

Exploring the effect of familiarity and perceptual load on change blindness in real-life scenarios.

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Abstract

Change blindness is the failure to notice when a change occurs in one's surroundings. As change blindness research continues to evolve, this study aims at contributing to the understanding of change blindness and attention as a whole, by conducting an ecologically valid study. In 6 experimental groups, familiarity and perceptual load were manipulated in order to observe the effects these factors may have on change detection. 66 participants were subjected to one of the conditions (resulting in 11 per experimental group) and virtually interacted with an RA who would eventually be swapped with another individual. Results from this study concluded that 79% of test subjects experienced change blindness and failed to detect the RA switch. There were no significant differences in change blindness among test conditions, leading us to believe that the effect of perceptual load on change detection may have a "tipping point" which when reached, would cause perceptual load to have a decreased impact on change blindness. This study may also hint that longer breaks in between the change may have a positive correlation with change blindness frequencies.

Introduction

Attention is a big part of the human experience. We've all heard how important it is to pay attention or have been in situations where a lack of focus has gotten us into some trouble. As much as we can try to give others our undivided attention, there are some real limitations in our ability to keep our sustained attention focused on one thing. Among some of these limitations is change blindness, which is defined as the failure to notice when a large change occurs in one's environment (Murphy & Murphy, 2018). Thus, the purpose of this summer project was to explore some of the factors that may be involved within change blindness and to also

note/observe the extent that said factors influence change detection. The main interest of this study was to examine familiarity and perceptual load in the context of change blindness.

Early Change Blindness in Lab Tasks

A majority of change blindness research takes place in lab settings. The mechanisms frequently used to explore this phenomenon are the flicker and forced choice detection paradigm (Simons, 2000). Using the flicker method, researchers would alternate between an original and modified image, while placing a blank screen between alternations, and participants were supposed to press a button when they detected a change. For the forced choice detection paradigm, participants would view both the altered and modified image once before responding and identifying the change. In both cases, observers were told that a change would occur. However, for the flicker paradigm, individuals were often unable to detect the change during the first cycle - or even up to a minute - of alternation (Rensik et al as cited in Simon, 2000, p. 3). These tasks essentially showed the presence of change blindness even when individuals are notified that a change will materialize.

But What about Change Blindness in Everyday Situations?

In more ecologically-valid studies, change blindness has been observed by exposing individuals to a large change in real world scenarios. A well-known and early example of this is a study conducted by Simons and Levin (1998). This study involved a research assistant (RA) posing as a student looking for directions; midway through speaking with college students, two confederates holding a door walked between the student and the RA. Unbeknownst to the students, a second, similar-looking RA was hiding behind the door, allowing the two RAs the opportunity to swap positions. The second RA then continued the conversation with the student,

pretending to be the first RA. Of the fifteen participants in the study, seven of them failed to notice this change, and thus roughly 50% experienced change blindness. This finding, while surprising, is not an isolated incident. Another study (Attwood et al., 2018) observed a change blindness rate of 42% when participants viewed pairs of slightly different artifacts in a museum. With these examples showing how change blindness can translate from lab-based scenarios into real-life settings, it becomes more and more important for us to understand the parameters involved in this phenomenon. Thus, in the current investigation, we manipulated two factors that we believe may modulate levels of change blindness, namely the amount of visual clutter, and the degree to which the participant and RA had a chance to get to know each other.

Visual Clutter, i.e., Perceptual Load Theory

As change blindness studies became more common, new theories were being used to aid with the understanding of change blindness. Among the theories considered, is the perceptual load theory. Perceptual load is defined as the amount of information involved in completing a task (Macdonald & Lavie as cited in Murphy & Murphy, 2018, p. 656). Therefore, it can be manipulated by toying with factors such as the amount of material involved in the task or the complexity of the materials. As an example, a cluttered background would be of higher perceptual load than a background with less clutter. The perceptual load theory then states that increasing perceptual load leads to a decreased ability to notice distractors. As the brain attempts to process more information, “distractors” are then categorized as less important to focus on and therefore are more likely to go unnoticed (Lavie, 1995; Forster & Lavie, 2008; Lavie & De Fockert, 2003; Murphy & Greene, 2016a; Murphy & Greene, 2017a as cited in Murphy & Murphy, 2018, p.656).

