Mistaken Eyewitness Identification Rates Increase When Either Witnessing or Testing Conditions get Worse

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Abstract
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Keywords
eyewitness identification, decision criterion, mistaken identification, lineups, strength-based mirror effect

Disciplines
Criminology | Psychology | Theory and Philosophy
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Abstract

We examined how giving eyewitnesses a weak recognition experience impacts their identification decisions. In two experiments we forced a weak recognition experience for lineups by impairing either encoding or retrieval conditions. In Experiment 1 ($N = 245$), undergraduate participants were randomly assigned to watch either a clear or a degraded culprit video and then viewed either a culprit-present or culprit-removed lineup identification procedure. In Experiment 2 ($N = 227$), all participants watched the same clear culprit video but were then randomly assigned to either view a clear or noise-degraded lineup procedure. Half of the participants viewed a culprit-present lineup procedure and the remaining participants viewed a culprit-removed lineup procedure. Not surprisingly degrading either encoding or retrieval conditions led to a sharp drop in culprit identifications. Critically, and as predicted, degrading either encoding or retrieval conditions also led to a sharp increase in the identification of innocent persons. These results suggest that when a lineup procedure gives a witness a weak match-to-memory experience, the witness will lower her criterion for making an affirmative identification decision. This pattern of results is troubling because it suggests that witnesses who encounter lineups that do not include the culprit might have a tendency to use a lower criterion for identification than do witnesses who encounter lineups that actually include the culprit.

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Public Significance Statement: Eyewitnesses lowered their criterion for making an affirmative identification from a culprit-absent lineup when either the witnessing (encoding) or testing (retrieval) conditions were made to be poor. This research helps us understand why eyewitnesses often make affirmative identification decisions under weak memory conditions rather than backing away from making any identification at all. We posit that any condition that leads to an eyewitness having a weak recognition response to a lineup, including the mere absence of culprit in the lineup, will result in eyewitnesses using a lowered criterion for making an affirmative decision.
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Since the mid- to late-1970s eyewitness scientists have learned a great deal about the variables that increase or decrease the chances of mistaken identification, but there is a fundamental question about mistaken eyewitness identification that has lurked in the background receiving little attention. Specifically, why do eyewitnesses mistakenly identify innocent persons? Cases of coincidental resemblance are seemingly rare, and while social influence is certainly a contributing factor, there are numerous laboratory examples of witnesses mistakenly identifying innocent persons who only fit a general description of the culprit under conditions that are devoid of any social influence whatsoever (see Wells, Yang, & Smalarz, 2015). We assume here that, if an eyewitness identifies an innocent person under these relatively optimal lineup conditions, then that eyewitness must have a relatively weak memory for the culprit. Although it is easy to understand that an eyewitness with a weak memory might not be able to identify the culprit, why would an eyewitness with such a weak memory pick anyone out of a lineup? The current studies seek to explain this troubling eyewitness behavior.

The propensity for eyewitnesses to make identifications from lineups when they should “back off” is readily evident in eyewitness identification experiments. Across 94 eyewitness identification studies, 21% of eyewitnesses picked an innocent person when the culprit was in the lineup and 48% picked an innocent person (rather than make no identification) when the culprit was not in the lineup (Wells, Yang, & Smalarz, 2015). These types of results are obtained in eyewitness identification experiments even when witnesses are warned that the culprit might not be present and are explicitly permitted to
make no identification. Clearly, these witnesses did not have sufficient memory strength
to perform well, but rather than back off and make no identification, they made mistaken
identifications.

The propensity of eyewitnesses to make identifications despite weak memories is
not just a laboratory phenomenon. There are now eleven published field studies
examining the outcomes of lineups involving eyewitnesses to serious crimes in actual
cases (Behrman & Davey, 2001; Behrman & Richards, 2005; Horry, Halford, Brewer,
Milne, & Bull, 2014; Horry, Memon, Wright, & Milne, 2012; Klobuchar, Steblay, &
Claigiuri, 2006; Memon, et al., 2011; Valentine, Pickering, & Darling, 2003; Wells,
Steblay, & Dysart, 2015; Wixted et al., 2015; Wright & McDaid, 1996; Wright &
Skagerberg, 2007). Collectively, these eleven studies examined the outcomes of 6,734
lineups (Wells, 2018). Eyewitnesses identified someone in 65% of these lineups, but 37%
of their identifications were of known-innocent fillers. Granted, eyewitnesses often have
poor views, and feel stress or fear at the time of witnessing. Days, weeks, or sometimes
months go by before eyewitnesses have the opportunity to view a lineup. But, if these
witnesses to serious crimes possess such a weak memory that there is more than a one-
third chance that they will point to an innocent person, then what process leads these
witnesses to make an identification at all rather than exercise the option of making no
identification?

We offer what, at first glance, appears to be a surprising answer to the question of
why eyewitnesses make affirmative identifications from lineups even though memory is
weak. Specifically, we argue that these affirmative identifications are made not *despite*
weak memory but *because* of weak memory. Specifically, we argue that a weak
recognition memory experience leads eyewitnesses to adopt a lower decision criterion (i.e., require a weaker match to memory in order to make an affirmative identification decision).

It is easy to understand how the probability of a hit (identifying the culprit from a culprit-present lineup) would go down when memory conditions are weaker. But why should the probability of false alarm (identifying an innocent person from a culprit-absent lineup) increase when memory gets weaker?

The basic memory literature, using repeated-measures word-memory experiments rather than single-trial eyewitness identification lineups, has shown that poorer encoding conditions lead to more false alarms than do better encoding conditions. This phenomenon has been the topic of some debate in the basic recognition literature (e.g., Criss, 2009; Starns, White, & Ratcliff, 2012). The dominant explanation for this phenomenon is that poor encoding conditions lead individuals to change their decision strategy (e.g., Wixted & Gaitan, 2002). Specifically, when memory is relatively weak, people tend to lower the amount of evidence they require before they make an affirmative response so as to avoid missing the opportunity to make a hit (Wixted & Gaitan, 2002). The finding that relatively-impoverished encoding conditions lead to both a decrease in hits and an increase in false alarms is commonly referred to as the strength-based mirror effect (e.g., Stretch & Wixted, 1998).

