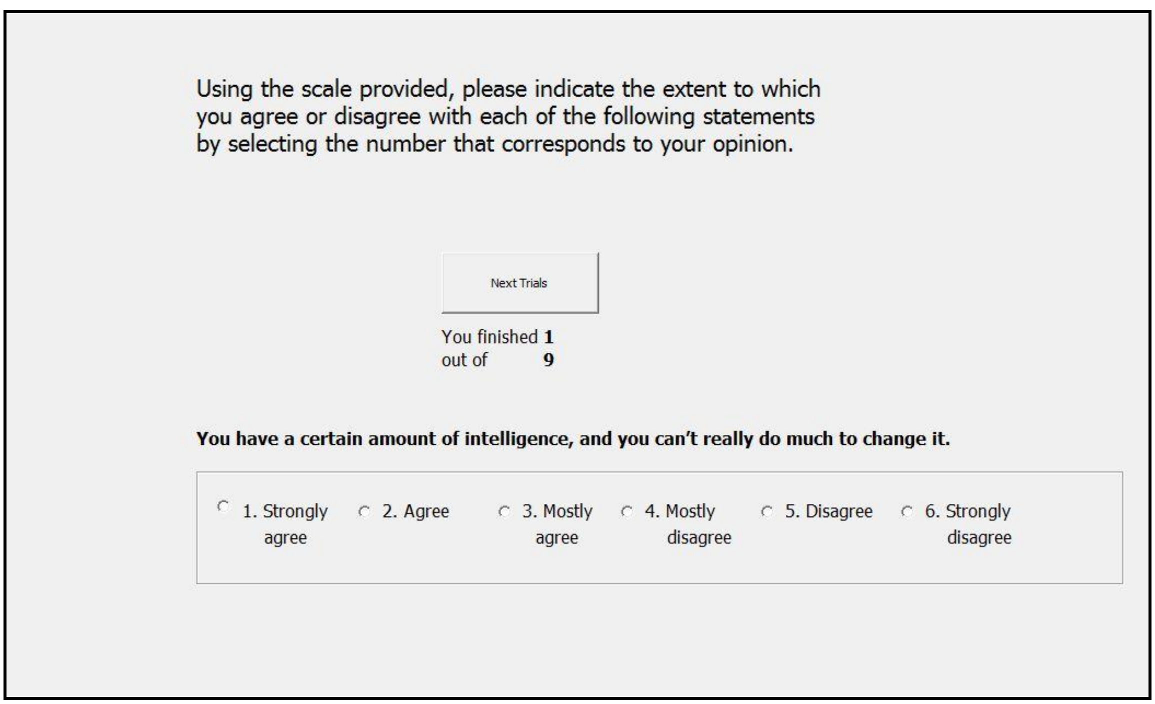


Figure 5. Screenshot of implicit belief questionnaire as presented on MS Excel.

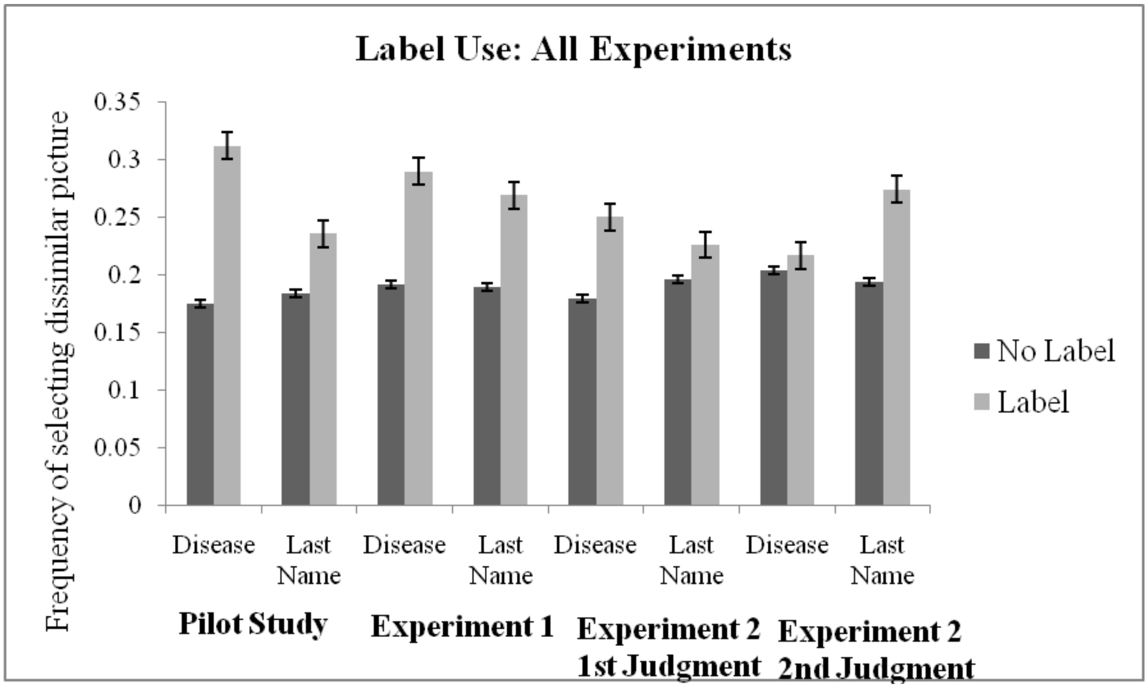


Figure 6. Frequency, measured as a proportion, of selecting the dissimiliar picture in the similarity judgment task with standard error bars shown.

