A Visual Cocktail Party Effect: The Role of Meaningfulness in Perception

An Honors Thesis (HONRS 499)

Ty C. Henkaline

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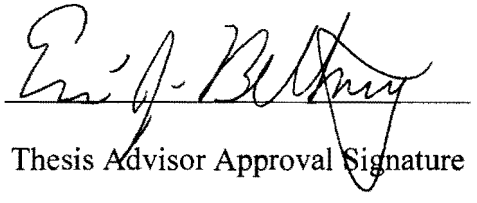
Thesis Advisor



Thesis Advisor Approval Signature

Ball State University

Muncie, Indiana

May, 2006

Expected Date of Graduation

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Running head: A VISUAL COCKTAIL PARTY EFFECT

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Abstract

According to the "cocktail party phenomenon" (Moray, 1959), a personally meaningful stimulus, like one's name, has a special ability to capture attention when presented in an unattended auditory channel. The present study was an attempt to replicate this effect in vision with a highly ecologically valid variant of the induced change blindness paradigm. Ninety students participated in a facial expression recognition task. In the final trial, the word on the model's shirt unexpectedly changed from *time* to either *house* or the participant's first name. Change blindness, or failure to notice the change, was significantly higher in the *house* condition (66%) than in the first name condition (24%), indicating the presence of a visual cocktail party effect. Surprisingly this effect occurred only among females. Results support the argument that meaningful words, such as names, are inherently able to unexpectedly grab our attention in visual as well as auditory contexts.

A Visual Cocktail Party Effect: The Role of Meaningfulness in Perception

It is not uncommon to be completely engaged in a conversation with a person or group of people, only to have your attention drawn away by the mention of your name in a previously unattended conversation. This is an example of the cocktail party effect, to which nearly everyone can relate. According to the "cocktail party phenomenon" (Moray, 1959), a personally meaningful stimulus, such as one's name, has a special ability to capture attention when presented in an unattended auditory channel. Although this effect has been addressed in the audition literature since the early 1950's, it has only recently become a topic of interest in vision research (Mack & Rock, 1998; Shapiro, Caldwell, & Sorenson, 1997). Is the cocktail party phenomenon limited to audition, or does it also occur in vision?

Recently researchers interested in visual cognition have increasingly utilized change blindness, which is the inability to detect changes to an object or scene (Simons & Levin, 1997), and inattentional blindness, which is a failure to see unattended items (Rensink, 2000), as paradigms for visual research. These tasks have been used as tools to investigate the conditions necessary for perception of an object or portion of a scene. Results from change and inattentional blindness tasks have been presented as evidence that attention is necessary for perception (Levin & Simons, 1997; Rensink, O'Regan, & Clark, 1997; Mack & Rock, 1998; Turatto, Bettella, Umilta, & Bridgeman, 2003). It seems that participants are unable to recall items or portions of scenes that they fail to attend to.

The present study is composed of components from both change and inattentional blindness tasks. Levin and Simons (1997) served as a model for the method of change and form of questioning while the general layout of the stimuli was adapted from Mack and Rock (1998).

In addition to studies from the change blindness and inattentional blindness literature, a highly relevant study using the attentional blink paradigm (Shapiro, Caldwell, & Sorenson, 1997) will be reviewed below.

In one change blindness task conducted by Levin and Simons (1997), participants viewed a video during which changes were made to objects of marginal interest between camera angle changes. The video depicted two actors sitting at a table, eating lunch, and conversing. Objects central in the scene were limited to the participants, their clothing, the chairs they occupied, the table, two plates, two cups, a can of soda, and a box of crackers. The video initially showed a side view of both actors at the table and cut to close up shots when each of them spoke. Across each camera cut, there was at least one change made to the scene. For example, in one shot an actor is wearing a scarf but, following a camera angle cut, the scarf disappeared. Participants were instructed to "pay close attention" when watching the video, but remained naïve to the possibility of continuity changes occurring. Following the video, they were asked whether they noticed any "unusual differences from one shot to the next." Of the 10 subjects who viewed the film, only 1 indicated that he or she had noticed a change. Eighty-nine of the ninety total changes went unnoticed. Before a second viewing, participants were explicitly told to search for changes in the scene, but still noticed an average of only about 2 of the 9 changes. With the results from this study, Simons supported the argument that attention is necessary for perception.