Additional research from the basic recognition literature suggests that varying the quality or quantity of cues at recognition can also produce a strength-based mirror effect (Hockley, Hemsworth, & Consoli, 1999; Kent, Lamberts, & Patton, 2018). Hockley et al. (1999, Experiment 1) had participants study a series of undisguised, to-be-remembered
faces (targets). Half of the faces during the recognition test were targets and the remaining were novel (not-previously-seen) faces. The critical manipulation was whether the faces were disguised (i.e., wearing sunglasses) during the recognition test. The results showed that participants made fewer hits and also more false alarms when the persons depicted in the test photos were wearing sunglasses. Again, the reduction in hits from putting sunglasses on the faces at test is easy to understand. But why should putting sunglasses on novel faces increase false alarms? Again, the prevailing view is that when the recognition cues are relatively weak, people tend to lower the amount of evidence they require before they can make an affirmative response so as to avoid missing the opportunity to make a hit.

A critical question is whether the strength-based mirror effect generalizes to the eyewitness-lineup context. Basic memory researchers have studied the strength-based mirror effect in the context of repeated-measures old/new recognition tasks. On an old/new recognition task, participants study a series of items at encoding (e.g., words, faces) and at recognition each trial includes either an “old” item that the participant studied at encoding or a “new” item that the participant did not study at encoding. On each trial, the participant is tasked with determining whether the item is “old” or “new”. While the old/new recognition task has obvious similarities to the typical eyewitness lineup task, there are also important differences. One potentially important difference is that on an eyewitness lineup, the eyewitness views an array of faces. An eyewitness with a relatively weak memory would presumably have more difficulty determining which lineup member provides the best match-to-memory; and, to the extent that an eyewitness finds it difficult to even form a preference, the eyewitness might decide not to make an
identification, which is an option they are explicitly given with a lineup. This idea is consistent with a host of relative judgment strategies that have been implemented in the WITNESS model (e.g., Clark, Erickson, & Breneman, 2011). With these relative-judgment strategies an eyewitness only identifies the best-matching lineup member if that lineup member is a sufficiently better match-to-memory than are the other lineup members. But if an eyewitness has a relatively weak match-to-memory, then the eyewitness should have difficulty forming a preference and the probability of a lineup rejection should increase. Thus, given the inconsistencies with other theories, it is not entirely clear that the strength-based mirror effect will generalize to the eyewitness context.

In our review of past work in the eyewitness literature, we found a few examples in which weaker encoding conditions led not only to a decrease in hits, but also to an increase in false alarms. Longer distances at encoding, shorter exposure times, and the presence of a disguise have all been shown to both decrease hits and increase false alarms (e.g., Lampinen, Erickson, Moore, & Hittson, 2014; Mansour et al., 2012; Memon, Hope, & Bull, 2003). Importantly, however, none of these experiments were specifically designed to examine the strength-based mirror effect, or attempted to find out why false alarms increase when match-to-memory is weak. Instead, in each case, the authors were focused on investigating different applied problems and their experiments happened to produce effects that fit the mirror-effect pattern. In the present work, we predicted the mirror-effect pattern a priori and specifically designed our experiments to develop a better understanding of the conditions that produce mirror effects and why these conditions lead to increases in false alarms.
If the strength-based mirror effect generalizes to the eyewitness literature, the finding that a lack of high-quality recognition cues at test leads to an increase in false alarms is particularly concerning (Hockley et al., 1999; Kent et al., 2018). Presumably concealing or degrading cues at test increases false alarms for the same reason that impoverished encoding conditions increase false alarms—when match-to-memory is weak, participants lower the amount of evidence they require to make an affirmative response because they do not want to miss an opportunity to make a hit (Wixted & Gaitan, 2002). This does not necessarily mean that participants value hits more than they do correct rejections. To the contrary, if a witness wanted to strike some balance between missing a hit and making a false alarm (missing a correct rejection), maintaining that balance would require the witness to lower her decision criteria for a weaker match-to-memory experience. As match-to-memory weakens, hits are going to go down, so in order to maintain the same balance between misses and false alarms, the participant will need to lower her criterion for making an affirmative response.

Why should eyewitness scientists be concerned that a lack of high-quality cues at recognition can lead people to require less evidence in order to make an affirmative recognition decision? Consider the difference between culprit-present and culprit-absent identification procedures. Clearly when the culprit is present in an identification procedure, the quality and quantity of cues available to the eyewitness will be better than when the culprit is absent from the identification procedure. And, whether a lack of high-quality cues is due to poor encoding conditions, poor retrieval conditions, or the mere absence of the culprit, eyewitnesses are likely to respond in the same manner—by lowering their standard for a face to be identified as the culprit (an affirmative response).
This reasoning recently led to the development of a provocative new hypothesis: culprit present-absent criteria discrepancy (Smith, Wells, Lindsay, & Myerson, 2018).

The culprit present-absent criteria discrepancy hypothesis begins with the non-controversial observation that witnesses who encounter a culprit-absent lineup will tend to have a weaker match-to-memory experience than will witnesses who encounter a culprit-present lineup. Because match-to-memory is weaker for the culprit-absent eyewitnesses, they will also shift their standards to require less evidence to make an affirmative identification than will culprit-present eyewitnesses. The result is that present-absent criteria discrepancy undermines identification performance. Indeed, if witnesses who encounter culprit-absent procedures tend to require less evidence for an affirmative identification than do witnesses who encounter culprit-present procedures, this will lead to the same number of culprit identifications but more innocent identifications than if culprit-absent participants used the same criteria as culprit-present participants (Smith et al., 2018). This happens because witnesses who are encountering innocent suspects are lowering their standards for making an affirmative identification, but witnesses encountering guilty suspects are not.