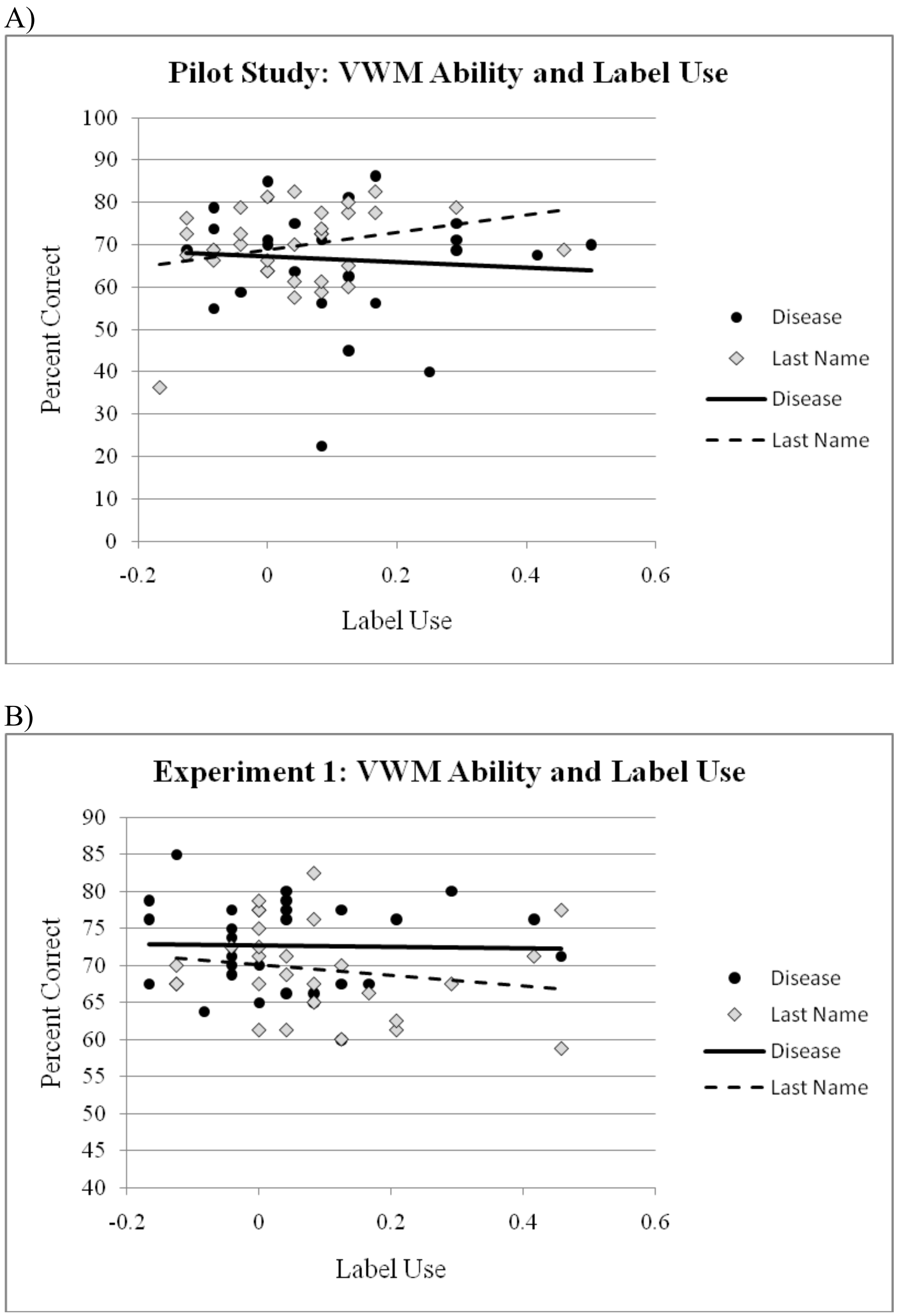
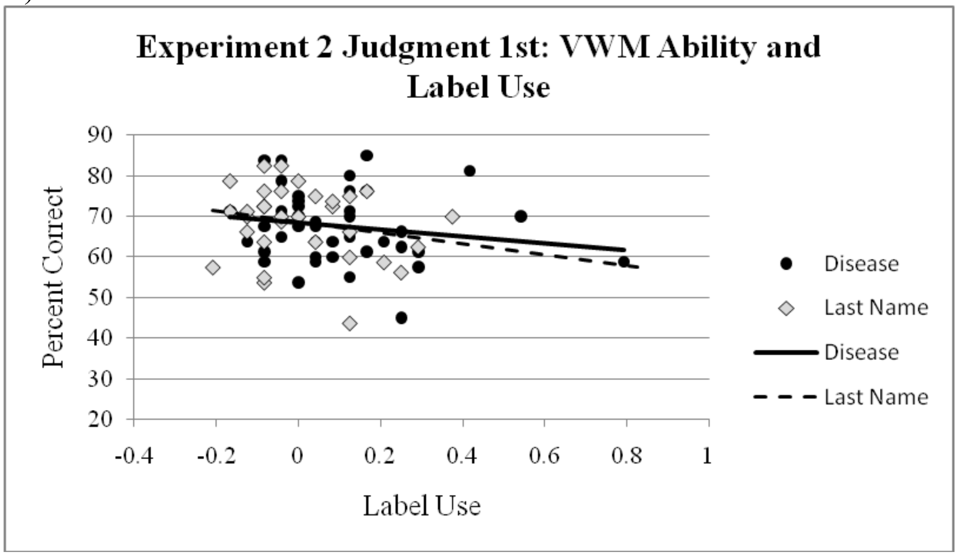


Figure 7. Correlations between VWM ablility, according to percent correct, and label use. Figures shown with individual data plotted and corresponding trendlines.

C)



D)

