Change Blindness Blindness: The Metacognitive Error of Overestimating Change-detection Ability

Daniel T. Levin, Nausheen Momen, and Sarah B. Drivdahl
Kent State University, Kent, OH, USA

Daniel J. Simons
Harvard University, Cambridge, MA, USA

Recent research has demonstrated that subjects fail to detect large between-view changes to natural and artificial scenes. Yet, most people (including psychologists) believe that *they* would detect the changes. We report two experiments documenting this metacognitive error. In Experiment 1, students in a large General Psychology class were asked if they thought they would notice the change in four different situations previously tested by Levin and Simons (1997) and Simons and Levin (1998). Most claimed that they would have noticed even relatively small changes that real observers rarely detected. In Experiment 2, subjects were tested individually and half were asked to predict whether someone else would detect the changes. Subjects again overestimated the degree to which changes would be detected, both by themselves and by others. We discuss possible reasons for these metacognitive errors including distorted beliefs about visual experience, change, and stability.

As many of the papers in this issue point out, people fail to detect surprisingly large changes to scenes. Subjects miss the appearance and disappearance of parts of natural and artificial scenes, they are oblivious to changes to the central objects in movies, and they even miss the substitution of one conversation partner for another (e.g. Blackmore, Brelstaff, Nelson, & Troscianko, 1995; Grimes, 1996; Henderson, 1997; Levin & Simons, 1997; McConkie & Currie, 1996; O'Regan, Deubel, Clark, & Rensink, 1997; Pashler, 1988; Phillips, 1974; Rensink, O'Regan, & Clark, 1997; Simons, 1996; Simons & Levin, 1998; for a review see Simons & Levin, 1997). Much of the interest in these findings is obviously based on the sheer size of the changes that go undetected.

Nobody would be interested in failures to notice the slight displacement of a single branch on a tree in the background of a natural scene. In part, this failure would be uninteresting because tree branches can move between views. Similarly, we doubt many psychologists would be interested if subjects missed small changes to object properties such as the disappearance of a small spot of paint on a background wall. What, then, separates small uninteresting change-detection failures from large, interesting ones?

Simons and Levin (1998) proposed a set of heuristics to aid in separating trivial change-detection failures from substantive ones. For example, if pre- and post-change properties instantiate different basic-level labels, then failure to detect the switch might be surprising. Also, if the pre- and post-change images are easily discriminable in side-by-side viewing, then failure to detect the switch would be similarly substantive. Of particular interest here is the final criterion they mentioned. That is, individuals unfamiliar with research demonstrating change blindness should predict successful change-detection. This criterion assumes that people have explicit beliefs about their cognitive and perceptual skills, and that these beliefs are often wrong. Such metacognitive failures reveal potentially dangerous gaps between individuals' estimations of their own abilities and the reality of limited cognitive and perceptual capacity. Here, we document a vast overestimation of change-detection ability. Subjects do, indeed, predict that they would notice changes that we have previously shown to be missed. Thus, we add "change blindness blindness"[1] to the growing list of metacognitive errors documented by cognitive psychologists.

METACOGNITIVE ERRORS IN VISION AND MEMORY

Although a wide variety of metacognitive errors have been reported, comparatively little research has explicitly assessed beliefs about vision. One exception is research demonstrating implicit beliefs in extramission. Many children and adults accept extramissionist explanations of vision (e.g. in order to see, something must leave the eyes) in a wide variety of situations (Winer, Cottrell, Karefilaki, & Chronister, 1996; Winer, Cottrell, Karefilaki, & Gregg, 1996). This finding shows that incorrect beliefs about vision can persist even in the face of the vast amount of experience we have as perceivers.

Other metacognitive errors result from overestimations of cognitive capacity rather than from qualitatively incorrect beliefs. For example, in studies of eyewitness memory subjects traditionally are very confident of their responses (Bothwell, Deffenbacher, & Brigham, 1987; Drivdahl & Zaragoza, 1997; Sporer, Penrod, Read, & Cutler, 1995). Yet, memory research ranging from

---

[1]Thanks to Bill Merriman for suggesting this phrase.

studies of eyewitness memory to flashbulb memories of dramatic events to simple list learning shows little relationship between confidence and accuracy (see for example, Neisser and Harsch, 1992; Roediger & McDermott, 1995).