Clearly, culprit present-absent discrepancy hypothesis does not posit that witnesses are aware that the culprit is absent and lower their criteria for that reason. After all, if they were aware that the culprit was absent, they would reject the lineup. Instead, the culprit present-absent criteria discrepancy hypothesis says that when witnesses encounter a culprit-absent lineup they experience difficulty because there is not a strong match to memory. This experience is very similar to having poor encoding and so they
adjust their decision criteria downward to help ensure that they will not miss the opportunity to identify the culprit.

In one sense, the culprit present-absent criteria discrepancy hypothesis involves a misattribution process. Specifically, although it is the absence of the culprit that is causing the weak experience of match to memory, the eyewitness attributes the difficulty to other things, such as poor viewing conditions or not having paid close attention during witnessing. In fact, there is evidence supporting this misattribution process. When witnesses encounter a randomly-assigned culprit-absent lineup they report having had a worse view and having paid less attention to the culprit than when they encounter a randomly-assigned culprit-present lineup (Bradfield, Wells, & Olson, 2002). In other words, witnesses misattributed their difficulty picking out the culprit to having had a poor view and having not paid close attention at encoding rather than to the actual reason for their difficulty picking the out the culprit, namely the absence of the culprit in the lineup.

In the present work, we directly examined how manipulating match-to-memory impacts eyewitness performance. We manipulated match-to-memory in two ways. In the first experiment, we manipulated the encoding experience, giving witnesses either a good view of the culprit or an impoverished view. In the second experiment, all witnesses had a good view of the culprit, but we made the recognition experience weak at the retrieval stage by adding noise to the lineup images. Neither of these experiments is intended to directly test the present-absent criteria discrepancy hypothesis. Rather, these experiments address two important questions related to the present-absent criteria discrepancy hypothesis. First, does the strength-based mirror effect generalize to the eyewitness-lineup context? As already noted above, there are reasons to believe that the strength-
based mirror effect will not generalize to the eyewitness context. Certainly, degraded encoding or testing conditions will lead to a reduction in culprit identifications, but the critical question is whether these degradations also increase the identification of innocent persons. Because the present-absent criteria discrepancy hypothesis is a special case of the more general strength-based mirror effect, it is first necessary to establish that the strength-based mirror effect generalizes to the eyewitness-lineup context. If the strength-based mirror effect does not generalize to the eyewitness context, then there is no basis for the present-absent criteria discrepancy hypothesis.

Second, is witness-criterion placement influenced by the match-to-memory experience at the time of the identification procedure? The present-absent criteria discrepancy hypothesis predicts that, compared to witnesses who encounter guilty suspects, witnesses who encounter innocent suspects will respond to the weaker match-to-memory experience by lowering their criterion for making an affirmative identification. The linchpin assumption of this hypothesis is that witness-criterion placement is influenced by the match-to-memory experience during the identification task. Indeed, because culprit-present and culprit-absent witnesses have identical experiences up until the identification task, the present-absent criteria discrepancy effect could only occur if witness-criterion placement is influenced by the match-to-memory experience during the identification task itself. By giving all witnesses the same viewing conditions and manipulating the quality of lineup photos, Experiment 2 directly tests the assumption that witness-criterion placement can be influenced by the match-to-memory experience at the time of the identification test. In other words, if degrading the quality of the photos in Experiment 2 results in witnesses lowering their decision criteria, then this
is critical evidence that witness criterion placement can be influenced by their experience on the lineup task. From a theoretical perspective, the idea that witnesses’ decision criteria are malleable during the lineup task is a key assumption of the culprit present-absent criteria discrepancy hypothesis. Hence, although this work does not directly test the culprit present-absent criteria discrepancy hypothesis, Experiment 2 tests one of the critical assumptions of the hypothesis.

Clearly, degrading either the encoding conditions (Experiment 1) or the retrieval conditions (Experiment 2) will reduce accurate identifications from culprit-present lineups. The critical question, however, concerns what happens in culprit-absent lineups. Our prediction is that degrading either encoding conditions or retrieval conditions will result in an increase in false alarms in culprit-absent conditions. The latter result would indicate that degraded memory conditions result in eyewitnesses lowering their decision criteria. Importantly, finding that degraded recognition conditions lead to an increase in false alarms would also demonstrate that eyewitness decision criteria are malleable during the lineup task.

Before proceeding to our first experiment, it is important that we clarify why we are relying only on false alarm rates for making inferences about decision criterion in these experiments. Inferences about decision criterion (the amount of information a witness requires to make an affirmative response) in eyewitness identification experiments are sometimes made on the basis of examining witness response biases, which are measured using one of two statistics ($c$ or $\beta$) calculated on the basis of both hits and false alarms (e.g., Macmillan & Creelman, 2005). But, when one is looking at strength-based mirror effects, as we are doing here, using culprit-present conditions to
examine decision criterion is not appropriate (e.g., Verde & Rotello, 2007). This is because choosing in culprit-present conditions is confounded with the strength of the memory signal coming from the culprit. Indeed, our prediction is that the weaker of our two memory conditions will lead to (1) worse discriminability and (2) a more lenient decision criterion (Wixted & Gaitan, 2002). The culprit-present condition confounds these two counteractive forces. Whereas a more lenient decision criterion should lead to an increase in choosing, worse discriminability should lead to a drop in choosing. Hence, it is entirely possible (likely even) that the procedure with the more lenient decision criterion (viz. the weaker memory condition) could lead to less choosing in the culprit-present lineup. The result is that, culprit-present data should not be included when making inferences about decision criteria. To the contrary, false alarm rates are solely influenced by criterion placement (Macmillan & Creelman, 2005), so when looking at strength-based mirror effects, false-alarm rates offer a cleaner measure of decision criteria than do other measures of response bias ($c$ or $\beta$).

Experiment 1: Weakening the Recognition Experience at Encoding

Experiment 1 Method

The Institutional Review Board for human research at a large Midwestern University approved this experiment.

