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Lineup Composition, Suspect Position, and the Sequential Lineup Advantage

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N. M. Steblay, J. Dysart, S. Fulero, and R. C. L. Lindsay (2001) argued that sequential lineups reduce the likelihood of mistaken eyewitness identification. Experiment 1 replicated the design of R. C. L. Lindsay and G. L. Wells (1985), the first study to show the sequential lineup advantage. However, the innocent suspect was chosen at a lower rate in the simultaneous lineup, and no sequential lineup advantage was found. This led the authors to hypothesize that protection from a sequential lineup might emerge only when an innocent suspect stands out from the other lineup members. In Experiment 2, participants viewed a simultaneous or sequential lineup with either the guilty suspect or 1 of 3 innocent suspects. Lineup fairness was varied to influence the degree to which a suspect stood out. A sequential lineup advantage was found only for the unfair lineups. Additional analyses of suspect position in the sequential lineups showed an increase in the diagnosticity of suspect identifications as the suspect was placed later in the sequential lineup. These results suggest that the sequential lineup advantage is dependent on lineup composition and suspect position.

Keywords: eyewitness identification, lineup procedures, sequential lineup advantage, recognition memory

Faulty eyewitness evidence played a role in 154 of the 207 DNA exonerations (Innocence Project, 2007). Although psychologists have been aware of this problem for 100 years (Munsterberg, 1908), only in the past 30 have we begun to make progress toward enhancing the reliability of eyewitness identification evidence through greater understanding of what goes wrong, as well as techniques and suggestions designed to improve the accuracy of identifications (e.g., Wells & Olson, 2003; Wells et al., 1998).

Wells (1978) argued that researchers could make a greater impact on the problem of mistaken identification by examining the influence of variables that were under the control of the criminal justice system. The subsequent focus on these so-called system variables has resulted in a number of recommendations that enhance the accuracy of eyewitness identification. These include warning the witness that the perpetrator may or may not be in the lineup (Malpass & Devine, 1981; but see Clark, 2005), double-blind administration of the lineup (Haw & Fisher, 2004; Phillips, McAuliff, Kovera, & Cutler, 1999), increasing the nominal size of the lineup and thereby decreasing the probability that an innocent suspect would be chosen by chance (Levi, 1998), and selecting foils (known-innocent individuals) that match the description of the perpetrator provided by the witness rather than on the basis of their similarity to the suspect (Wells, Seelau, Rydell, & Luus, 1994).

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One of the most influential system-variable reforms involves how lineups are presented to a witness. Lindsay and Wells (1985) were the first to report that sequential lineup presentation can reduce the incidence of mistaken identifications. In a sequential lineup, lineup members are viewed one at a time and a witness must make a yes-or-no decision about each person as that person is presented. Witnesses also do not know how many faces they will see when they begin the identification process, which prevents them from feeling compelled to choose as they come to the end of the series of faces. Lindsay and Wells argued that the sequential lineup is superior to the simultaneous lineup (viewing all lineup members at once) because witnesses tend to make a relative judgment in a simultaneous lineup and choose the lineup member who looks most like the perpetrator (Wells, 1984). Of course, this is problematic if the police have an innocent suspect. In contrast, according to Lindsay and Wells, witnesses viewing a sequential lineup are less likely to make relative judgments. Specifically, witnesses are more likely to compare each lineup member with their memory for the perpetrator (an absolute judgment). As a result, in a sequential lineup, a witness might bypass a lineup member who resembles the perpetrator if the witness believes that a better match has yet to be shown.

Lindsay and Wells (1985) found that the diagnosticity of a suspect identification, which considers correct and false identification rates (see Wells & Lindsay, 1980), was greater for the sequential lineup than for the simultaneous lineup. Lindsay et al. (1991) showed an advantage for the sequential lineup under a range of circumstances, including a lineup in which the suspect wore the same clothing as was worn during the crime or a lineup that included poorly matched foils. A meta-analysis by Steblay, Dysart, Fulero, and Lindsay (2001) confirmed the superiority of the sequential lineup. Although both correct and false identification rates were lower in sequential lineups than in simultaneous

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lineups, the sequential superiority effect arises because the false identification decrease is proportionately larger than the correct identification decrease. Overall accuracy, computed as the sum of correct identifications and correct rejections, was higher for sequential than for simultaneous lineups.