Our goal here is to document a metacognitive error similar to those discussed above. Beliefs about change-detection ability seem to reflect an overestimate of cognitive/perceptual capabilities. They may also reflect a deeper, qualitatively incorrect understanding of perception based on selective generalization from everyday visual experiences. In Experiment 1, we report the results of a large-scale survey in which subjects almost universally claimed they would notice changes that usually went unnoticed when tested by Levin and Simons (1997) and Simons and Levin (1998). Subjects were shown images taken directly from stimulus materials in the previously mentioned studies, thereby eliminating the possibility that overestimations of change-detection ability were caused by overestimations of the perceptual salience of the actual changes. Experiment 2 replicates and extends this finding by showing that subjects make these overestimates whether they are asked about their own capabilities or those of others. Experiment 2 also examines estimations of short-term memory capacity in a non-visual context to determine if overestimations are limited to change detection in natural scenes.

EXPERIMENT 1

Method

Subjects.   A total of 300 students in a large General Psychology class completed a brief questionnaire and the accompanying consent form in class. Another 26 completed surveys, but did not fill out the form correctly and were not included in the analysis. Response forms gave subjects the option of participating for class credit while having their data excluded from the research data set, and four subjects did so. The actual number of responses recorded for each question is, in three cases, somewhat fewer than 300 (range: 292–297; see Figure 4) due to invalid responses.

Materials.   Four different change-detection scenarios were described. The first three were situations tested in Levin and Simons (1997). In two of these, subjects were asked to imagine that they were watching a movie depicting a conversation between two actresses at a restaurant (for wordings see Appendix). In scenario A, the plates on the table change from red to white across shots. In scenario B, an actress is wearing a large colourful scarf that disappears and reappears across shots. These changes were illustrated with four static frames from the movie (see Figure 1). Scenario C depicted a change from one actor to another across a change in camera position (see Figure 2). Again, subjects were asked to imagine watching a movie in which they saw one actor in a first shot
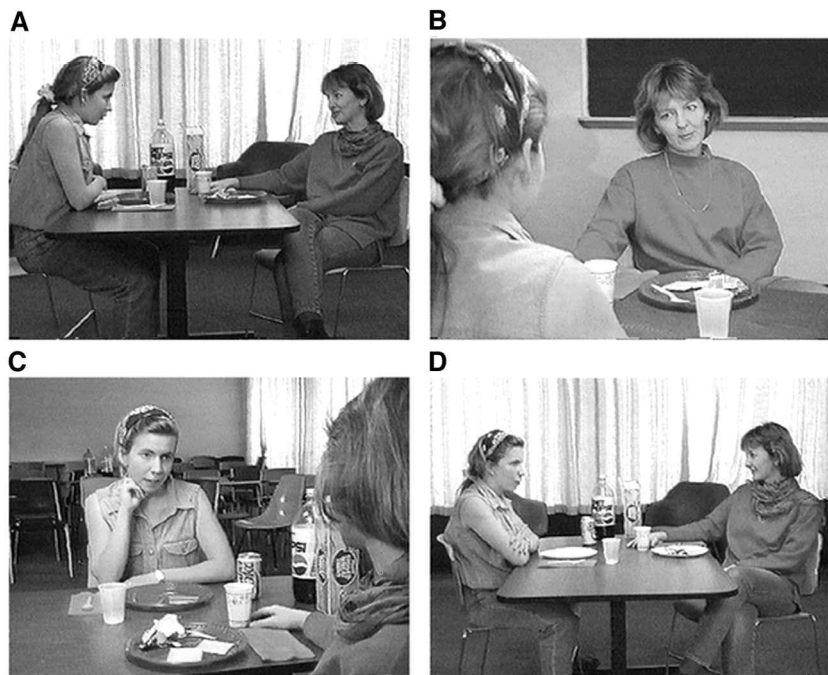
FIG. 1.   Stimulus for change-detection scenarios A and B.

and a second one in the immediately following shot. Scenario D was from an experiment in which one conversation partner was switched for the other during a real-world interaction (taken from Simons & Levin, 1998). In this case, subjects were asked to imagine that they were walking on the Kent campus when they were approached by a lost pedestrian asking directions. While giving directions, they were interrupted by two people carrying a door and during the interruption the pedestrian changed into another person. Subjects were shown a colour overhead depicting the two people (Figure 3).

Pictures were digitized stills from the VHS videos used as stimuli (A–C) or records (D) in the original experiments. They were output from the computer using ink-jet printers and were photocopied (in colour) onto overhead transparencies for presentation to the class.