Shapiro, Caldwell, and Sorenson (1997) investigated the possible existence of the visual cocktail party effect, using the attentional blink paradigm. The "attentional blink" (Raymond, Shapiro, & Arnell, 1992) refers to people's inability to perceive a probe, or subsequent target, when it is placed within about 100 and 500 ms of a previously presented target in a rapid serial visual presentation. In experiments 1 and 2, participants were required to identify a noun or

name target and then to identify the presence or absence of a second target (probe) which was their own name, another name, or a specified noun from among a noun distracter stream (Experiment 1) or a name distracter stream (Experiment 2). Results indicated that participants did not experience an attentional blink for their own names but did for other names or nouns.

While in a change blindness task such as Levins and Simon (1997) participants are instructed to generally view a scene, in an inattentional blindness task the attention of participants is directed to a specific task related to the scene.

In one well known paradigm, Mack and Rock (1998) instructed participants to watch a computer screen and determine which line of a cross was longer in a series of slides, each of which was displayed for 200 ms. The participants engaged in two such tasks before they viewed the experimental slide, which contained an unexpected object in the periphery of the scene known as the critical stimulus. For example, in one such case a small black box was presented in a randomly selected quadrant of the scene. Other critical stimuli included objects like colored geometric shapes, happy and sad faces, and words. Following the trial in which the critical stimulus was presented, participants were asked whether they had seen anything on the screen other than the cross figure. Often participants noticed the critical stimulus less than 50% of the time.

Mack and Rock (1998) found significant differences in the amount of people who detected their own name relative to others' names or common nouns in a laboratory study utilizing the cross procedure mentioned above, but they did not determine if this effect would generalize for a study using a more ecologically valid procedure. In their studies related to meaningfulness Mack and Rock (1998) found that only 12.7% of participants indicated that they had failed to notice their name as a critical stimulus which differs markedly from the 35% who

failed to indicate noticing someone else's name and the 50% who failed to indicate noticing a common noun (e.g., *time* or *house*).

Although the studies above addressed their respective issues in novel ways, they each had noteworthy drawbacks relative to the study of the role of meaningfulness in perception. Levin & Simons (1997) had a high level of ecological validity, but failed to directly address the role of meaningfulness in perception and did not include a competing task. Shapiro, Caldwell, and Sorenson (1997) had a competing task but a low level of ecological validity. Mack and Rock (1998) included a competing task but also had a low level of ecological validity. The present study addresses the role of meaningfulness in perception in a novel way, combining elements from each of these studies to produce a highly ecologically valid procedure that includes a competing task. Relative to the two-dimensional cross task and word identification distraction tasks used by Mack and Rock (1998) and Shapiro, Caldwell, and Sorenson (1997) respectively, the present study engages participants in a mundane face-recognition task.

In the present study, meaningfulness of a critical stimulus is manipulated under conditions of high ecological validity to gain insight into its influence on the capture of attention in visual scenes. The independent variable is the level of meaningfulness of the critical stimulus. A high level of meaningfulness is operationally defined in the experimental group as the presence of a participant's first name in the periphery of a visual scene, whereas a low level of meaningfulness is operationally defined in the control group by the presence of a common noun in the same portion of the scene. The dependent variable is whether or not the participant is able to explicitly identify the change made to the scene. With results from Mack and Rock (1998) and Shapiro, Caldwell, and Sorenson (1997) in mind, I hypothesize the more meaningful

stimulus, the participant's name, will attract more attention and, therefore, will be noticed more frequently than the less meaningful stimulus, the common noun *house*.