The Effect of Familiarity on Attention

To support why one of the aims of this project was to explore familiarity in the context of change blindness, one can turn to work by Pieters et al. (2002) and Flowers et al. (1981). Pieters et al. (2002) asked 119 participants to browse through magazines with 58 advertisements. Using infrared eye-tracking to collect eye fixation data as well as a memory task to evaluate memory, they found that original and familiar advertisements attracted the largest amount of attention. Flowers et al. (1981) asked 90 participants to view letter sequences for a specific amount of time. Their data led to the conclusion that familiarity may play a role in directing attention to a particular spatial area (Flowers et al., 1981). Therefore, from these results, we can infer that familiar objects or people may capture the participant's attention, which may in turn cause rates of change blindness to decrease.

Using Perceptual Load Theory to Investigate Change Blindness

Murphy & Murphy (2018) is one of the only investigations to date to employ perceptual load theory to investigate rates of change blindness. Their study manipulated perceptual load by presenting some participants with an area of higher clutter (using pictures, posters etc) and the other participants with an area of little to no clutter. Participants were brought into a room where they submitted their consent forms to participate in a "personality test". The first RA then said "just one second" before moving behind a divider and being replaced with the second RA. The subjects were then interviewed in a second room and questioned in order to determine whether or not they noticed the change in RA identity. First, a researcher would ask if anything unusual occurred. If participants said yes, they'd be asked to describe it and unless they mentioned the swap, they would be asked the second question. The second inquiry was then if there was

anything unusual about the researcher. Once again, if they didn't mention the swap they'd be probed further. The final question was simply if they'd noticed the swap. If at any time, the participants mentioned the change in researcher, they'd be debriefed (Murphy & Murphy, 2018).

Of the 103 participants, 63, or roughly 61%, detected the change, which meant they did not experience change blindness (Murphy & Murphy, 2018). Of note, the results revealed a difference in rates of change blindness based on the perceptual load manipulation; while 71% of individuals detected the change in the low load condition, only 52% detected the change in the high load setting. These results support the perceptual load theory by demonstrating how increased clutter (load in this scenario) leads to an increased ability to ignore the visual distractors, resulting in more instances of change blindness. To date, no one has investigated the role of familiarity on change blindness, nor have they combined the two manipulations.

The Current Study

While Murphy and Murphy's (2018) study was a novel, important investigation, questions remain as to the nature of change blindness. Thus we aimed to validate and extend the work done by Murphy and Murphy (2018) by both investigating the effect of perceptual load on change blindness, and determining whether the degree/quality of interaction between the RA and participant affects rates of change blindness. Due to the global COVID-19 pandemic, we modified the original study design by conducting our study online, using a virtual video chat platform. This additional change will allow us to ascertain whether attention to a virtual person is similar to attention to someone in-person. Note, once data collection can resume in-person, we will conduct the same study in-person to be able to experimentally determine whether attention to others varies across contexts.

Drawing from perceptual load theory, we hypothesized that deeper and more meaningful interactions between the RA and participants in lower load conditions will lead to less change blindness and more change detection. By focusing on the quality of interaction as one of the main variables in this study, one can understand when individuals are less likely to be filtered out of people's attention along with other “distractors”. The virtual aspect of the experiment also provides a unique insight into what our brain prioritizes within computer screens and computer tasks, which is very valuable information for COVID-19 virtual learning and working.

Methods

Participants

66 participants of various ethnicities, aging from 18-34 participated in this study. Among the 66, 17 were males while the rest identified as females. These participants were all recruited from online advertising (U of A undergraduate research initiative, U of A student listserv, social media) and were compensated with a \$5 gift card for 30 minutes of their time.

Apparatus & Stimuli

The research assistants in this study used an HP laptop to conduct the video chat through google meets. Invitation links were sent to participant emails where they'd simply click to join. Analysis also shows that among the participants, 63/66 used laptops for the video chat. 2/66 used phones (one of which used a phone for the chat and laptop for questionnaires) and 1/66 used a desktop. All questionnaires were delivered through google forms and data about change detection was recorded on Excel.

Design & Procedure

The study was a between-subjects design and consisted of a 2 (perceptual load; low versus high) by 3 (familiarity; baseline versus moderate familiarity versus higher familiarity). This meant that each individual only completed 1 of the 6 possible combinations of factors. Perceptual load was manipulated by changing the amount of clutter in the background. The low load condition consisted of a plain white wall as the background in the video chat, whereas the high load condition consisted of an open closet, filled with clothes and some suitcases. The level of familiarity was manipulated by having varying levels of conversation between the RA and participant before the swap. In the baseline/control group, there was little to no interaction between the RA and participant before the RA swap. The test subject would simply join the google meeting and spend 4 minutes filling out a form with questions such as “what is your favourite movie?” and “what is your biggest regret?”. The purpose of the baseline group was to test if simply having conversation decreases the likelihood of experiencing change blindness, or if more meaningful discussions are necessary as well. In the light conversation group, participants and the RA had a 4-minute conversation about “light” topics such as the weather and their favourite TV shows. In the deep conversation group, participants and the RA had a 4-minute conversation about deeper topics such as life goals and regrets. RA order was counterbalanced, so that exactly half of the time each RA started the study or ended the study.