**Participants and Design.** Two-hundred and forty-five undergraduate students participated in exchange for course credits. Each participant was randomly assigned to

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1 Those who have fit signal detection models to data are well aware that the predicted false alarm rate is equal to $\phi(-c)$, where $\phi(.)$ is the normal cumulative distribution and $c$ refers to the decision criterion (e.g., Dunn, 2010). Hence, signal detection models assume that an observed false alarm rate is solely influenced by the decision criterion.
one cell of a 2 (good view of culprit, poor view of culprit) x 2 (culprit-present lineup, culprit-removed lineup) between-participants factorial design.  

We chose to use a sample size of 60 per cell and then conducted pilot testing using a culprit-present lineup to find a level of degradation in the video that would reduce accurate identifications enough to be statistically significant at a nominal alpha level of .05 with a sample size of 60 per cell. None of the data presented in this paper are from the initial pilot testing as the pilot testing was only used to determine the level of degradation that was required to significantly reduce culprit identifications with our desired sample size. Screen shots of the close-up view for the clear and degraded videos are shown in Figure 1.

**Materials.**

**Culprit Videos.** Each participant was presented with one of two versions of the same culprit video (still frames from the two versions of this video are depicted in Figure 1). Half of the participants viewed a relatively high-resolution culprit video in which the culprit's facial features were clearly visible. In this version of the video, participants watched a video of a scene from an airport that showed six people standing in a check-in line, each with a small suitcase. At one point, the second person in the line begins checking for his airline ticket and, not immediately finding it, allows two people to go ahead of him. While others are looking away, he switches his similar-looking suitcase with the third person. Shortly thereafter, the bag switcher leaves the line, walking toward the camera for a very good camera view of his face, and exits. The total amount of time that the bag-switcher was in view was 45 seconds. Five of those seconds were close-up

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2 Additional conditions were run in this experiment that gave witnesses the option of responding “not sure” rather than making either an identification or rejection decision. These participants were not included in this manuscript. See supplemental materials for an analysis including these participants.
views of his face. The remaining participants viewed a relatively low-resolution version of the same culprit video in which it was more difficult to make out the culprit's facial features. In order to create the low-resolution culprit video, we increased the brightness of that video to the extent that it was difficult to make out the culprit's facial features (see Figure 1).

Figure 1. Screen shot examples from the clear and degraded videos in Experiment 1.

![Screen shot from clear video](image1) ![Screen shot from degraded video](image2)

**Lineups.** Half of the participants viewed a 6-person culprit-present lineup in which the culprit was surrounded by five known-innocent fillers who generally fit the culprit's description. To create our culprit-absent lineups, we used the removal-without-replacement method (Wells, 1993). Hence, participants in the culprit-absent condition viewed a 5-person lineup that included only the fillers from the culprit-present lineup. In our opinion, the removal-without-replacement method offers a cleaner test of the hypotheses tested in the current experiments than does the alternative culprit-absent procedure in which the culprit is replaced by another person (i.e., a designated innocent suspect). This is because the traditional replacement method changes two things at once, namely removing the culprit and also bringing in a totally new lineup member to replace the culprit. The effects on witness responding of adding this new lineup member can be
complex and depend on a variety of similarity relations between the new lineup member and the culprit, as well as the new lineup member and the other lineup members. The removal-without-replacement method, however, is a purer test of our hypotheses because witness responses can be more clearly attributed to the mere absence of the culprit.

We selected lineup fillers based on their similarity to the culprit. The culprit always appeared in position 5 (bottom middle) of the 2 x 3 lineup array. We did not assess lineup fairness \textit{a priori}. Rather, we assessed \textit{resultant} lineup fairness (Wells, 2019) or the fairness that was actually achieved in our culprit-absent lineup conditions. Resultant lineup fairness can be calculated in the same ways as traditional lineup fairness, but instead of using a mock-witness task – which may or may not provide an accurate estimate of fairness on the actual lineup task – one applies the lineup fairness measure directly to the experimental lineup data. To calculate resultant lineup fairness, we calculated the resultant $E'$ (Tredoux, 1998) achieved for the culprit-absent lineup. Tredoux's (1998) $E'$ varies from 1 to $k$ where $k$ is the total number of lineup members; hence, in the present experiment, Tredoux's $E'$ could range from 1 to 5. For participants in the clear-view condition, $E'$ was equal to 3.31 and for participants in the poor-view condition, $E'$ was equal to 3.18. Hence, our culprit-absent lineups were moderately fair.

Note that resultant lineup fairness is only applicable to culprit-absent lineups. Indeed, when the culprit is present in the lineup, resultant lineup fairness is strongly affected by the extent to which the culprit matches the eyewitness' memory for the culprit and hence, it is not a good measure of fairness for culprit-present conditions.

\textbf{Procedure.} Prior to viewing the culprit video, participants were told that the study concerned how people form impressions of other people. After viewing the video,
participants were told that we wanted them to view a lineup to see if they could identify the person who switched the bag. All participants were warned that the actual culprit might or might not be in the lineup and were given an explicit option of making no identification. Participants were then shown a photo-lineup that included the culprit embedded among five innocent people or viewed a lineup with only the five innocent people (the removal-without-replacement method of creating a culprit-absent lineup, Wells, 1993).

After making an identification decision, participants were asked to indicate how confident they were in their decision on a scale from 0% to 100% in 10% increments. All participants were then debriefed fully about the methods and purpose of the experiment, given their course credit, and dismissed.

**Experiment 1 Results**

Table 1 displays the proportions of witnesses who identified the culprit, an innocent person, or made no identification as functions of culprit-presence and video-degradation conditions.

**Identification decision accuracy.** We first assessed the impact of video quality, culprit-presence, and the interaction term on identification decision accuracy using hierarchical binary logistic regression analysis. When the culprit is present, the correct decision is to identify that individual and both filler identifications and rejections are incorrect decisions. When the culprit is absent, the correct decision is to reject the lineup and falsely identifying anyone from the lineup is an incorrect decision. Hence, for the purpose of this model, both culprit identifications and correct rejections were coded as
accurate responses (accurate = 1) and all other responses were coded as inaccurate (inaccurate = 0).