Method

Participants

The participants were 33 male and 57 female undergraduate students enrolled in an introductory psychology course or an upper level social sciences colloquium. As part of their course requirements for research participation, the introductory psychology students had the option to participate in the present study. Participants taken from the social sciences colloquium were compensated with bonus points for their participation. Participants were required to have normal or corrected vision, have normal motor skills, and consider English their primary language.

Materials

Materials included a Gateway E-series computer, a Gateway VX1130 20" monitor, a Nikon digital camera, a standard table and chair, mouse, and a keyboard. Photographs were edited using Microsoft Paint version 5.1 and saved as 24 bit bitmap images (1024 x 768 pixels) with horizontal and vertical resolutions of 299 dpi. Stimuli were presented using E-prime 1.1.

Stimuli

The stimuli consisted of a fixation slide and five photographs separated by five mask slides. The fixation slide was presented for 1500 ms, the photographs for 1200 ms, and the mask slides for 300 ms. The stimuli were presented twice, first as a practice block and then as an experimental block. All participants viewed the same practice block of stimuli before viewing the experimental block.

Because the participant was involved in a facial recognition task as a distraction, the five photographs depicted an actor displaying different facial expressions in each photograph (See Appendix A for examples). In the practice block, the photographs depicted the actor displaying anger, happiness, sadness, happiness, and disgust respectively. In the experimental block, the photographs depicted the actor displaying happiness, anger, disgust, happiness, and sadness respectively. The only portion of the photographs that differed, with the exception of the critical change, was the man's facial expressions. Location, background, lighting, and posture were held constant.

The critical change was made to the word printed on the actor's t-shirt. In all photographs except the final photograph of the experimental block, the critical photograph, the word on the actor's shirt was *time*. The word on the shirt was different, or changed, in the critical photograph. For the control group, the word on the actor's shirt in the critical photograph was *house* while, for the experimental group, the word was the participant's first name. For all photographs, the word was superimposed on the shirt using the text box feature in Microsoft Paint.

Procedure

Participants signed up on-line prior to arriving at the laboratory. All participants with name lengths shorter than 4 letters or longer than 6 letters were assigned to the control condition, and all other participants were assigned to the experimental or control condition randomly. If the participant was assigned to the experimental condition, the experimenter would create the necessary stimulus slide using the software mentioned above before the participant's arrival.

After signing the informed consent, the participant was directed to follow the instructions on the computer screen (For a complete copy of the instructions, see Appendix B). The

instructions included a description of the stimuli, which included a description of the content of the photographs, the number of photographs that would be presented, and the duration they would be displayed. They were also informed that the emotional expression on the actor's face would change in each picture. This was followed by an explanation of the participant's task, which was to click the left mouse button as soon as he or she saw a photograph in which the actor was displaying a happy facial expression.

Next the participant began viewing the stimuli. After completing the practice block, the computer output two feedback slides indicating whether or not the participant had responded to the happy expressions. These were followed by a refresher set of instructions before the completion of the experimental block and the presentation of its relevant feedback slides.

The participant was then asked whether or not he or she noticed any changes in the photographs with the exception of the actor's facial expressions. If the response identified a change other than the critical change, the experimenter continued to ask the participant if he or she had noticed any other changes until the response was negative or the critical change had been identified. The experimenter then documented the response and debriefed the participant.

Results

Results from a chi square test indicate that there was a significant difference between the experimental and control groups with respect to their ability to explicitly identify the change which was made to the words on the actor's shirt (X^2 (1) = 9.074, $p < .005$; see Figure 1). Participants in the experimental group, who were presented with the experimental block of stimuli in which the word on the actor's shirt changed from *time* in the first 4 photographs to the participant's first name in the final photograph, were able to identify the critical change more frequently than those in the control group, who were presented with the experimental block of

stimuli in which the word on the actor's shirt changed from *time* in the first 4 photographs to *house* in the final photograph. In the experimental group 34 of the 45 (75.6%) participants were able to identify the critical change while in the control group only 20 of the 45 (44.4%) participants were able to identify the critical change.