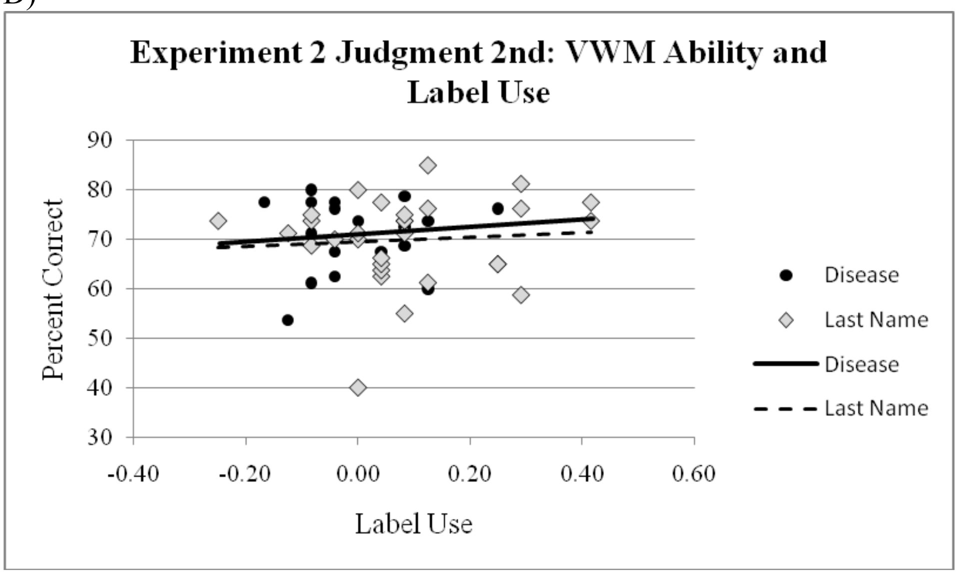
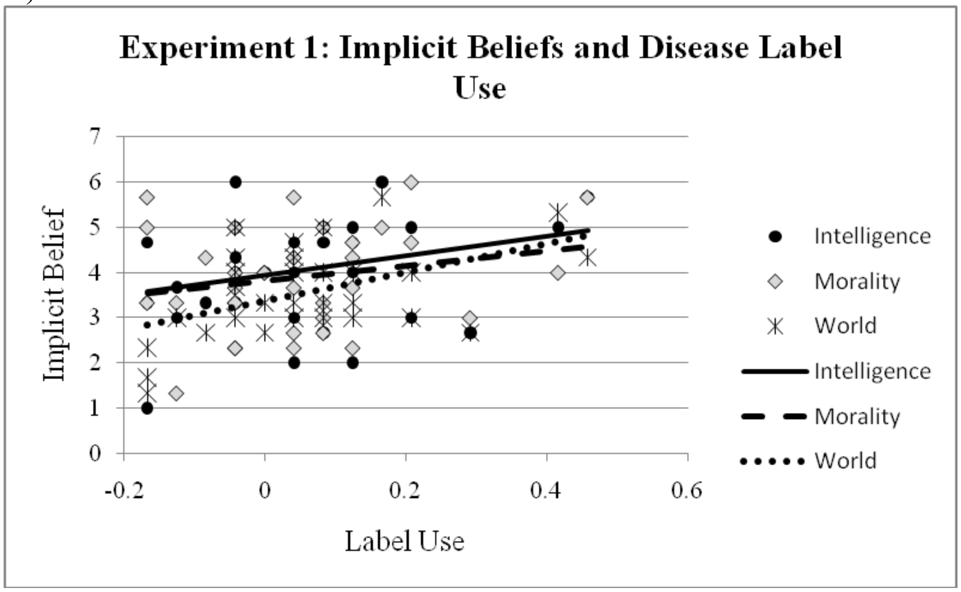


Figure 7. Continued

A)



B)

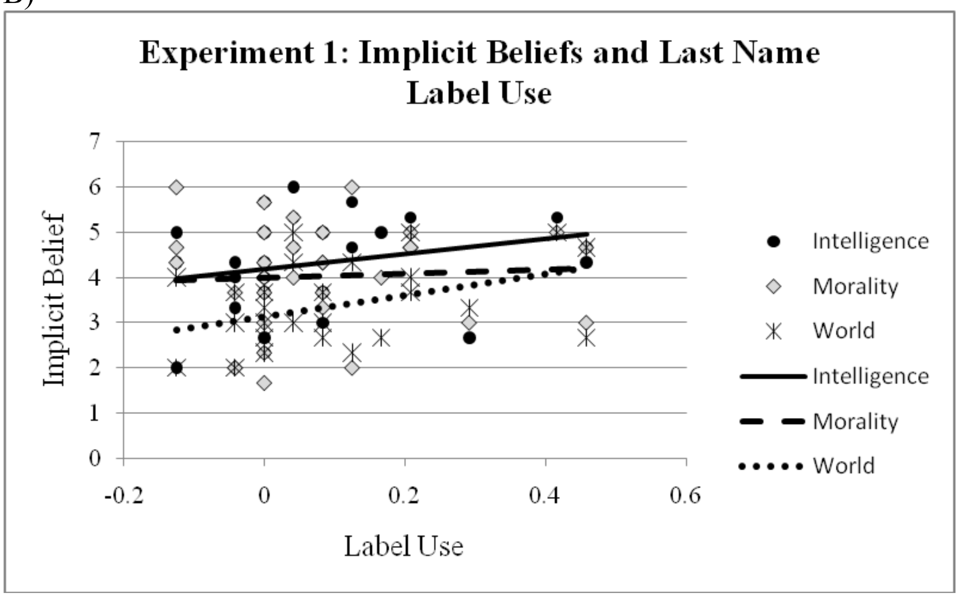
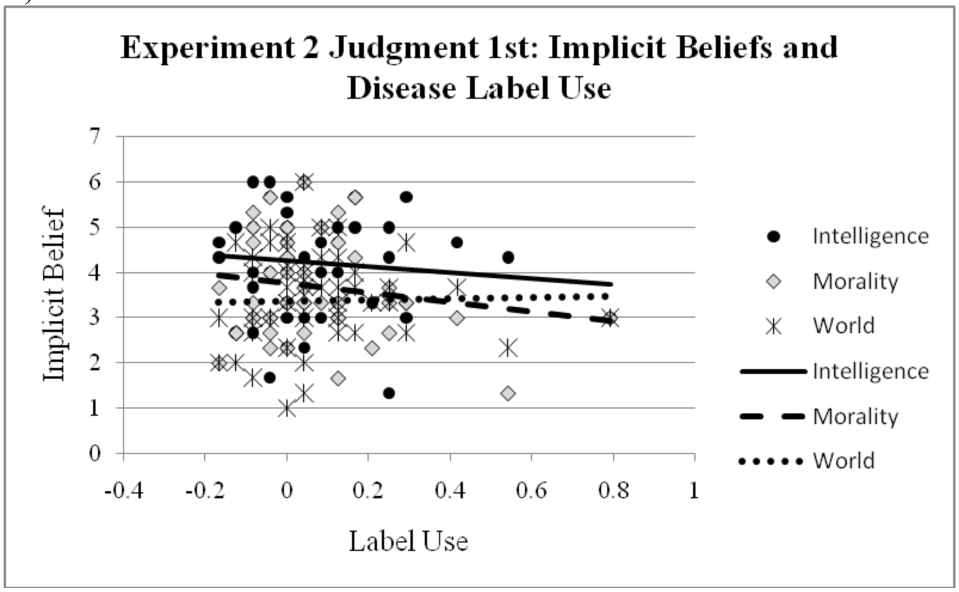


Figure 8. Correlations between implicit beliefs (0= traits are fixed; 7 = traits are flexible) and label use. Data shown with individual data and trendlines.