Neither culprit-presence nor the interaction term significantly predicted identification accuracy, \( B_s \leq .55, SEs \geq .29, \) Wald’s \( \chi^2(1) \leq 1.58, ps \geq .21, e^B \leq 1.74. \) Identification accuracy did vary by video-quality; the odds ratio for accurate identifications decisions was 6.69 times greater for the clear versus the degraded video, \( B = 1.90, SE = .29, \) Wald’s \( \chi^2(1) = 42.44, p < .001, e^B = 6.69, (95\% CI [3.78, 11.86]). \)

Although the interaction term was not significant, our prediction was that degraded encoding conditions would decrease accuracy in both culprit-present and culprit-absent identification procedures. Accordingly, we proceeded to examine the simple slopes of encoding conditions as a function of culprit presence. When the culprit was present, the odds ratio for accurate-identification decisions was 8.34 times greater for the clear versus the degraded video, \( B = 2.18, SE = .42, \) Wald’s \( \chi^2(1) = 26.90, p < .001, e^B = 8.34, (95\% CI [3.88, 20.13]). \) In the culprit-removed condition, the odds ratio for culprit-removed accurate-identification decisions was 5.07 times greater for the clear versus degraded video, \( B = 1.62, SE = .41, \) Wald’s \( \chi^2(1) = 16.05, p < .001, e^B = 5.07, (95\% CI [2.29, 11.23]). \)

**Analyses of type of error in culprit-present conditions.** Because there are two ways in which a participant viewing the culprit-present condition can make an error (a false rejection or a mistaken identification of an innocent person), we next examined whether false rejections and mistaken identifications from culprit-present lineups differed as a function of video quality. There was a significant effect of video quality on mistaken identifications in the culprit-present conditions; the odds ratio for culprit-present
mistaken identifications of innocent persons was 8.34 times greater for the degraded versus the clear video, $B = 3.41, SE = 1.04$, Wald’s $\chi^2(1) = 10.70$, $p = .001$, $e^B = 30.22$, (95% CI [3.91, 233.64]). Likewise, the odds ratio for culprit-present false rejections was 2.36 times greater for the degraded versus the clear video, $B = .86, SE = .42$, Wald’s $\chi^2(1) = 4.25$, $p = .04$, $e^B = 2.36$, (95% CI [1.04, 5.33]).

Table 1. Identification decisions in Experiment 1: Clear vs. degraded encoding conditions

<table>
<thead>
<tr>
<th>Culprit-present</th>
<th>Clear video</th>
<th>Degraded video</th>
</tr>
</thead>
<tbody>
<tr>
<td>Culprit ID</td>
<td>78.3%</td>
<td>29.0%</td>
</tr>
<tr>
<td>Innocent ID</td>
<td>1.7%</td>
<td>33.8%</td>
</tr>
<tr>
<td>No ID</td>
<td>20.0%</td>
<td>37.1%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Culprit-removed</th>
<th>Clear video</th>
<th>Degraded video</th>
</tr>
</thead>
<tbody>
<tr>
<td>Innocent ID</td>
<td>21.0%</td>
<td>57.4%</td>
</tr>
<tr>
<td>No ID</td>
<td>79.0%</td>
<td>42.6%</td>
</tr>
</tbody>
</table>

**Confidence.** We used a hierarchical binary logistic regression analysis to examine whether confidence could discriminate between accurate and inaccurate identification decisions and whether this effect was dependent on the presence of the culprit, the quality of viewing conditions, or the three-way interaction term. As eyewitness confidence increased, so did the odds of making a correct identification decision, $B = 0.18, SE = 0.06$, Wald's $\chi^2(1) = 8.92$, $p = .003$, $e^B = 1.20$, (95% CI [1.07, 1.36]). Importantly, the three-way interaction among confidence, viewing conditions, and culprit presence was not significant, $B = 0.03, SE = 0.27$, Wald's $\chi^2(1) = 0.12$, $p = .91$, $e^B = 1.03$, (95% CI [0.61, 1.74]); however, the discriminative properties of eyewitness confidence were dependent on both the quality of viewing conditions, $B = 0.37, SE = 0.13$, Wald's $\chi^2(1) = \ldots$
7.92, \( p = .005 \), \( e^B = 1.45 \), (95% CI [1.12, 1.88]) and on the presence of the culprit, \( B = 0.28 \), \( SE = 0.13 \), Wald's \( \chi^2(1) = 4.62 \), \( p = .03 \), \( e^B = 1.33 \), (95% CI [1.03, 1.72]).

To follow up the interaction between confidence and viewing conditions, we examined the simple slopes of confidence separately for clear and degraded viewing conditions. When viewing conditions were clear, increases in confidence predicted increases in accuracy, \( B = 0.37 \), \( SE = 0.10 \), Wald's \( \chi^2(1) = 14.16 \), \( p < .001 \), \( e^B = 1.45 \), (95% CI [1.19, 1.76]); however, when viewing conditions were degraded, confidence was not significantly related to accuracy, \( B = 0.01 \), \( SE = 0.08 \), Wald's \( \chi^2(1) = 0.00 \), \( p = .95 \), \( e^B = 1.01 \), (95% CI [0.86, 1.18]). We used the same approach to follow up the significant interaction between confidence and culprit presence. When the culprit was present, increases in confidence predicted increases in accuracy, \( B = 0.45 \), \( SE = 0.09 \), Wald's \( \chi^2(1) = 27.05 \), \( p < .001 \), \( e^B = 1.56 \), (95% CI [1.32, 1.85]). Likewise, when the culprit was absent increases in confidence also predicted increases in accuracy, \( B = 0.20 \), \( SE = 0.07 \), Wald's \( \chi^2(1) = 8.66 \), \( p = .003 \), \( e^B = 1.22 \), (95% CI [1.07, 1.39]); however, the effect size was smaller when the culprit was absent than when the culprit was present.