Although most lineups in the United States are simultaneous lineups (Wogalter, Malpass, & McQuiston, 2004), various jurisdictions around the United States have begun using sequential lineups (e.g., State of New Jersey, 2001) or have evaluated their effectiveness in the field (e.g., Hennepin County, Minnesota [Klobuchar, Steblay, & Caligiuri, 2006], and the state of Illinois [Mecklenburg, 2006]). Legislation is pending in other states to make sequential lineups standard procedure (Jonsson, 2007). On the basis of the Steblay et al. (2001) meta-analysis, the movement toward the use of sequential lineup presentation seems reasonable.

However, recent findings and additional analyses, published after the Steblay et al. (2001) meta-analysis, have suggested that sequential lineups may not be superior to simultaneous lineups. For example, Meissner, Tredoux, Parker, and MacLin (2005) showed parallel decreases in correct and false identifications for sequential lineups compared with simultaneous lineups, suggesting that the sequential lineups produced a conservative shift in the response criterion, but with little change in identification accuracy. According to the criterion shift account, the false identification rate for the sequential lineup is reduced not because witnesses are discriminating better between targets and nontargets, but because they simply are less willing to choose.

McQuiston-Surrett, Malpass, and Tredoux (2006) pointed out two factors that may complicate the evaluation of sequential versus simultaneous lineups. The first is that in the sequential lineup, witnesses are typically led to believe that there are more lineup members to be viewed than there actually are. In contrast, in a simultaneous lineup, the number of lineup members is obvious to the witness. The second factor is that one overarching decision is required in a simultaneous lineup (who, if any, of these individuals committed the crime), but up to six decisions must be made in a six-person sequential lineup (Was it Number 1? Was it Number 2? etc.). Zimmerman, Malpass, and MacLin (2006) showed that the sequential lineup advantage disappeared when these two factors were equated in simultaneous and sequential lineups.

In addition to these findings, the present study was motivated by a recent meta-analysis by Clark, Howell, and Davey (in press), who compared simultaneous and sequential lineups in two different analyses. In one, they restricted their analysis to only those studies that directly compared simultaneous and sequential lineups and reported the same pattern of results as Steblay et al. (2001): greater diagnosticity of suspect identifications for sequential than for simultaneous lineups. In a second analysis, Clark et al. examined a larger corpus of simultaneous lineups, including many that were not part of a simultaneous–sequential comparison. That comparison showed that suspect identifications were equally as diagnostic in simultaneous and sequential lineups.

To explore why the diagnosticity advantage only occurred for studies that directly compared simultaneous and sequential lineups, Clark et al. (in press) compared the set of simultaneous lineups that were part of a simultaneous–sequential comparison to the broader set of simultaneous lineups that were not part of a simultaneous–sequential comparison. They found that simultaneous lineups that were part of a simultaneous–sequential comparison had higher false identification rates and lower foil identification rates in target-absent lineups than did the broader set of simultaneous lineups. In other words, the target-absent lineups used in simultaneous–sequential comparisons appeared to be more biased than the target-absent lineups that were not part of a simultaneous–sequential comparison.

This finding led us to hypothesize that the sequential lineup advantage may only occur for lineups biased against the innocent suspect, leading to an increase in false identifications relative to the sequential lineup. In other words, if the innocent suspect matches the description of the perpetrator provided by the eyewitness better than do any of the other lineup members, the innocent suspect might stand out in the simultaneous lineup. This is much less likely to occur when those same lineup members are presented sequentially.

Our first step in testing this hypothesis was to attempt a replication of the Lindsay and Wells (1985) study with one change involving the selection of foils. It appears that Lindsay and Wells constructed a biased lineup given that their innocent suspect was chosen from the simultaneous lineup at a rate (.43) approaching that of the actual perpetrator (.58). The use of a biased lineup was also promoted as a strong test of the superiority of the sequential lineup:

> Although some studies and real-world cases have demonstrated that innocent suspects may be identified even when they are not particularly similar in appearance to the criminal, a stronger test of the value of sequential lineup presentation was provided by having a similar-looking innocent suspect. (Lindsay & Wells, 1985, p. 560)

Specifically, their designated innocent suspect "was selected on the basis of pilot testing to be the most similar in appearance to the confederate of 18 available photos of men fitting the general description" (p. 560). However, there was no information provided about how the other lineup members were selected.