It is interesting to note a significant condition by sex of participant interaction (Control: X^2 (1) = 5.993, $p < .05$; Experimental: X^2 (1) = .062, $p = .803$; see Table 1, Figure 2). In the control condition, in which the word on the actor's shirt changed from *time* to *house*, change blindness rates for the males were similar to those experienced in the experimental condition, in which the name on the actor's shirt changed from *time* to the participant's first name; the opposite occurred for the female participants. In the experimental condition 14 of the 19 (73.7%) males were able to explicitly identify the change and in the control condition 10 of the 14 (71.4%) males were able to do so. On the other hand, in the experimental condition 20 of the 26 (76.9%) females were able to explicitly identify the change while in the control group only 10 of the 31 (32.3%) females were able to do so.

Discussion

The purposes of the present study were to (1) determine whether or not the "cocktail party phenomenon" (Moray, 1959) exists in vision, (2) determine whether or not the meaningfulness of a critical stimulus mediates its ability to attract attention, and (3) extend the work of Mack and Rock (1998) and Shapiro, Caldwell, and Sorenson (1997), who found that a person's name is significantly more likely to be noticed than other less meaningful stimuli using the inattentional blindness and the attentional blink paradigms respectively, using a change blindness procedure with a higher level of ecological validity. It was expected that results from the present study would (1) provide evidence indicating the existence of the cocktail party effect

in vision, (2) identify meaningfulness as an important attribute of critical stimuli, and (3) extend the aforementioned related work, demonstrating the visual cocktail party effect using a highly ecologically valid change blindness procedure.

Results from the present study indicate that the cocktail party effect exists in vision under realistic viewing conditions. After participating in a facial recognition task in which participants viewed two sets of five static photographs of a single actor, they were significantly more likely to notice a change to the wording on the actor's shirt when the critical stimulus was their first name than when it was the common noun *house*. More than 75% of participants were able to explicitly identify the critical change when the critical stimulus was their first name compared to just over 44% who were able to explicitly identify the critical change when the critical stimulus was the common noun *house*.

Results showed a condition by sex interaction, which indicates that only women experienced the visual cocktail party effect. According to the results, men were able to explicitly identify the critical change when the critical stimulus was their name (74%) only slightly more often than when the critical stimulus was the word *house* (71%). In contrast, females were better able to identify the critical change when the critical stimulus was their name (76%) as opposed to the word *house* (32%), demonstrating the visual cocktail party effect.

Overall, it seems as if the participants' first names had a special capacity to divert their selective attention away from the facial recognition task at hand to the critical change made to the wording on the actor's shirt. Potential explanations and interpretations of this occurrence are numerous. These results support the idea that a system running parallel to conscious visual perception has the capacity to identify meaningful stimuli and, in turn, draw visual attention to

them. With this additional visual attention, meaningful stimuli such as names are then placed into working memory and potentially long term memory, facilitating later recall.

Results from the present study serve as evidence that meaningfulness is an important attribute of critical stimuli. In the present study, the participant's first name represented a highly meaningful stimulus while the common noun *house* represented a less meaningful stimulus. As mentioned earlier, results indicated that, with respect to meaningfulness, the high-level stimulus attracted significantly more attention than the low-level stimulus. Future research utilizing change blindness and inattentional blindness paradigms should consider meaningfulness as an important attribute of critical stimuli.

Like those of Mack and Rock (1998) and Shapiro, Caldwell, and Sorenson (1997), results from the present study add to the growing evidence supporting the existence of a visual cocktail party effect. This is particularly important because the present study uses a different paradigm—namely induced change blindness—and a more ecologically valid procedure than Mack and Rock and Shapiro et al.