**Experiment 2: Weakening the Recognition Experience at Retrieval**

At what point do eyewitnesses make an adjustment in their decision criteria? One possibility is that witnesses set their decision criteria at the time of encoding. In other words, in Experiment 1 it is possible witnesses set their decision criteria as soon as they realized that they had a good, clear view or a poor, degraded view. But, what if all eyewitnesses had the same good, clear encoding experience and then encountered a lineup in which the images were either clear or were degraded? Would witnesses adjust their criteria downward due to the poor retrieval conditions of a degraded lineup? We
hypothesized that regardless of whether the weak recognition memory experience is the result of unfavorable encoding conditions or the result of unfavorable retrieval conditions, witnesses will lower their decision criterion to avoid missing the chance of identifying the culprit.

**Experiment 2 Method**

The Institutional Review Board for human research at a large MidWestern University approved this experiment.

**Participants and Design.** Two-hundred and twenty-seven people participated in exchange for course credits. Each participant was randomly assigned to one cell of a 2 (noise-degraded lineup, clear lineup) x 2 (culprit-present lineup, culprit-removed lineup) factorial design.

We chose to use a sample size of 55 per cell and then pilot tested the materials to find a level of degradation in culprit-present lineup that would reduce accurate identifications enough to be statistically significant at $p < .05$ with a sample size of 55 per cell. None of the data presented in this paper are from the initial pilot testing as the pilot testing was only used to determine the level of degradation that was required to significantly reduce culprit identifications with our desired sample size. The degradation was achieved by adding visual noise to the lineup images. The clear and noisy lineups are shown in Figure 2 for both the culprit-present and culprit-removed lineups.

**Materials and Procedure.** The video in Experiment 2 was the same as the clear video used in Experiment 1 except that a new actor served the role of the bag-switcher. With the exception of using a different actor as the bag-switching culprit (in the video and the lineup) and manipulating the strength of the recognition experience at retrieval.
(degrading the lineup rather than the video), all materials and procedures were the same in Experiment 2 as they were in Experiment 1.

As in Experiment 1, experimenters selected lineup fillers based on their similarity to the culprit. The culprit always appeared in position 2 (top middle) of the 2 x 3 lineup array. Also as in Experiment 1, we used resultant $E'$ (Tredoux, 1998) to assess the actual lineup fairness achieved in our culprit-absent conditions. Under clear retrieval conditions, $E'$ was equal to 2.47 and under degraded retrieval conditions $E'$ was equal to 3.65. Hence, our culprit-absent lineups were moderately fair.
Experiment 2 Results

Table 2 displays the proportions of witnesses who identified the culprit, identified an innocent person, and made no identification as functions of culprit presence and lineup clarity conditions.

Identification decision accuracy. As in Experiment 1, we used a hierarchical binary logistic regression analysis to examine the impact of video quality, culprit-presence, and the interaction term on identification decision accuracy. Decision accuracy
was coded as in Experiment 1, where culprit identifications from the culprit-present lineup and correct rejections from the culprit-removed lineup were treated as accurate (accuracy = 1) and all other identification decisions were treated as inaccurate (accuracy = 0). Neither culprit-presence nor the interaction term between culprit-presence and lineup quality significantly predicted identification accuracy, $B_s \leq .99$, $SEs \geq .30$, Wald’s $\chi^2(1) \leq 2.65$, $ps \geq .10$, $e^B \leq 2.69$. Identification accuracy did vary by lineup quality; the odds ratio for accurate identification decisions was 6.70 times greater for the clear versus the degraded lineup, $B = 1.94$, $SE = .30$, Wald’s $\chi^2(1) = 41.80$, $p < .001$, $e^B = 6.70$ (95% CI [3.87, 12.55]). As in Experiment 1, although the interaction term was not significant, our prediction was that degraded encoding conditions would decrease accuracy in both culprit-present and culprit-absent identification procedures. Accordingly, we proceeded to examine the simple slopes of encoding conditions as a function of culprit presence. When the culprit was present, the odds ratio for culprit-present accurate identification decisions was 11.68 times greater for the clear than versus the degraded lineup, $B = 2.46$, $SE = .45$, Wald’s $\chi^2(1) = 29.72$, $p < .001$, $e^B = 11.68$, (95% CI [4.83, 28.26]). Likewise, when the culprit was removed, the odds ratio for culprit-removed accurate identification decisions was 4.35 times greater for the clear versus the degraded lineup, $B = 1.47$, $SE = .41$, Wald’s $\chi^2(1) = 13.09$, $p < .001$, $e^B = 4.35$, (95% CI [1.96, 9.64]).

**Analyses of type of error in culprit-present conditions.** Because there are two ways in which a participant viewing the culprit-present condition can make an error (a false rejection or a mistaken identification of an innocent person), we next examined whether false rejections and mistaken identifications from culprit-present lineups differed as a function of video quality. There was a significant effect of video quality on mistaken
identifications in the culprit-present conditions; the odds ratio for culprit-present mistaken identifications of innocent persons was 5.48 times greater for the degraded versus the clear lineup, \( B = 1.70, SE = .51, \) Wald’s \( \chi^2(1) = 11.18, p = .001, e^B = 5.48, (95\% \text{ CI [2.02, 14.84]}) \). Likewise, the odds ratio for culprit-present false rejections was 3.69 times greater for the degraded versus the clear lineup, \( B = 1.31, SE = .45, \) Wald’s \( \chi^2(1) = 8.37, p = .004, e^B = 3.69, (95\% \text{ CI [1.52, 8.92]}) \).