Our goal was to follow Lindsay and Wells's (1985) procedures. However, we used foils who resembled the perpetrator such that the innocent suspect did not stand out. The results of Experiment 1 show no evidence for a sequential lineup advantage. Moreover, the low choosing rate for our innocent suspect, coupled with the meta-analysis of Clark et al. (in press), led us to propose that the likely reason for this failure is that the sequential lineup advantage is dependent on the use of a biased lineup. This led us to manipulate the level of lineup bias in Experiment 2.

Experiment 1

Experiment 1 was designed to be a replication of the procedures used by Lindsay and Wells (1985). All participants for Experiments 1 and 2 were treated in compliance with the ethical standards of the American Psychological Association and the University of Oklahoma Institutional Review Board.

Method

Participants

Eighty-four students from the University of Oklahoma assisted with the development of the materials used in this experiment. One hundred ninety-three students participated in the staged-crime ex-

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periment. All participants signed up through an online program that allowed the students to participate in experiments as part of a course requirement.

Materials

The faces used for the lineup foils and the replacement for the confederate–perpetrator were obtained from the Arkansas Department of Correction Web site (http://www.state.ar.us/doc/inmate_info) with search parameters corresponding to the physical characteristics of the confederate (perpetrator): Caucasian male; brown hair; brown eyes; between 200 and 230 lb; between 5 ft, 11 in., and 6 ft, 2 in.; and between 20 and 25 years old. Information about these seven characteristics was available in the database for each inmate. The ranges were chosen so that a sufficiently large pool of faces was extracted. From this pool, Curt A. Carlson attempted to find faces that looked like the perpetrator and selected 20.

A group of 15 participants compared these 20 faces with the perpetrator's to find the face that was most similar in appearance. The face with the greatest average similarity rating became the innocent suspect. Once a face was chosen as the innocent suspect, the five faces that were chosen as the next-best matches to the perpetrator were used as foils for both the target-present and target-absent lineups. Note that the same foils were used in both the target-present and the target-absent lineups (as Lindsay and Wells, 1985, did).

An effective size estimate was obtained for the target-present lineup following the procedures of Malpass (1981). Unlike the nominal size of the lineup, which is often held constant at six individuals, effective size provides more information by revealing how many members match the description of the perpetrator provided by the eyewitness. We used Tredoux's E' (Tredoux, 1998) as our effective size estimate because it, unlike Malpass's (1981) original measure of effective size, is based on a known sampling distribution. Otherwise, it is essentially the same measure. Tredoux's E' takes a maximum value of k (equal to the nominal lineup size) and a minimum value of 1. If some lineup members garner fewer choices than expected by chance, this will cause the value of E' to decrease from k toward 1 depending on the number of lineup members falling at or below chance levels of choosing.

Sixty-nine participants served as mock witnesses by spending a couple of minutes learning the description of the perpetrator (they did not see his face) and then picking from the lineup the individual who best matched the description. The result was an effective size of 3.78 (95% confidence interval = 3.29–4.43). An effective size of 3.78 compares favorably with estimates from archival studies. For example, Steblay (personal communication, October 1, 2006) found that the effective size for a subset of 37 of the 280 six-person lineups used in the Hennepin County field study was 3.72. Valentine and Heaton (1999) analyzed 16 live and 25 photo lineups. The mean effective size ranged from 4.24 to 4.46 for these nine-person lineups.

Procedure

The participants (in groups of up to 6) were brought into a waiting area and were told by the experimenter, "Please have a seat. I'm running a little late and need to finish setting up the computers for your experiment. I'll be back in just a few minutes." After about 30 s, the confederate, a 20-year-old male Caucasian, entered the room and said, "Sorry, I didn't know anyone was going to be in here. I'll get out of your way in just a minute." As he said this, he looked directly at each participant to ensure that they viewed his face. He subsequently rummaged through a cabinet directly next to the participants until he found a pink purse. On finding the purse, he quickly left the room. The duration of the staged crime was 20–30 s.