Procedure.   For each of the four scenarios, the experimenter (DTL) read a description of the change to the class (see Appendix), displayed a colour overhead showing pre-change and post-change views, and then pointed out the change to subjects. Subjects were asked to record whether they thought they would have noticed the change ("yes" or "no") and also to rate their confidence

FIG. 2.   Stimulus for change-detection scenario C.

in their response on a scale ranging from 1 ("Not very confident") to 5 ("Very confident").

Results

Responses and confidence ratings for each of the four scenarios are shown in Figure 4. The majority of subjects indicated they would notice each of the changes. To get a sense of the size of the overconfidence effect, we compared the percentage of subjects indicating they would detect the change with the percentage observed empirically in prior experiments. Across all four scenarios, an average of 11% of subjects actually detected the changes in our previous experiments whereas an average of 83% of subjects in the present survey predicted they would detect the changes, $t(3) = 8.91$, $p = .003$; paired t-test. X^2 tests comparing empirical base rates of change-detection with estimated change detection were highly significant for each of the four scenarios (X^2s = 195 or greater). Confidence ratings were quite high. Of subjects who predicted they would notice each change, mean ratings were 3.88, 3.98, 3.83, and 4.43, for scenarios A, B, C, and D respectively.

FIG. 3.   Stimulus for change-detection scenario D.

Discussion

The results of this survey confirm the intuition that subjects massively overestimate their ability to detect changes. Where 0% of subjects actually noticed each of three changes in Levin and Simons' (1997) movie experiments, 76.3%, 90.5%, and 69.5% of subjects in the current experiment estimated that they would notice the same changes, and where approximately 46%[2] of subjects noticed the person-switch executed by Simons and Levin (1998), 97.6% of subjects thought they would notice if they were in the same situation. Even when the perceptual salience of the change was clearly visible, subjects still confidently overestimated their ability to detect changes.

---

[2]Data are from Simons and Levin (1998) Experiment 2. In this experiment 33% of subjects clearly noticed the change (4/12), and 41% (5/12) clearly did not. Three of the twelve subjects said they did not notice anything unusual when the door passed, but nonetheless claimed to have seen the switch when asked directly. Therefore, the 46% empirical baseline represents the average of the lowest plausible estimate of noticing (the four who clearly noticed the change) and the highest (adding in the three who gave ambiguous responses). In Simons and Levin's (1998) first experiment, 47% of subjects noticed a similar switch.

A: Notice Plates Switch?
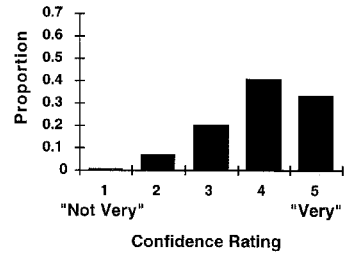Survey:
Y = 76.3%   N = 24.7%
(229/300)

Actual:
Y = 0%   N = 100%
(0/10)
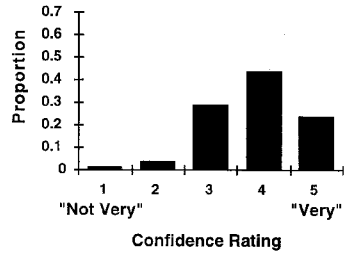
B: Notice Scarf?

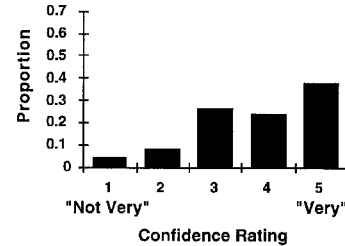Survey:
Y = 90.5%   N = 9.5%
(269/297)

Actual:
Y = 0%   N = 100%
(0/10)

C: Notice Actor Change?
Survey:
Y = 69.5%   N = 30.5%
(203/292)

Actual:
Y = 0%   N = 100%
(0/10)

D: Notice Person Change?

Survey:
Y = 97.6%   N = 2.4%
(288/295)

Actual:
Y = 46%[2]   N = 54%
(5.5/12)

FIG. 4.   Number of change-detection responses and distributions of confidence ratings for Experiment 1.