Table 2. Identification decisions in Experiment 2: Clear vs. degraded retrieval conditions

<table>
<thead>
<tr>
<th></th>
<th>Clear lineup</th>
<th>Degraded lineup</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Culprit-present</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Culprit ID</td>
<td>73.2%</td>
<td>19.0%</td>
</tr>
<tr>
<td>Innocent ID</td>
<td>10.7%</td>
<td>39.7%</td>
</tr>
<tr>
<td>No ID</td>
<td>16.1%</td>
<td>41.4%</td>
</tr>
<tr>
<td><strong>Culprit-removed</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Innocent ID</td>
<td>38.6%</td>
<td>73.2%</td>
</tr>
<tr>
<td>No ID</td>
<td>61.4%</td>
<td>26.8%</td>
</tr>
</tbody>
</table>

**Confidence.** As in Experiment 1, we used a hierarchical binary logistic regression analysis to examine whether confidence could discriminate between accurate and inaccurate identification decisions and whether this effect was dependent on the presence of the culprit, the quality of retrieval conditions, or the three-way interaction term. As eyewitness confidence increased, so did the odds of making a correct identification decision, \( B = 0.16, SE = 0.07, \) Wald's \( \chi^2(1) = 5.83, p = .02, e^B = 1.17, (95\% \text{ CI [1.03, 1.33]}) \). The three-way interaction among certainty, retrieval conditions, and culprit presence was not significant, \( B = 0.04, SE = 0.29, \) Wald's \( \chi^2(1) = 0.02, p = .89, e^B = 1.04, (95\% \text{ CI [0.59, 1.83]}) \); however, as in Experiment 1, the discriminative properties of eyewitness confidence were dependent on both the quality of retrieval conditions, \( B = .28 \)
SE = 0.14, Wald's $\chi^2(1) = 3.81, p = .051, e^B = 1.32, (95\% CI [0.999, 1.74])$ and on the presence of the culprit, $B = 0.43, SE = 0.14, Wald's $\chi^2(1) = 8.98, p = .003, e^B = 1.54, (95\% CI [1.16, 2.04])$.

To follow up the interaction between confidence and retrieval conditions, we examined the simple slopes of confidence separately for clear and degraded retrieval conditions. When retrieval conditions were clear, increases in confidence predicted increases in accuracy, $B = 0.29, SE = 0.09, Wald's \chi^2(1) = 9.44, p = .002, e^B = 1.33, (95\% CI [1.11, 1.60])$; however, when retrieval conditions were degraded, confidence was not significantly related to accuracy, $B = 0.01, SE = 0.10, Wald's \chi^2(1) = 0.01, p = .91, e^B = 1.01, (95\% CI [0.84, 1.22])$. We used the same approach to follow up the significant interaction between confidence and culprit presence. When the culprit was present, increases in confidence predicted increases in accuracy, $B = 0.51, SE = 0.10, Wald's \chi^2(1) = 27.41, p < .001, e^B = 1.66, (95\% CI [1.37, 2.01])$; however, when the culprit was absent confidence was not significantly associated with accuracy, $B = 0.12, SE = 0.07, Wald's \chi^2(1) = 2.41, p = .12, e^B = 1.12, (95\% CI [0.97, 1.30])$.

**General Discussion**

The above experiments demonstrate two important phenomena: (1) that the strength-based mirror effect generalizes to the eyewitness identification context, and (2) that witness decision criteria are malleable at the time of the lineup task. We have shown that a weak sense of recognition lowers eyewitnesses’ decision criteria regardless of whether the weak sense of recognition is due to poor encoding conditions or due to noisy retrieval conditions. Although there is a lot of evidence that people will set a lower decision criterion on a recognition task if the encoding conditions are poor (e.g.,
Weak Memory Leads Witnesses to Lower Their Criteria

Lampinen et al., 2014; Stretch & Wixted, 1998), there are only a handful of studies from the basic recognition literature that have examined how poor retrieval conditions impact decision criteria (Hockley et al., 1998; Kent et al., 2018). Experiment 2 is the first lineup experiment to demonstrate that degraded retrieval conditions lead witnesses to lower their decision criteria. At a theoretical level, the results of Experiment 2 indicate that the decision criteria that eyewitnesses use for a lineup are influenced by the match-to-memory experience on the lineup task. That is, regardless of why an eyewitness’ experience leads them to feel as though none of lineup members is a good match their memory of the culprit, the weak recognition experience itself leads them to lower the amount of evidence required for an identification.

The magnitude of the effects observed in these two experiments are quite remarkable. In Experiment 1, the mistaken identification rate increased from 21% for the clear-viewing conditions to 57% for the degraded-viewing conditions. Likewise, in Experiment 2, the mistaken identification rate increased from 39% in the clear culprit-absent lineup to 73% in the degraded culprit-absent lineup. Clearly, decreasing the number of high-quality cues available to the eyewitness had a drastic impact on the mistaken identification rate.

The most profound theoretical implication of these results is that they provide indirect support for the present-absent criteria discrepancy theory (Smith et al., 2018). Past research has demonstrated that manipulations of decision criterion can decrease innocent-suspect identifications to a greater extent than culprit identifications (Eisen, Smith, Olaguez, & Skerritt-Perta, 2017; Smith et al., 2018). Other research has shown that witnesses who encounter culprit-absent procedures report having had worse encoding
conditions than do witnesses who encounter culprit-present procedures (Bradfield et al., 2002). Both of these patterns are consistent with present-absent criteria discrepancy, but connecting either of these effects to present-absent criteria discrepancy requires one to assume that decision criteria are malleable during a lineup task. Experiment 2 provides strong support for the assumption that witnesses’ decision criteria are not fixed prior to observing the lineup but instead are influenced by the lineup itself. Indeed, witness-participants who viewed a degraded lineup set their decision criteria lower than did participants who viewed a clear lineup, as evidenced by the increase in false identifications of innocent persons when the lineup was degraded. Because the clear-lineup and degraded-lineup conditions were identical up until the lineup task, it is clear that the criterion-changing effect occurred during the identification task.