Mack and Rock (1998) found evidence for the visual cocktail party effect using an inattentional blindness procedure in which the critical word appeared in a scene in which no words had previously been displayed. Although the present study is modeled similarly to Mack and Rock (1998), it is different with respect to how the critical stimulus is added to the scene and its level of ecological validity; instead of adding the critical word to a low ecologically valid scene, a change is made to an existing word in high ecologically valid scene.

Shapiro, Caldwell, and Sorenson (1997) investigated the existence of the visual cocktail party effect with the attentional blink paradigm; the "attentional blink" (Raymond, Shapiro, & Arnell, 1992) refers to people's inability to perceive a probe, or subsequent target, when it is

placed within about 100 and 500 ms of a previously presented target in a rapid serial visual presentation. Because of the rapid presentation of stimuli, the attentional blink procedure forces participants to identify targets quickly, with slides presented for as little as 60 ms. In contrast, in the present study slides were presented for a lengthy 1.2 seconds, and participants were still often unable to detect the change.

The present study could have a variety of implications. First, it could serve as a springboard for research in visual encoding and memory. Results indicating the presence of a visual cocktail party effect undoubtedly lead to questions regarding why we are able to encode and recall more meaningful stimuli more easily than less meaningful stimuli in particular situations. Second, the present study provides information that enables us to better understand what stimuli qualities facilitate the capture of attention, especially in change blindness tasks. Recently Simons and Ambinder (2005, p. 45) called for such research stating: "more research is needed to establish what draws attention to some scene elements and not others in a change-detection task." Third, the present study provides a useful mold for change blindness stimuli that could be used in future research. This is the first time a facial recognition task has been used in conjunction with a wording change on an actor's clothing to induce change blindness.

One limitation of the present study was the absence of differentiation between the role of familiarity and meaningfulness of the critical stimulus in attracting attention. Based on previous findings by Mack and Rock (1998), it was assumed that meaningfulness was responsible for the visual cocktail party effect. Although in subsequent studies Mack and Rock (1998) found that familiarity alone was not enough to produce significant differences in change detection rates, it is possible that familiarity is confounded with meaningfulness. In most cases, a person's first name is more familiar to them than the word *house*, which could explain the decreased amount of

change blindness experienced by those in the experimental condition, in which the participant's first name acted as the critical stimulus.

A second limitation pertains to the facial expression displayed in the critical slide. In all cases, participants saw an actor displaying a sad facial expression in the critical photograph. While this is a minor flaw, in the future the facial expressions displayed in the final photograph should be counterbalanced to eliminate any possible effect facial expressions may have.

Because the present study used both a novel paradigm and novel stimuli to produce its desired results with a highly ecologically valid procedure, it should be considered for future use in similar situations. Taken together, the new paradigm and stimuli produce a desirable amount of variability for induced change blindness studies. The following are just a few of many more specific opportunities for further research related to the present study.

First, future research could be conducted in response to the first limitation of the present study, investigating whether the visual cocktail party effect is due to familiarity or meaningfulness. The only necessary change to the procedure would involve the critical stimuli; instead of *house* and the participant's first name, perhaps more equally familiar, yet unequally meaningful stimuli could be used. Mack and Rock (1998) evaluated the role of familiarity in critical stimuli using the word pairs *the* and *tie* and *and* and *ant* as critical stimuli using the line-length-judgment task mentioned above, but found insignificant but large differences in both cases. It is important to note the low level of ecological validity inherent in their task as well as a relatively small sample size of 20. Future research should further explore the role of familiarity in change blindness stimuli.

Second, the facial expression recognition task accompanied by a wording change in the periphery provides a model for future change blindness and inattentional blindness researchers

interested in investigating the interaction between emotions and selective attention. In the future, studies could be done investigating the possibility that the emotion displayed by the actor in the photographs has an effect on whether or not people are able to detect changes in the periphery of the scene. Also, the task at hand could be reversed, with the participant engaged in a word recognition task instead of a facial expression recognition task, to investigate whether or not various attributes of facial expressions mediate change blindness, as meaningfulness of a critical word does in the present study.