C)



D)

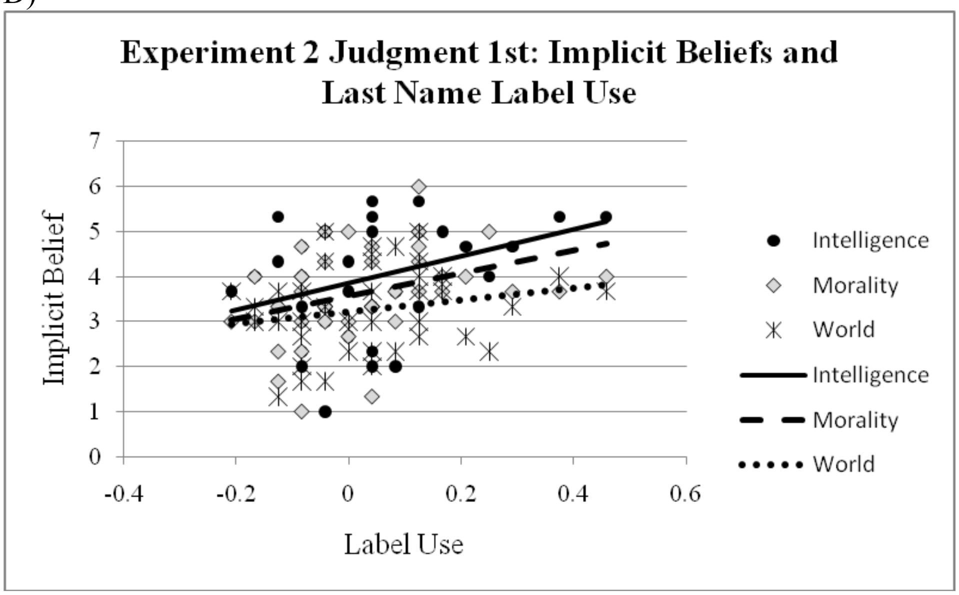
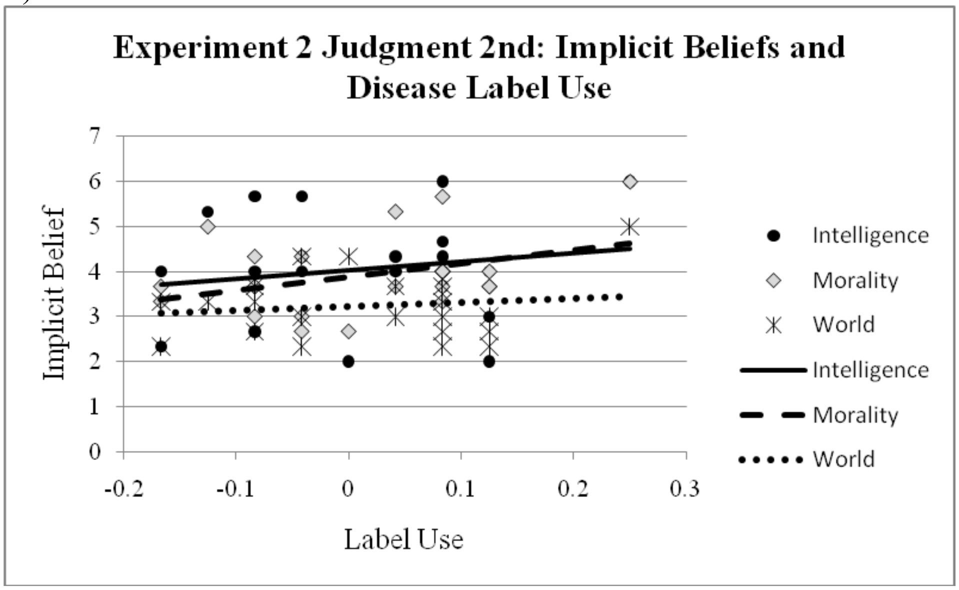


Figure 8. Continued

E)



F)