The current findings add to growing evidence that the mere absence of the culprit from a lineup leads witnesses to set a lower decision criterion. After all, removing the culprit from the lineup produces an all-noise situation that would be expected to mimic what happens when the lineup images are degraded by noise (i.e., lowering of the decision criterion). Notice the strong parallelism in Experiment 2 for what happens to false alarms when the culprit-present lineup is made noisy (false alarms go from 10.7% to 39.7%), and what happens when the lineup images are clear but the culprit is removed (false alarms from 10.7% to 38.6%). It makes sense that weakening the recognition experience by removing the culprit from the lineup would have the same type of effect (lowering decision criteria) as weakening the recognition experience by degrading the lineup images. Indeed, these are two different ways to operationalize a weak match-to-memory.
Prior to present-absent criteria discrepancy hypothesis, our theories and models of eyewitness identification had assumed that the decision criterion that eyewitnesses use for culprit-present lineups is the same criterion that they use for culprit-absent lineups (e.g., Clark, 2003; Wixted & Mickes, 2014). Implicit in the idea that witnesses who encounter culprit-absent lineups use the same decision criteria as witnesses who encounter culprit-present lineups is the assumption that decision criteria are uninfluenced by the match-to-memory experience on the lineup task. The results of Experiment 2 demonstrate that this assumption is erroneous. Degrading the quality of photos on the lineup task led to an increase in false alarms. Clearly, degrading photos did not make the lineup members a better match to the witnesses’ memories for the culprit. Instead, degrading the photos increased false alarm rates because the degraded match to memory led witnesses to lower their criteria for identification.

Limitations and Future Directions

**Differentiation versus Criterion Shift Accounts.** Overall, these data are consistent with the idea that eyewitnesses set a lower decision criterion when the recognition experience at test is weak rather than strong, regardless of whether the weak recognition experience is due to poor encoding conditions or degraded retrieval conditions. There is, however, a potential alternative account of why false alarms increase when encoding and retrieval conditions are impoverished. The differentiation account (e.g., Criss, 2006; 2009) postulates that poor encoding conditions result in a memory representation that has more potential to be confused with (or is more difficult to differentiate from) a similar foil than when encoding conditions are good. Although the differentiation account has focused primarily on good versus poor encoding, this account could easily be extended to
good versus poor retrieval conditions. Indeed, an extension of the differentiation account would postulate that poor retrieval conditions result in a memory representation that has more potential to be confused with a similar foil than when retrieval conditions are good.

We cannot definitively rule out the differentiation account. In effect, however, the differentiation account postulates that the increase in false alarms from poor encoding or retrieval conditions is due to an increase in witnesses’ perceived similarity (reduced ability to detect dissimilarities) between their memory of the culprit and a similar foil rather than due to a lowering of decision criterion. Both accounts predict a rise in false alarms when encoding and retrieval conditions are degraded. However, it is not clear why the differentiation account would predict that witnesses’ confidence in their false alarms would be reduced by poor encoding and retrieval conditions. The lowering of criterion account, in contrast, clearly predicts that the increased false alarms from poor encoding and retrieval conditions will be made with lower confidence, which is what the current experiments found. Of course, some version of the differentiation hypothesis might be able to explain this reduction in confidence. At this point, however, we agree with the dominant interpretation in the basic literature that these strength-based mirror effects are the result of changes in decision criteria (e.g., Wixted & Gaiten, 2002).

**Re-evaluating eyewitness decision strategies.** The findings from the present experiments have interesting implications for eyewitness decision strategies that have been implemented with the WITNESS model (Clark, 2003). Many of the different decision rules that have historically been implemented in the WITNESS model should be re-evaluated in light of strength-based mirror effect data. For example, in the introduction of this paper, we noted that one relative-judgment strategy assumes that witnesses only
make an identification if the best-matching lineup member is a sufficiently better match-to-memory than are all remaining lineup members (Clark et al., 2011). Clearly, degrading either encoding or retrieval conditions (as we did in Experiments 1 and 2) makes the recognition task more difficult. And, when recognition tasks become more difficult, the extent to which a witness prefers one lineup member over the rest should also decrease (because everyone is starting to look more like "noise"). Yet, this did not lead witnesses to "back off" from making an identification. Rather, degrading either encoding or recognition conditions led to a sharp increase in false-positive identifications. In order to explain this pattern of results, the aforementioned relative-judgment strategy would need to assume not just that witnesses lowered their criteria for making an affirmative identification, but that witnesses lowered their criterion for what they consider a sufficiently better match-to-memory. This assumption may or may not be plausible, but our purpose is not to evaluate the viability of this particular assumption. Our purpose here is to shed some light on how the WITNESS model might leverage strength-based mirror effect data in order to discriminate among the large number of lineup decision strategies that have been examined in past works (e.g., Clark et al., 2011).

Another interesting implication for the WITNESS model is that these data clearly demonstrate that eyewitness decision criteria are malleable during the recognition task. To date, the WITNESS model has assumed that decision criteria are set in advance of the recognition task and do not change during the recognition task. The data from Experiment 2 clearly demonstrate that decision criteria are malleable during the recognition task. This introduces a new theoretical complexity that researchers will have to consider in future implementations of the WITNESS model.
Conclusion

In two experiments we have demonstrated that the strength-based mirror effect extends to eyewitness identification contexts. Perhaps the most interesting aspect of this research is what it reveals about the malleability of eyewitnesses’ decision criteria. Eyewitnesses do not necessarily set their criterion prior to the lineup task, or if they do, this criterion is malleable during the lineup task. If the lineup provides a weak match-to-memory experience, eyewitnesses will lower their criterion for making a positive identification. While previous research has demonstrated that poor encoding can influence decision criterion, we show that degrading lineup photographs at retrieval produces the same effect. It would seem that any manipulation that results in a witness having a weak match-to-memory experience on a lineup task leads the witness to lower her criterion for making an affirmative identification. One way to give a witness a weak match-to-memory experience on a lineup task is to remove the culprit from the lineup procedure. To the extent that witnesses react to the absence of the culprit in the same manner that they react to other sources of a weak match-to-memory, we would expect witnesses who encounter culprit-absent procedures to have a lower criterion for making an affirmative identification than do witnesses who encounter culprit-present procedures.
References