One potential concern about this conclusion is the baseline of empirically observed change detection we used. In the first three scenarios, none of the 10 subjects tested by Levin and Simons (1997) noticed the change. Therefore, it might be that we are using an artificially low baseline of detection because we chose changes that were particularly hard to detect, and/or we had too few observations to confidently claim 0% detection. Neither of these concerns are particularly acute in the present case because: (a) Subjects could plainly see the exact size of the changes and should have been able to adjust their expectations for the subtlety of the change; (b) the never-detected changes we used were not isolated cases of 0% change-detection in the original reports; and (c) even if the baseline were slightly higher than 0%, overestimates were still far greater.

EXPERIMENT 2

Experiment 2 addresses two potential shortcomings of Experiment 1. First, Experiment 1 was conducted under relatively uncontrolled conditions during the first lecture of a large class. Subjects may not have given their responses full attention. In Experiment 2, therefore, subjects were tested individually or in small groups and were able to proceed at their own rate through a packet containing descriptions and images for each scenario. Second, the initial survey asked subjects to estimate whether they themselves would notice the change. Perhaps the self-reference was responsible for a good part of the overestimate. Subjects consistently over-rate their abilities and positive traits on a wide variety of measures (see for example Alicke, 1985). Therefore, to test the effects of the self reference, Experiment 2 included two conditions, one that asked subjects if *they* would detect the change, and one written in the third person, asking if *someone* would notice the change.

To provide a baseline for more general overestimates of cognitive skills and possible response biases, we also asked subjects to judge whether they thought they could hear 10 digits then reproduce them in a typical digit-span test. If change blindness blindness is a particularly large metacognitive error or is caused by a general tendency to respond "yes" on this survey, subjects will be more accurate in estimating their digit-span than their change-detection ability.

Method

Subjects.   Fifty-four Kent State University students were tested individually or in small groups (*n* = 25 in the Self condition, and 29 in the Other condition).

Materials and Procedure.   The descriptions and pictures from each of the four scenarios from Experiment 1 were converted into testbook format. Subjects were instructed, both verbally and in writing, to "Imagine each of the situ-

ations" and to consider whether they would notice any of the changes described. Subjects read a scenario and then turned the page to view a picture of the change. After seeing the picture, they judged whether they would notice the change and rated how confident they were in their judgement (7-point scale). Responses were recorded on a separate response sheet.

Two different packets were created. In the Self condition, the questions referred directly to the subject, asking subjects "if you would notice ...". In the Other condition, subjects were asked to image someone perceiving the scene, and then were asked "if he/she would notice ..." (see Appendix). For each subject or group of subjects, the scenarios were pseudo-randomly shuffled.

In addition to the four scenarios from Experiment 1, a scenario was created which asked subjects to imagine they (or someone else) were having their digit-span measured (see Appendix). The response form asked them to indicate whether they would have a digit-span of at least 10 items and to rate how confident they were in their response.

Results and Discussion

Subjects again overestimated their ability to detect changes. Across the four test items, subjects indicated they would notice 3.20 of the changes (compared to 3.34 changes in Experiment 1). Figure 5 compares estimates for each of the items in Experiments 1 and 2.

The self/other manipulation had little effect on the size of the overestimates. Subjects in the Self condition indicated they would notice 3.4 of the changes, whereas subjects in the Other condition indicated a person would notice 3.0 of the changes, $t(52) = 1.509$, $p = .137$.

Confidence ratings were again quite high. Mean ratings among subjects who indicated they would notice each change were 4.5, 5.3, 5.6, and 5.8 (on a 7-point scale) for scenarios A (plate), B (scarf), C (actor), and D (door). 40.74% of subjects predicted digit-spans of 10 or more, an achievement that actually characterizes approximately 0.45% of subjects (based on mean of 6.6 and SD of 1.13 reported by Wechsler, 1952). Estimates of success were greater in the Self condition (64%) than in the Other condition, 21%; $X^2(1) = 10.43$, $p < .005$. Table 1 presents comparisons between the digit-span scenario and the change-detection scenarios. Overall, estimates of change-detection success for scenarios A, B, and C were significantly higher than estimates in the digit-span task. In the Self condition, estimates for the scarf scenario (B) were more optimistic than for the digit-span scenario, and in the Other condition estimates for all three change-detection scenarios were more optimistic. No comparison was made between scenario D and the digit-span scenario because they have different empirical base rates.