The experimenter returned immediately after the perpetrator left and told the participants that they had just witnessed a staged crime. They were separated into their own cubicles with a computer and instructed to write a detailed description of the perpetrator. The descriptions were collected about 5 min after the mock crime. Participants were next randomly assigned to complete either a simultaneous or a sequential lineup.

Before the sequential lineup, participants read the following:

> You are about to view a sequential lineup containing 12 individuals. Each member of the lineup will be presented one at a time. The lineup may or may not contain the criminal—you must decide whether or not he is present. Your goal is to press the "y" key to indicate "yes, this is the criminal," or press the "n" key to indicate "no, this is not the criminal." After pressing "y" or "n," you will immediately see the next face in the lineup. However, only your first "y" response counts.

Participants were told that there would be 12 members of the lineup even though there were only 6 to prevent them from lowering their choosing criterion as they neared the end of the lineup. After the experimenter answered any questions, the participants began the lineup by pressing the spacebar. Each face was presented individually in the center of the screen, and the next face came up immediately after a response was made. The order of the lineup members was random. "None of the above" was registered if each of the six faces was rejected. The instructions before a simultaneous lineup were as follows:

> You are about to view a simultaneous lineup. All of the members of the lineup will be presented at once. The lineup may or may not contain the criminal—you must decide whether or not he is present. Your goal is to press the number (1–6) corresponding to the criminal's face. If the criminal is not present, press the zero key.

All instructions and lineup members were presented to each participant on a computer screen (35.6 cm diagonal) using the E' program (Schneider, Eschman, & Zuccolotto, 2002). Note that because the experimenter read the instructions to the participants, the experimenter knew what kind of lineup was being tested. However, computer control of the experiment prevented any experimenter influence on the participants' choice. Furthermore, the experimenter was not aware whether a lineup included the perpetrator or the innocent suspect.

The lineup was presented after the experimenter answered any questions. The participants were randomly assigned to view a lineup that contained the perpetrator or a lineup in which the perpetrator was removed and replaced with the innocent suspect. Three different versions were counterbalanced across participants, each with the perpetrator (or innocent suspect for the target-absent lineup) in a different position. During the sequential lineup, the lineup members were presented in the center of the screen (8.9

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cm × 12.7 cm). For the simultaneous lineup, the six faces (6.0 cm × 7.5 cm, with 1.5 cm between each face) were presented in two rows of three. Each participant was seated at a desk approximately 45 cm from the computer screen.

Results and Discussion

T1 Table 1 shows the data from the current study on the left and the Lindsay and Wells (1985) data on the right. "ID suspect" constitutes a correct choice of the perpetrator in the target-present lineup or an incorrect choice of the innocent suspect in the target-absent lineup; "ID foil" constitutes the choice of any of the five foils; and "No ID" indicates that the participant made no selection from the lineup.

Lindsay and Wells (1985) found no significant difference in the rate at which the perpetrator was chosen from the target-present lineups, whereas we found a nonsignificant simultaneous advantage, $\chi^2(1, N = 102) = 3.05$, $p = .08$. They also found that the innocent suspect was chosen more often in the simultaneous lineup, contrary to the present results, which showed no difference, $\chi^2(1, N = 91) = .469$, $p = .49$. Finally, they reported that the sequential lineup showed a significantly higher diagnosticity than did the simultaneous lineup (3.06 vs. 1.35). That is, a suspect identification was more diagnostic of the suspect's guilt in a sequential lineup than in a simultaneous lineup. Our data showed the opposite. However, because the false identification rates were very low in the present experiment, which tend to give extremely high ratios, we evaluated the relative diagnosticity statistically by computing Cohen's h for the target-present and target-absent difference for simultaneous and sequential lineups and then computed a z score from h (Cohen, 1988, p. 209). These two z scores, one for simultaneous lineups and one for sequential lineups, can be compared by taking their difference divided by $\sqrt{2}$ (see Rosenthal, 1991, p. 62). This analysis showed that the diagnosticity advantage for the simultaneous lineup was not significant ($z = 1.81$, $p = .07$).