Finally, one notable result that remains unaddressed is the significant interaction between participant sex and condition. It is important to note that, in the confines of this paper, this difference has been interpreted as evidence supporting the existence of the visual cocktail party phenomenon in women, implying that the high level of meaningfulness inherent in women's first names has a special ability to grab their visual attention. While all evidence presented in the present paper supports this explanation, one could just as easily interpret the severe change blindness of the women in the control group in the opposite manner and argue that the word *house* fails to grab the women's visual attention. Future research could investigate the possibility that there may be another underlying effect besides the visual cocktail party effect at work in this particular situation. In either case, replication and the potential explanation of this isolated effect could have extensive implications.

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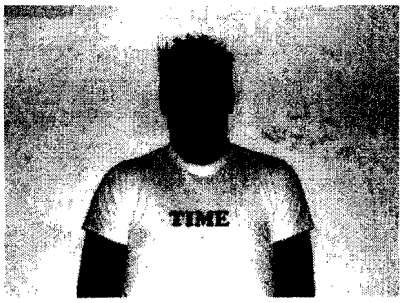
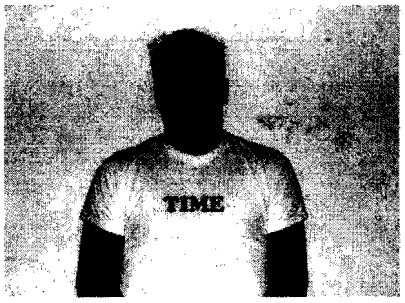
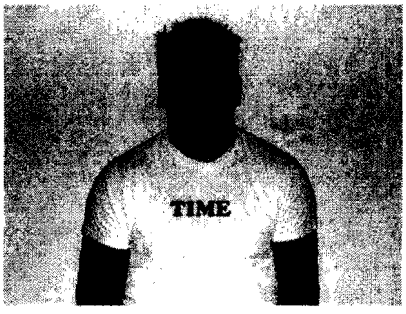
Appendix A







Appendix B

Practice Block

Instructions 1:
This experiment is set up to run automatically. To advance to the next screen or to start the experiment, just click the LEFT MOUSE BUTTON.

Instructions 2:
When the experiment starts, you will see a sequence of FIVE photographs, all of one person. Each photograph will be displayed for only a second. The emotional expression on the person's face will change with each photograph.

Your Job: Click the LEFT MOUSE BUTTON once as soon as you see a photograph in which the person has a HAPPY expression.

Note: There may be more than one photograph in which the person is displaying a happy expression, so be prepared to respond more than once.

Instructions 3:
Trial 1
Remember:
1. When the experiment starts stare directly at the small cross in the center of the screen
2. Shortly, the FIVE photographs will appear in sequence, one-by-one, for about 1 second each.
3. Click the LEFT MOUSE BUTTON once as soon as you see a photograph of a HAPPY expression.
4. Click the LEFT MOUSE BUTTON to start now!

Participant views practice block.

Feedback:
Great! You responded to the 1st [or 2nd] HAPPY expression!
[reaction time]
[percent correct]

Or:
Uh oh! You did not respond to the 1st [or 2nd] HAPPY expression!

Experimental Block

Instructions 1:
Trial 2
Remember:
1. When the experiment starts stare directly at the small cross in the center of the screen
2. Shortly, the FIVE photographs will appear in sequence, one-by-one, for about 1 second each.
3. Click the LEFT MOUSE BUTTON once as soon as you see a photograph of a HAPPY expression.
4. Click the LEFT MOUSE BUTTON to start now!

Participant views experimental block and receives feedback.