The procedure of the study was as follows: after the 4 minutes with the first researcher, the RA then faked a knock and left the room briefly. This allowed the second researcher to enter the room and continue the study with the participants as if nothing had changed. The second researcher then provided the test subjects with online questionnaires (via google form). After the questionnaires had been completed, participants were then asked 3 questions. The first was if

they had noticed anything strange, followed by if they had noticed anything unusual about the RA. Lastly, they were outright asked if at any time during the study, it seemed like there was a swap in the RA. The three questions were similar to those used by Murphy & Murphy (2018), in order to ensure that participants were being truthful about their observations. Afterwards, participants were then debriefed and compensated and their data was collected in an excel spreadsheet.

Results

The 66 participants were split equally across the 6 experimental conditions. Unlike prior work, an overwhelming number of participants experienced change blindness (52 out of 66, or 79%), with only 21% noticing a change in RAs. This is in contrast to the results from Murphy & Murphy (2018), who found 61% noticed the change in RAs.

As there were only 11 participants in each group, we did not anticipate finding any significant results, however, we still conducted Chi-squared analyses to determine whether the proportion of individuals who experienced change blindness varied across our experimental manipulations. We found no difference between rates of change blindness as a function of load [$\chi^2(1)=0$, $p=1$; low load: 26/33; high load: 26/33] or familiarity [$\chi^2(2)=1.27$, $p=.53$; none: 16/22; light: 19/22; deep: 17/22].

Discussion

The main goal of this project was to find support for the hypothesis that change blindness would occur less with higher amounts of familiarity and low load. We tested 66 participants, and

found change blindness rates of 79%, with no significant modulation of change detection rates across our manipulations of load and familiarity. This is in contrast to prior work by Murphy & Murphy (2018), and could be due to one or more of the three reasons, discussed below in turn.

One convincing explanation for these findings may be due to the specific methods used for the current study. Namely, and in contrast to prior work, the entirety of the study was conducted online, which essentially led to less experimental control and more variability of the participants' environment. Certain participants may have had a lot of distractions in their homes, negating our perceptual load manipulation and resulting in less focus/engagement with the researcher and therefore more change blindness. One can suspect that due to variability in participant environments and the virtual aspect of this study, there were higher levels of distraction and or load than would occur in an in-person setting. Therefore, the ability for subjects to be exposed to “low load” conditions was minimized. However, regardless of the load imposed by several factors, this experiment was designed to create an area that surely had higher perceptual load than the other. The fact that increased perceptual load didn't have a statistically significant impact on change blindness could indicate that once a certain level of high load is reached, increasing said load will no longer affect results. Generally speaking, this study could be used to hint that the effect of perceptual load on change blindness reaches a maximum and then plateaus (see Figure 1). This interpretation would be supported by the perceptual load theory as essentially, increasing load increases change blindness until a certain maximum (tipping) point.