Overall, Experiment 2 closely replicates Experiment 1 and further reveals large overestimations for both the Self and the Other conditions. In addition,
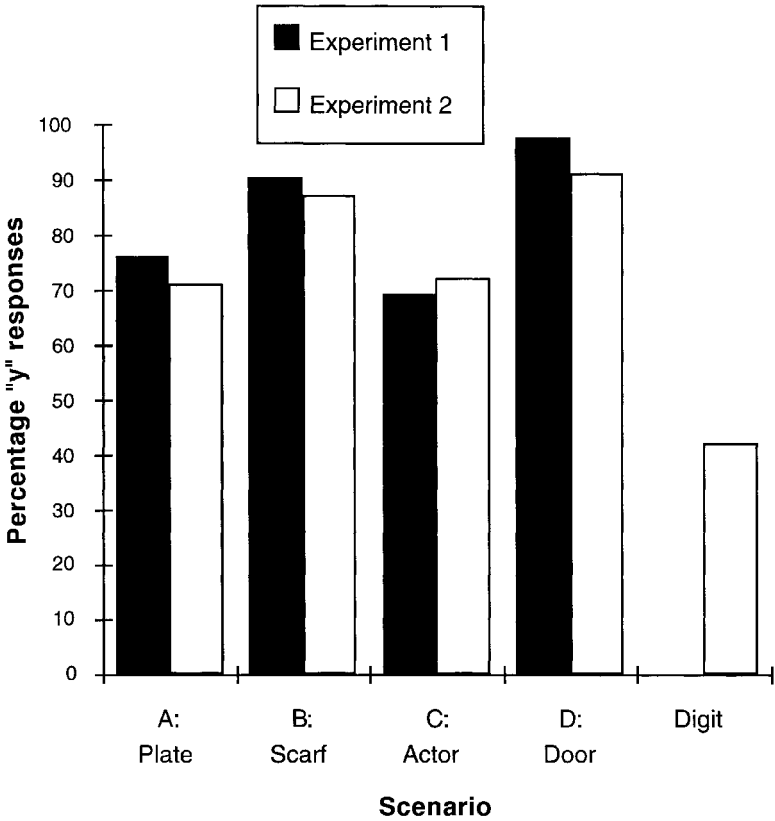
FIG. 5.   Percentage of change-detection responses and positive digit-span responses in Experiments 1 and 2.

TABLE 1
Comparisons between change-detection scenarios and the
digit-span scenario

Scenario	Overall		Self		Other	
	$X^2(1)$	p	$X^2(1)$	p	$X^2(1)$	p
Plate—Digit	9.8	<.005	1.3	ns	10.3	<.005
Scarf—Digit	23.1	<.001	5.4	<.025	18.0	<.001
Actor—Digit	10.7	<.005	.33	ns	15.0	<.001

Significant X^2s indicate that overestimates were larger in the change-detection scenario than in the digit-span scenario. Comparisons were based on 2×2 classification of subjects according to whether they claimed successful change-detection in each scenario and whether they claimed success on the digit-span task.

responses to the digit-span scenario suggest that the overestimate was not caused by simple response biases. The minority of "yes" responses in the "Other" condition indicates that subjects are willing to give negative responses, and perhaps suggests they are more accurate in estimating short-term memory capacity than they are in estimating their change-detection ability. However, this latter conclusion should be considered preliminary. Although we confirmed that our subjects had not learned about the digit-span task in their general psychology class, most of them had received more general information about the limits of short-term memory. This may have caused their estimates to be somewhat more accurate. In any case, the fact that digit-span was nonetheless overestimated, suggests that a broad tendency to underappreciate cognitive and perceptual limits may contribute to our effect.

One interesting facet of the digit-span estimates was their sensitivity to the Self vs. Other manipulation. Although it is not possible to be certain why this happened, the lack of an illustration of the digit-span scenario may have been critical. Subjects were therefore left to their own devices to imagine the string of numbers they would be asked to remember. Research on the "above average" effect suggests that this kind of flexibility may allow subjects to opportunistically define positive traits to allow themselves a high rating (Dunning, Meyerowitz, & Holzberg, 1989). Perhaps the digit-span scenario allowed subjects to opportunistically imagine a stimulus they could remember. This flexibility may have combined with motivation to appear intelligent on the digit-span task to produce the strong Self–Other effect.