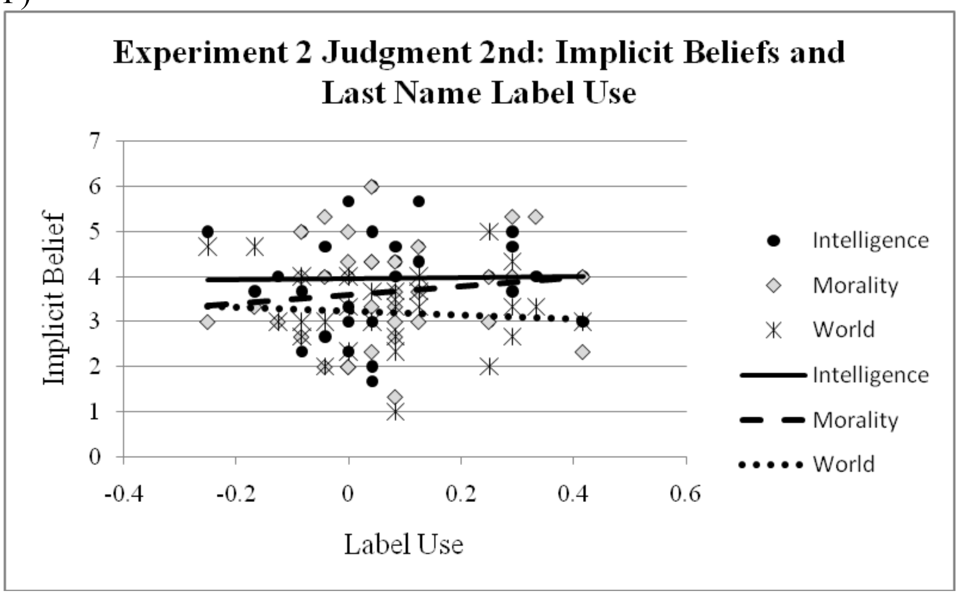
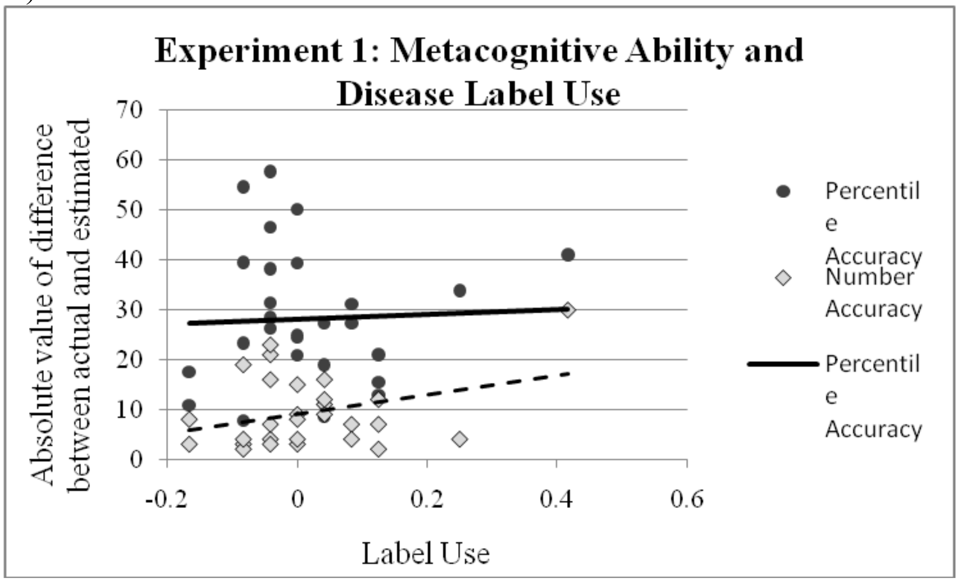


Figure 8. Continued

A)



B)

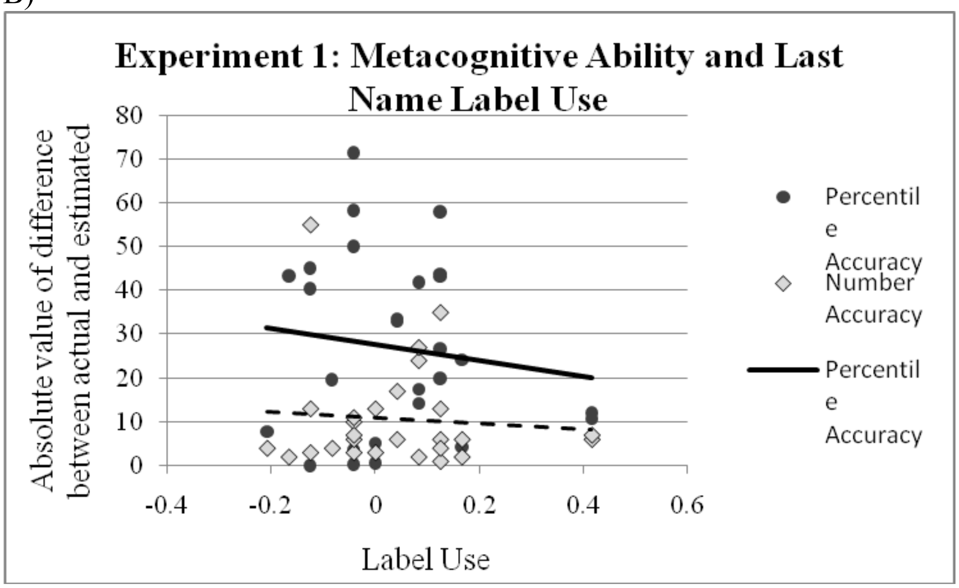
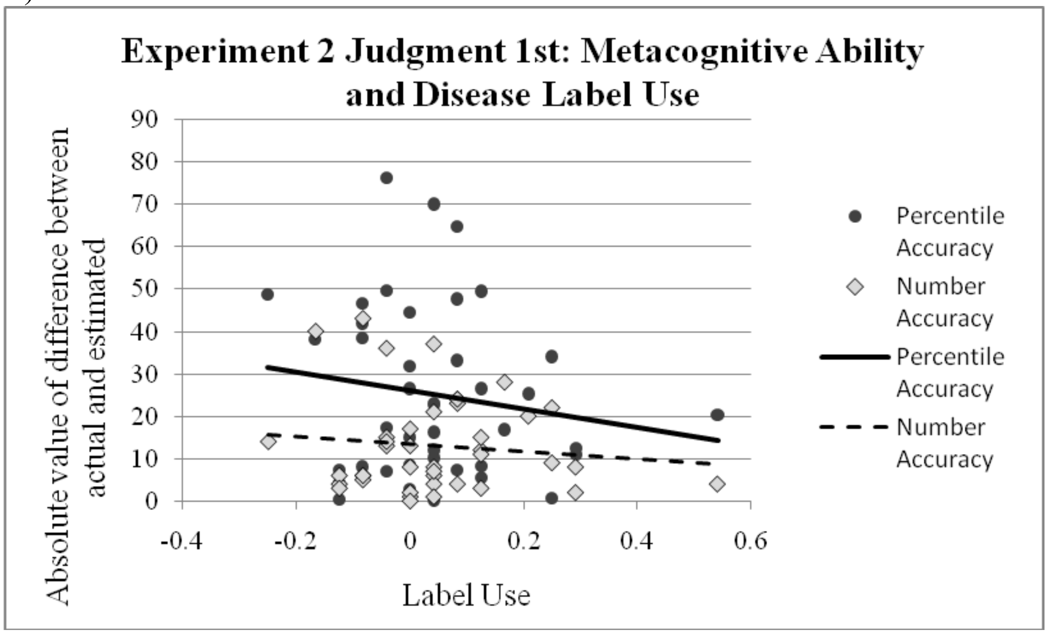


Figure 9. Correlations between metacognitive ability and label use. Figures shown with individual data points and trendlines.