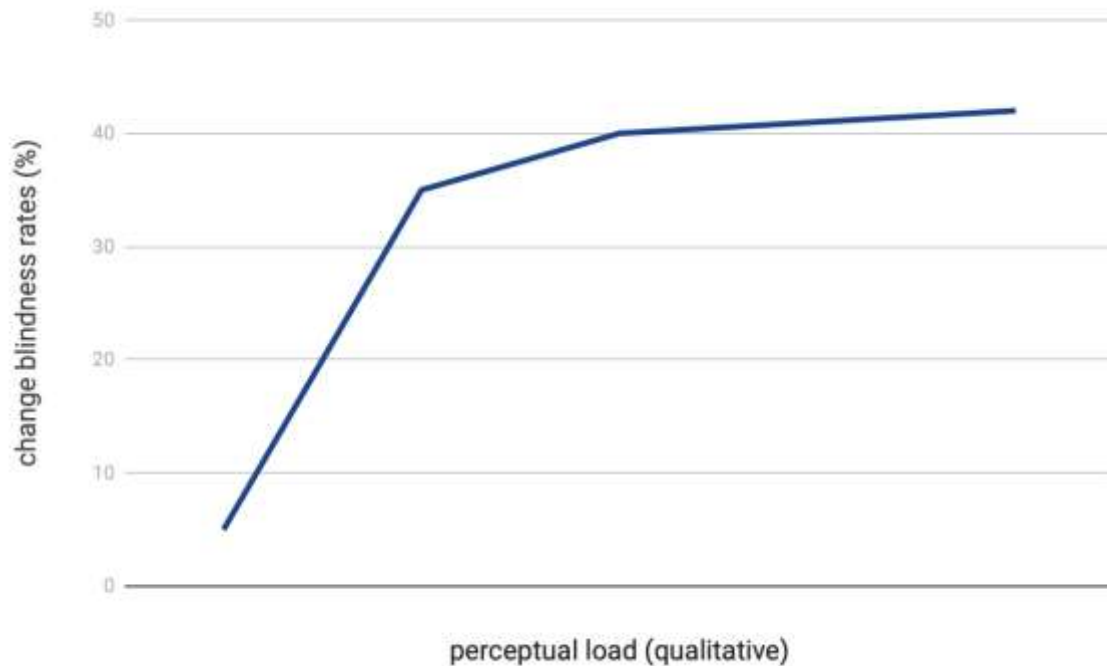


Figure 1: A visual description of what a “tipping point” for perceptual loads effect on change blindness would depict. As shown in the figure, there's a positive correlation between load and change blindness, until a certain point where increasing the load has minimal effect on change blindness rates.

A second potential explanation for the high levels of change blindness could be screen size, other computer specs or volume. These factors would affect how clearly participants could see and identify the researchers. However, all participants did have to provide information as to what device they used during the study. It was found that all (with the exception of one phone user) participated with laptops/desktops with an average screen size of 14 inches. In addition, 65/66 participants didn't mention anything about sound or sound quality issues.

A third potential reason could be due to the length of time in which the change occurred. Rather than inconspicuously introducing the change, as in lab-based tasks, in the current study

there was a break before the swap occurred. When using the lab-based flicker method, the change is noticeable without the presence of the flicker, however, introducing the flicker reduces change detection (Noë, Pessoa, & Thompson, as cited in Murphy & Murphy, 2018, p.655). A previous experiment by Rensink, O'Regan and Clark (2000) consisted of a computer task where 10 individuals were shown images and asked to press a key when they noticed a change. Within this 2000 study, it was found when the blank/break was presented for 40 milliseconds rather than 180 milliseconds, individuals were able to detect the change at faster response rates. This data was also compared with detection rates without the presence of an interruption. Overall, Rensink, O'Regan and Clark (2000) found that although change blindness was present, response rates for change detection decreased with both the presence and longer duration of the blank. In the present study, the break between the change in researcher typically lasted 30 seconds to a minute. Compared with 180 milliseconds, this timing is significantly larger. If change detection follows the previously described trend (decreasing with longer blank duration), this larger break could greatly account for the low amounts of change detection.

The main takeaways from this experiment are as follows. In this study, evidence was found to support that in real life situations, a larger break results may be the cause of increased change blindness and perceptual load may have a “tipping point” or maximum ability to impact change detection rates. After this tipping point has been reached, one can predict that perceptual load will have little to no effect on change blindness rates.

Overall, this study did provide insight into change blindness in real world situations. By placing individuals in common situations (a google meet and online questionnaires) which have become more prevalent in the COVID-19 reality, we're able to witness what our brain prioritizes and dismisses within the context of familiarity/interaction and perceptual load. It's been shown

that individuals may be more susceptible to change blindness (especially in virtual conditions) than we unconsciously assume. Although the hypothesis for the study wasn't supported by results found, due to the limited number of participants per experimental group, these findings cannot necessarily be extrapolated to comment on the perceptual load theory as a whole. In order to fully explore the familiarity factor, future studies should have experimental groups with a larger number of participants. In addition, in-person experiments should be aimed for in order to have greater control over variables and to test if whether or not the virtual aspect of this study was the cause of the deviation from expected results. Another interesting route for future research is to explore the so-called "tipping point" of perceptual load. Finding more support/opposition for its existence could influence how we understand attention as a whole.

Acknowledgements

A big thank you to Dr. Dana A. Hayward of the University of Alberta who greatly assisted with proposals, planning, writing, data analysis and more. Another thank you to Salma Saeed who acted as one of the two RA's. Finally, appreciation goes out to the Laidlaw Foundation for enabling the development and execution of this project.

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