One concern about both experiments is that subjects may have misunderstood the scenarios. Although our wording was intended to emphasize that changes were unexpected, subjects may have assumed that we were asking if they would detect the changes given that they knew in advance that the change would occur. In other words, they may have thought the question asked if they could detect a change given that they were paying close attention to the changing objects. If so, a positive response might be accurate. Two observations mitigate against this possibility. First, during debriefing a number of subjects claimed that they would notice our changes because they had noticed similar changes when viewing movies. Given that these continuity errors in movies are almost certainly unexpected and incidental, the prevalence of this report suggests that our scenarios exemplified similarly unexpected changes.

In addition, if subjects are overconfident because they think change detection is effortless, they should think that focusing attention of the changing object is irrelevant. Therefore, we asked a sub-set of subjects in Experiment 2 (after they had completed the questionnaires), "Do you think that it is important to pay attention directly to the object that changes, or would you just see it [the change]?" Of the 25 subjects asked this question, 9 indicated that they would have to focus their attention on the objects, 13 said they would just see the change, and 3 gave indeterminate responses. Those who said they would just

see the changes indicated they would notice an average of 3.3 changes, whereas those who said they would need to focus attention on the changes thought they would notice 3.4 ($F < 1$). Therefore, many subjects thought they could detect changes without focusing attention on the changing object, and there was no difference in the degree of overestimation between those who thought attention would be necessary and those who did not.

GENERAL DISCUSSION

Experiments 1 and 2 document a large overestimate of change-detection ability. In both cases, the vast majority of subjects thought they could detect changes that few people actually do. This effect was robust across different testing situations and types of change, regardless of whether questions referred to the subjects own performance or to that of others. Previous research suggests a number of possible explanations for this effect. First, biases in reasoning about everyday events may lead subjects to believe that the few situations in which they have noticed changes (such as continuity errors in movies) are signs of error-free change detection. In addition, more general beliefs about the "direct" feeling of perception and the stability of the natural world may lead to the expectation that violations of stability would be immediately apparent.

A large body of research shows that subjects attend to "hits" more than "misses" when considering their success at everyday tasks (see for example, Gilovich, 1991; Hearst, 1991), and that these highly available instances exert a powerful effect on reasoning and decision making (Tversky & Kahneman, 1973). For example, many of us hold the belief that we are more likely to need an item once we have thrown it away. This belief is based on a few salient instances when we threw away a later needed item, rather than on the hundreds of times we disposed of useless things. In our experiments, subjects may have relied on the accessibility of one or two salient change-detection successes in completing the questionnaire. This is clearly consistent with subjects' reports that they had noticed continuity errors in movies and therefore believed themselves capable of detecting the changes we described.

In addition to the increased availability of memories of successful change detection, overestimates are likely influenced by the "direct" feel of perception. We have the sense that all of the information in a scene is available to us just by looking at it. This sense might generalize to the brief disruptions in our scenarios. A similar metacognitive error is discussed by Gopnik (1993) who suggests that we falsely believe that we have direct access to our own cognitive processes. Instead, we are only aware of these processes via inference. In both cases, a compelling illusion of direct knowledge obscures the underlying inferential processes. This illusory directness may lead subjects to believe that the changes will capture their attention because they would appear as sudden onsets. If subjects have an intuitive understanding of the visual system's

sensitivity to these onsets (e.g. Jonides & Yantis, 1988), then their overestimates would be enhanced.

Finally, these overestimations may reflect the implausibility of these changes occurring in the real world. In a sense, this "error" may actually reflect a deeper understanding of the structure of natural events. Typically, spatiotemporal continuity is a powerful cue to the continued existence of an individual object over time. If subjects understand this, then they understand how unusual the changes we described would be in the real world—people are not typically replaced during a conversation. They may simply infer that they would surely notice such unexpected and unusual events. Viewed this way, the error we have documented is not based not on illogical reasoning, but on the metacognitive belief that unusual events ought to be noticed (for additional discussion see Noë, Pessoa, & Thompson, this issue).

For this explanation to hold true, subjects must interpret the change detection situation in a real-world context. In the real world, changes to object identity that preserve spatiotemporal continuity are truly unusual. However, in dynamic artificial scenes, such as computer interfaces, inferences about the real world need not hold. Objects in a given location *can* unexpectedly changing identity. For example, most computer operating systems allow users to switch between programs with a click of the mouse. This switch can occur accidentally and may not be noticed despite changes to the entire display (e.g. some of the menu headings might change names, indicating the activation of a new program). In other situations, changes to data display modes may go unnoticed with potentially devastating consequences (Peterson, 1995). Despite these important differences between real-world and artificial displays, overestimations of change-detection ability may generalize from natural scenes where it is not a problem to artificial scenes where no constraint prevents instantaneous, and potentially important changes from occurring. By examining metacognitive errors in both types of display, we may gain a better appreciation both for the mechanisms underlying change detection and for the beliefs that influence our understanding of our environment.