C)



D)

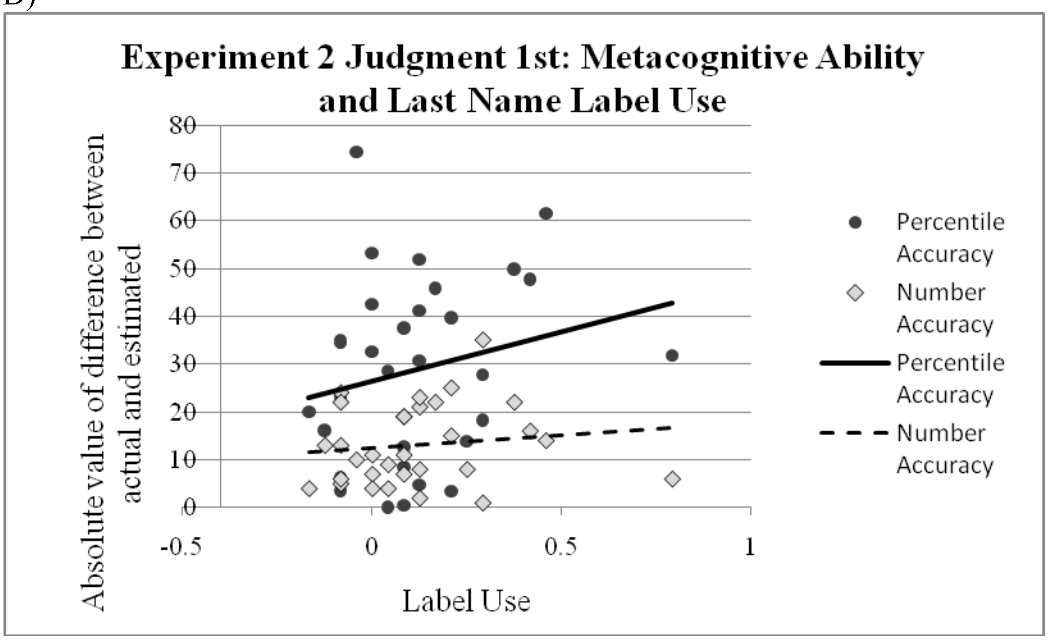
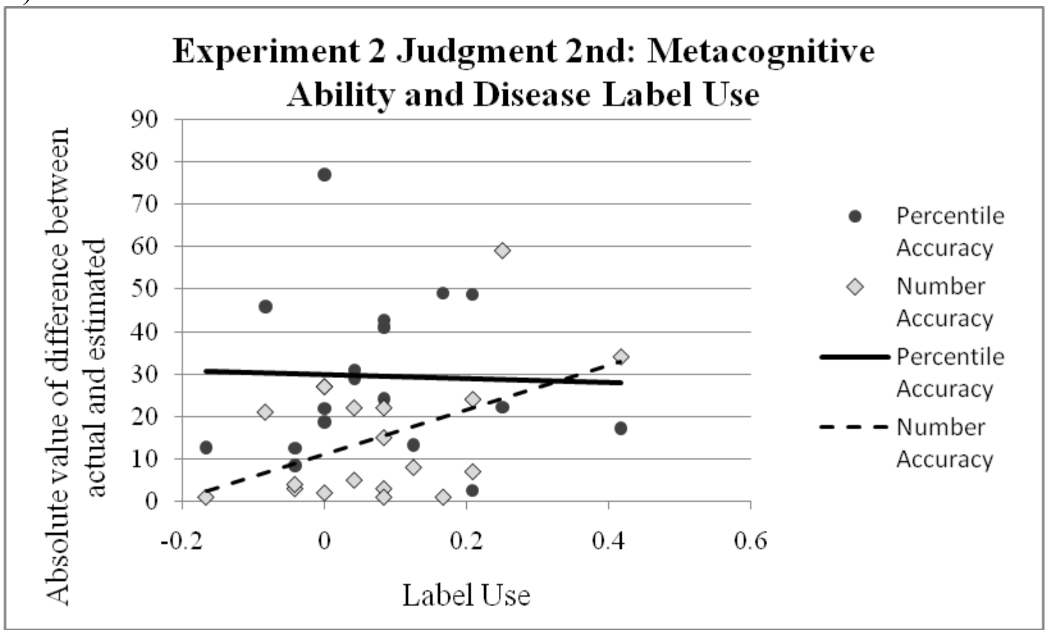


Figure 9. Continued

E)



F)