Table 1

Sex by Condition Interaction

Experimental/Control Group				Did the subject notice the change?		Total
				Yes	No	
Experimental	Sex	Male	Count	14	5	19
			% within Sex of participant	73.7%	26.3%	100.0%
		Female	Count	20	6	26
			% within Sex of participant	76.9%	23.1%	100.0%
	Total		Count	34	11	45
			% within Sex of participant	75.6%	24.4%	100.0%
Control	Sex	Male	Count	10	4	14
			% within Sex of participant	71.4%	28.6%	100.0%
		Female	Count	10	21	31
			% within Sex of participant	32.3%	67.7%	100.0%
	Total		Count	20	25	45
			% within Sex of participant	44.4%	55.6%	100.0%

Figure 1

Were Participants Able to Identify the Critical Change?

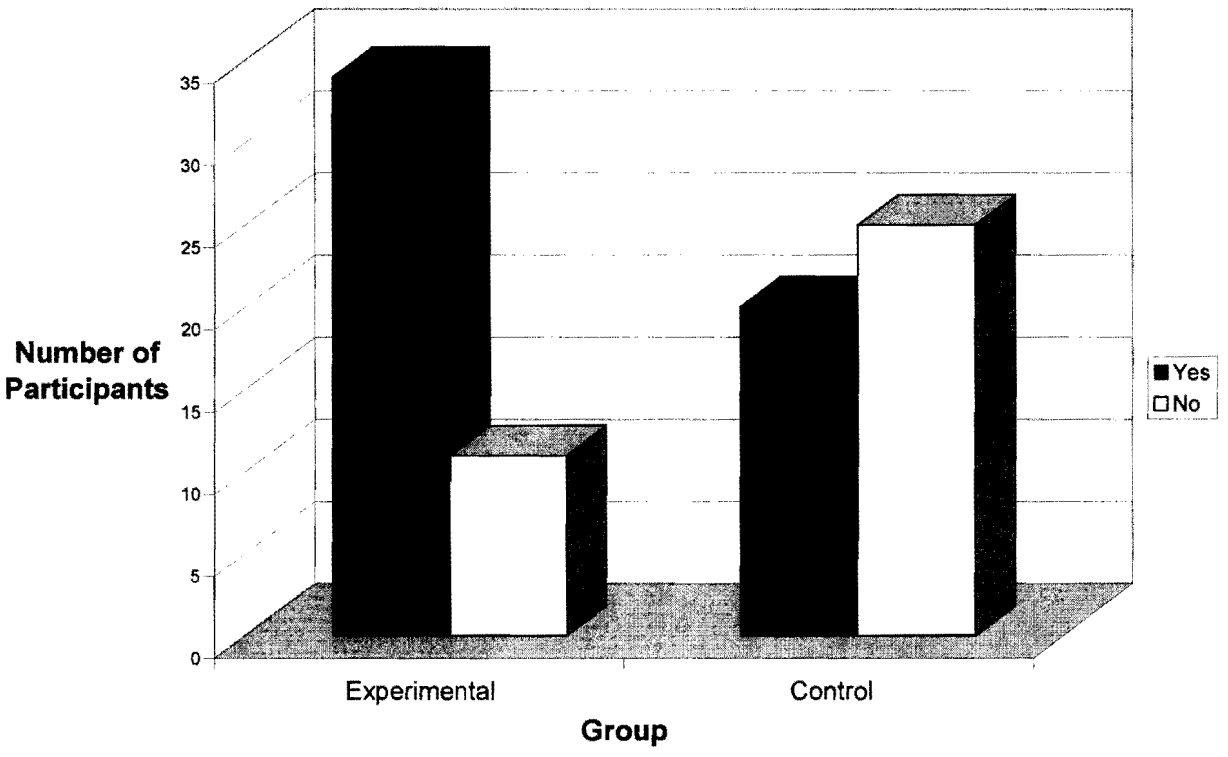


Figure 2

Were Participants Able to Identify the Change?

(Sex by Condition Interaction)