REFERENCES

Alicke, M.D. (1985). Global self-evaluation as determined by the desirability and controllability of trait adjectives. *Journal of Personality and Social Psychology, 94*, 1621–1630.

Blackmore, S.J., Brelstaff, G., Nelson, K., & Troscianko, T. (1995). Is the richness of our visual world an illusion? Transsaccadic memory for complex scenes. *Perception, 24*, 1075–1081.

Bothwell, R.K., Deffenbacher, K.A., & Brigham, J.C. (1987). Correlation of eyewitness accuracy and confidence: Optimality hypothesis revisited. *Journal of Applied Psychology, 72*, 691–695.

Drivdahl, S.B., & Zaragoza, M.S. (1997). *Elaborative processes and false memory for suggested events*. Poster presented at the 58th Psychonomics Society meeting. Philadelphia, PA.

Dunning, D., Meyerowitz, J.A., & Holzberg, A.D. (1989). Ambiguity and self-evaluation: The role of idiosyncratic trait definitions in self-serving assessments of ability. *Journal of Personality and Social Psychology, 57*, 1082–1090.

Gilovich, T. (1991). *How we know what isn't so: The fallibility of human reason in everyday life*. New York: The Free Press.

Gopnik, A. (1993). How we know our minds: The illusion of first-person knowledge of intentionality. *Behavioral and Brain Sciences, 16*, 1–14.

Grimes, J. (1996). On the failure to detect changes in scenes across saccades. In K. Akins (Ed.), *Perception* (Vol. 2, pp. 89–110). New York: Oxford University Press.

Hearst, E. (1991). Psychology and nothing. *American Scientist, 79*, 432–443.

Henderson, J.M. (1997). Transsaccadic memory and integration during real-world object perception. *Psychological Science, 8*, 51–55.

Jonides, J., & Yantis, S. (1988). Uniqueness of abrupt visual onset in capturing attention. *Perception and Psychophysics, 43*, 346–354.

Levin, D.T., & Simons, D.J. (1997). Failure to detect changes to attended objects in motion pictures. *Psychonomic Bulletin and Review, 4*, 501–506.

McConkie, G.W., & Currie, C.B. (1996). Visual stability across saccades while viewing complex pictures. *Journal of Experimental Psychology: Human Perception and Performance, 22*, 563–581.

Neisser, U., & Harsch, N. (1992). Phantom flashbulbs: False recollections of hearing the Challenger news. In E. Winograd & U Neisser (Eds.), *Affect and accuracy in recall: Studies of "flashbulb" memories*. New York: Cambridge University Press.

O'Regan, J.K., Deubel, H., Clark, J.J., & Rensink, R.A. (1997). Picture changes during blinks: Not seeing where you look and seeing where you don't look. *Investigative Ophthalmology and Visual Science, 38*(4), S707.

Pashler, H. (1988). Familiarity and visual change detection. *Perception and Psychophysics, 44*, 369–378.

Peterson, I. (1995). *Fatal defect: Chasing killer computer bugs*. New York: Random House.

Phillips, W.A. (1974). On the distinction between sensory storage and short-term visual memory. *Perception and Psychophysics, 16*, 283–290.

Rensink, R.A., O'Regan, J.K., & Clark, J.J. (1997). To see or not to see: The need for attention to perceive changes in scenes. *Psychological Science, 8*, 368–373.

Roediger, H., & McDermott, K.B. (1995). Creating false memories: Remembering words not presented on lists, *Journal of Experimental Psychology: Learning, Memory, and Cognition, 21*, 803–814.

Simons, D.J. (1996). In sight, out of mind: When object representations fail. *Psychological Science, 7*, 301–305.

Simons, D.J., & Levin, D.T. (1997). Change Blindness. *Trends in Cognitive Science, 1*, 261–267.

Simons, D.J., & Levin, D. T. (1998). Failure to detect changes to people in a real-world interaction, *Psychonomic Bulletin and Review, 5*(4), 644–649.

Sporer, S.L., Penrod, S., Read, D., & Cutler, B. (1995). Choosing, confidence, and accuracy: A meta-analysis of the confidence-accuracy relation in eyewitness identification studies. *Psychological Bulletin, 118*, 315–327.