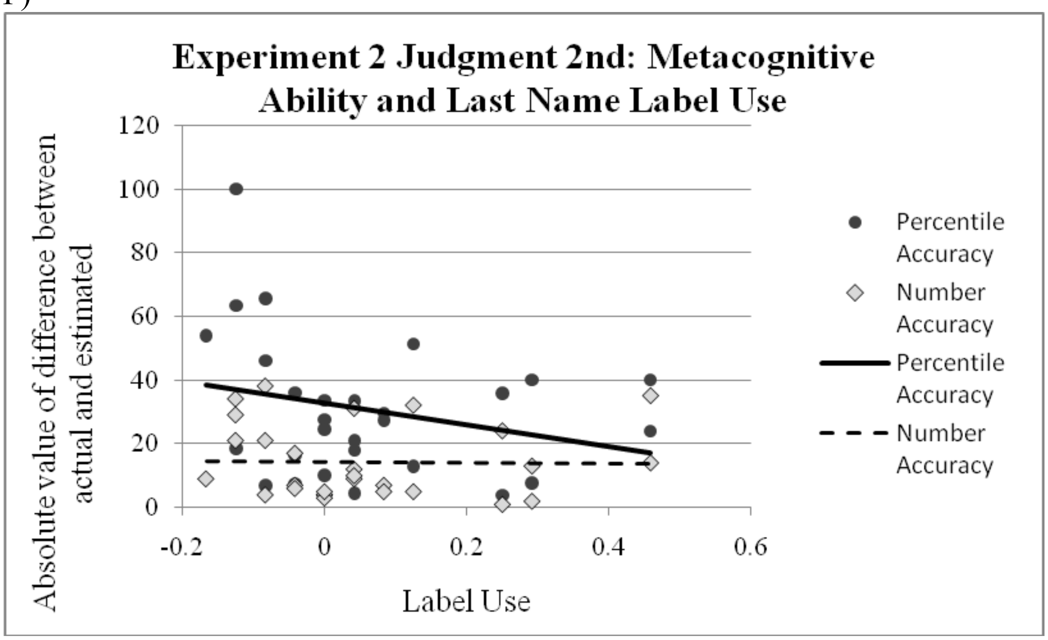


Figure 9. Continued

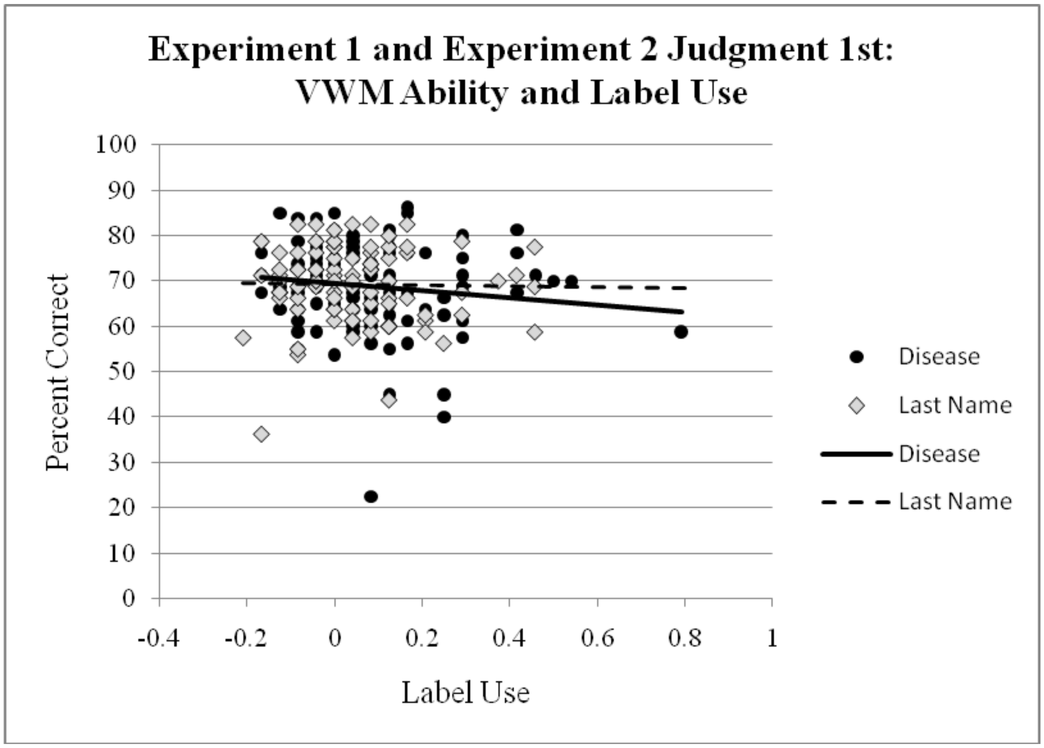
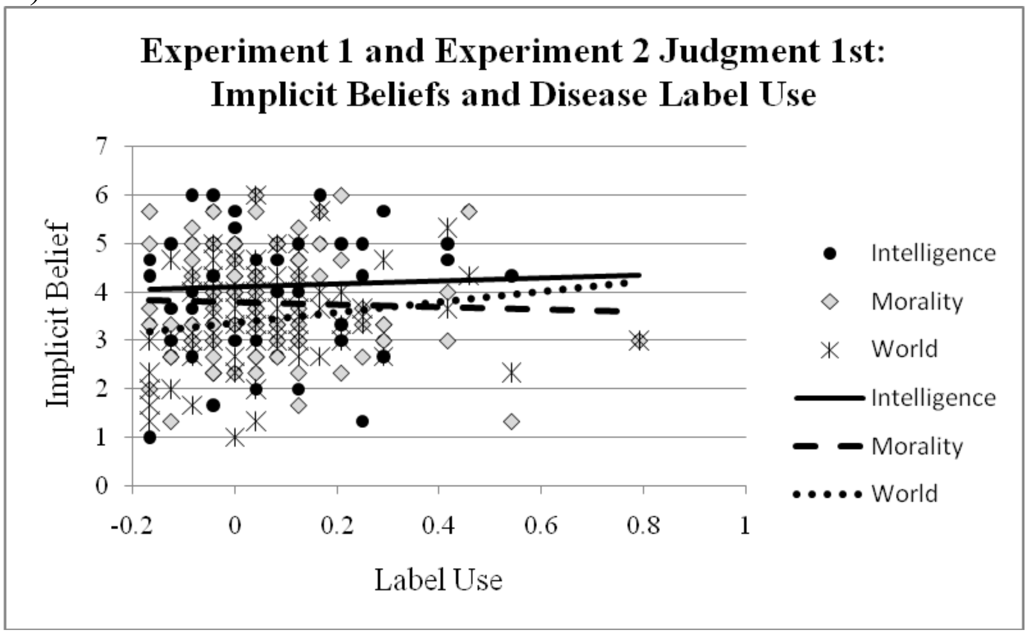


Figure 10. Correlations between VWM ability and label use in Experiment 1 and 2. Shown with individual data points and trendline.