Tversky, A., & Kahneman, D. (1973). Availability: A heuristic for judging frequency and probability. *Cognitive Psychology, 5*, 207–232.

Wechsler, D. (1952). *The range of human capacities*. Baltimore: Williams & Wilkins.

Winer, G.A., Cottrell, J.E., Karefilaki, K.D., & Chronister, M. (1996). Conditions affecting beliefs about visual perception among children and adults. *Journal of Experimental Child Psychology, 61*, 93–115.

Winer, G.A., Cottrell, J.E., Karefilaki, K.D., & Gregg, V.R. (1996). Images, words, and questions: Variables that influence beliefs about vision in children and adults. *Journal of Experimental Child Psychology, 63*, 499–525.

APPENDIX:
SCENARIOS USED IN EXPERIMENTS 1 AND 2

Scenario A: Plate-change

You are watching a movie. In a certain scene, two actors are having a conversation in a busy restaurant and in a series of shots you see one actor, then the other as each in turn talk. In the shot of actor A, you can see red plates on the table. On the next shot of actor B, you can still see the table, but now the plates are white.

Question on response form for scenarios A–D (Experiment 2): First, say if you think you would notice the change by circling "Yes" (you would notice the change) or "No" (you would miss the change).

Other Condition in Experiment 2

A person is watching a movie. In a certain scene, two actors are having a conversation in a busy restaurant and in a series of shots s/he sees one actor, then the other as each in turn talk. In the shot of actor A, s/he sees red plates on the table. On the next shot of actor B, s/he can still see the table, but now the plates are white.

Question on response form (Experiment 2): First, say if you think he/she would notice the change by circling "Yes" (you would notice the change) or "No" (you would miss the change).

Scenario B: Scarf-change

You are watching a movie. In a certain scene, two actors are having a conversation in a restaurant and in a series of shots you see one actor, then the other as each in turn talk. In the first half of the scene, actor A is wearing a large colourful scarf. In the middle of the scene, the camera cuts to actor A, but now the scarf is missing.

Other Condition in Experiment 2

A person is watching a movie. In a certain scene, two actors are having a conversation in a restaurant and in a series of shots s/he sees one actor, then the other as each in turn talk. In the first half of the scene, actor A is wearing a large colourful scarf. In the middle of the scene, the camera cuts to actor A, but now the scarf is missing.

Scenario C: Actor-change

You are watching a movie. In a certain scene, you see an actor sitting at his desk in a small office. The actor looks up in response to a ringing phone, gets up from his chair and walks by the camera to answer a phone in the hall. In the next shot there is a different actor, wearing different clothes, walking to the phone and answering it.

Other Condition in Experiment 2

A person is watching a movie. In a certain scene, s/he sees an actor sitting at his desk in a small office. The actor looks up in response to a ringing phone, gets up from his chair and walks by the camera to answer a phone in the hall. In the next shot there is a different actor, wearing different clothes, walking to the phone and answering it.

Scenario D: Person-change

You are walking on the Kent campus and a man with a puzzled look asks you to help him find the library. You stop and give him directions. While you are giving directions, two people carrying a door rudely walk between you and the lost pedestrian. After the door has passed, the person you were giving directions to is now a different person wearing different clothes.

Other Condition in Experiment 2

A person is walking on the Kent campus and a man with a puzzled look asks him/her to help him find the library. He/she stops to give him directions. While that person is giving directions, two people carrying a door rudely walk between him/her and the lost pedestrian. After the door has passed, the person asking for directions is now a different person wearing different clothes.

Digit-span Scenario (Experiment 2)

Self Condition

Imagine that you are in a memory experiment. In this experiment, a psychologist slowly reads you a sequence of random digits and then asks you to remember them, in the correct order (for example, s/he might read the digits, 2, 9, and 3 and then ask you to repeat them). How long of a string of digits (how many digits) could you repeat accurately?

Question: Would you be able to remember 10 or more numbers? Yes/No

Other Condition

Imagine that a person is in a memory experiment. In this experiment, a psychologist slowly reads her/him a sequence of random digits and then asks to remember them, in the correct order (for example, s/he might read the digits, 2, 9, and 3 and then ask to repeat them). How long of a string of digits (how many digits) could they repeat accurately?

Question: Would they be able to remember 10 or more numbers? Yes/No