A)



B)

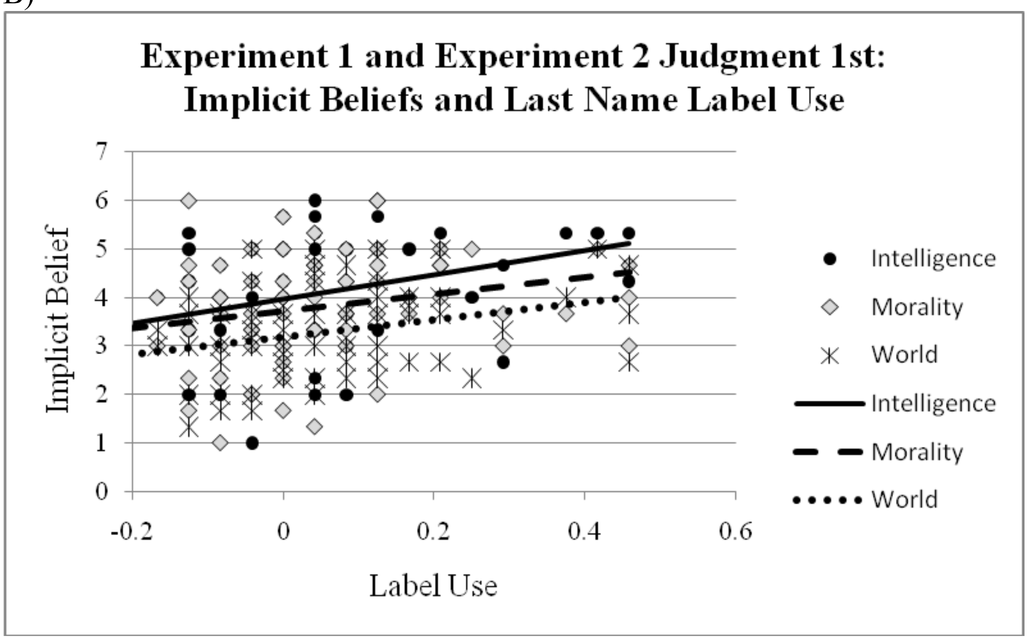
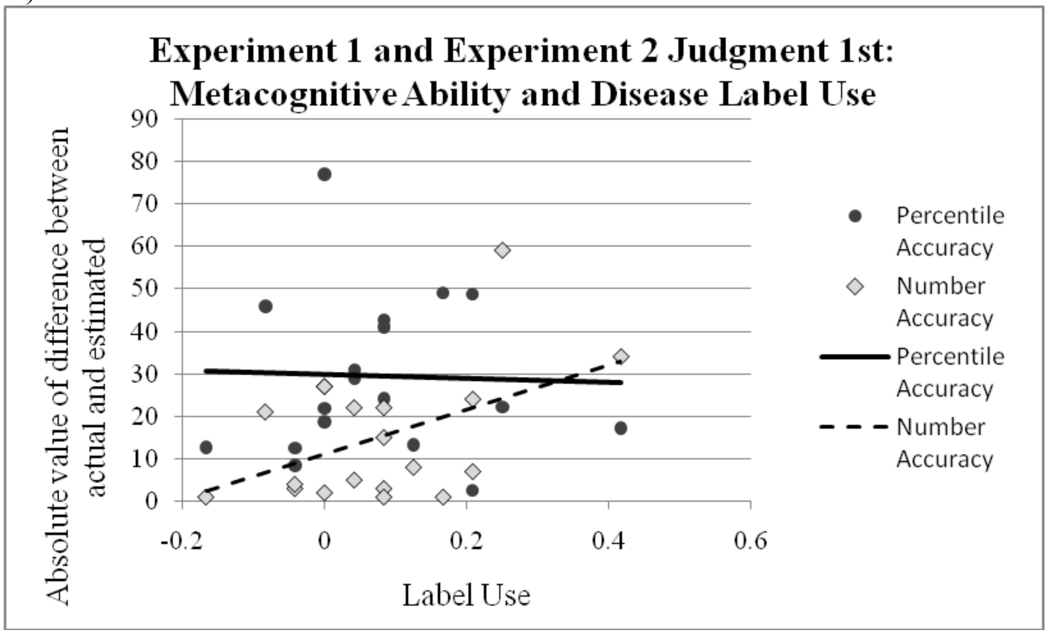


Figure 11. Correlations between implicit beliefs and label use. Shown with individual data points and trendlines.

A)



B)

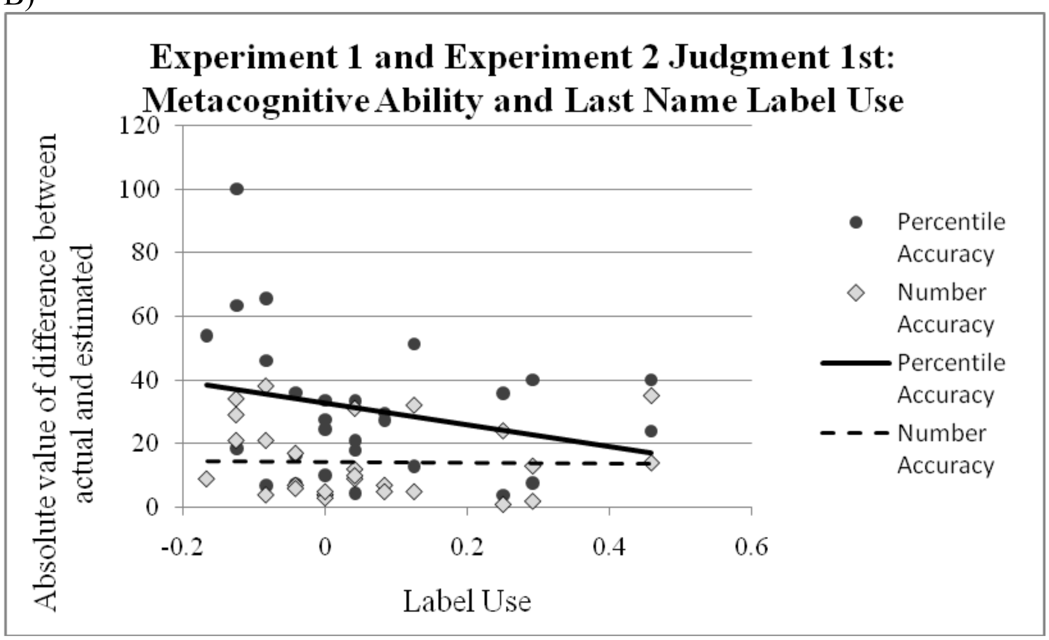


Figure 12. Correlations between metacognitive ability and label use. Shown with individual data points and trend lines.

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