Experiment 1 did not replicate the sequential lineup advantage shown by Lindsay and Wells (1985). An obvious difference between the two sets of results was that Lindsay and Wells's participants selected the innocent suspect in the simultaneous lineup at a much higher rate than did our participants (.43 vs. .02). This was accompanied by a small decrease in the hit rate for their perpetrator (.58) compared with ours (.72) for the simultaneous lineup. Although the reduced false alarm rate might be due to our perpetrator's being better encoded or inherently more identifiable than Lindsay and Wells's perpetrator, the greater extent of the false alarm rate drop compared with the hit rate increase led us to posit that lineup fairness was more important than the quality of encoding of the perpetrator. However, because the sequential lineup advantage arises in large part from false identification rate differences, the absence of a sequential lineup advantage in Experiment 1 could have been due to the floor effect produced by an innocent suspect who lacked sufficient similarity to the perpetrator. In Experiment 2, innocent suspects were selected in such a way as to ensure high similarity to the perpetrator.

The primary goal of Experiment 2 was to vary lineup fairness to assess the robustness of the sequential lineup advantage. The Experiment 1 results indicate that our target-absent lineups were not biased (and no sequential lineup advantage was found). Considering only those witnesses who made any identification from a target-absent lineup, the proportion who chose the innocent suspect did not deviate from chance. In contrast, most of the published simultaneous–sequential lineup comparisons have reported innocent suspect identification rates (considering only those witnesses who made any identification) that are considerably above chance.

A second issue explored in Experiment 2 concerns the placement of the suspect in the sequential lineup. Lindsay and Wells (1985) reported no differences as a function of whether the suspect was presented in the first, third, or fifth position in the sequential lineup. Sporer (1993) also found no differences due to the target's position. Perhaps because of these results, subsequent studies often fixed the position of the suspect, and other studies that did vary the position did not examine position effects. Fewer than half of the simultaneous–sequential comparisons listed in McQuiston-Surrett et al.'s (2006, pp. 144–149) Table 1, for which information about counterbalancing was available, counterbalanced the position of the target in sequential lineups. Early reports showing no effect of target position may have led researchers to assume that it no longer needed to be considered.

Clark and Davey (2005) found that the identification rate for the target was lower when the target appeared later in the sequential lineup and was preceded by a high-similarity foil than when the target appeared earlier in the lineup, before that same high-similarity foil. The explanation was that witnesses who saw the high-similarity foil first essentially "spent" their choice on the foil before the target was presented. A similar argument was offered by Memon and Gabbert (2003). Although in their study the target was fixed in the fourth position, they suggested that the very low

Table 1
Comparison of Experiment 1 With Lindsay and Wells (1985)

	Experiment 1				Lindsay & Wells (1985)			
	Target present		Target absent		Target present		Target absent	
AQ: T1	Sim	Seq	Sim	Seq	Sim	Seq	Sim	Seq
ID suspect	.72 (.06)	.57 (.07)	**.02** (.02)	.05 (.03)	.58 (.06)	.50 (.06)	**.43** (.06)	.17 (.05)
ID foil	.08 (.04)	.02 (.02)	.21 (.06)	.12 (.05)	.12 (.04)	.02 (.02)	.15 (.05)	.18 (.05)
No ID	.21 (.06)	.41 (.07)	.77 (.06)	.84 (.06)	.30 (.06)	.48 (.06)	.42 (.06)	.65 (.06)
N	53	49	48	43	60	60	60	60

Note. Standard errors are presented in parentheses. Boldface indicates the key comparison of interest and motivation for Experiment 2. Sim = simultaneous lineups; Seq = sequential lineups; ID = identification.

correct identification rates for older witnesses may have been because “older adults may find it more difficult to ignore ‘familiar’ foils” (p. 345), and they concluded, “The position of the target may be critical in determining the effects of sequential testing.” In Experiment 2, the position of the suspect was random for both target-present and target-absent sequential lineups.

Experiment 2

Experiment 2 tested the hypothesis that the sequential lineup advantage in false identification rate arises only when target-absent lineups are biased. Experiment 2 consisted of four phases, each of which is described in turn and each of which involved a unique set of participants. We conducted the first two phases of the experiment to obtain stimulus materials appropriate for the experimental conditions but with minimal experimenter influence. Specifically, the goal of Phase 1 was to obtain a set of faces that looked similar to the perpetrator. Three innocent suspects were selected, and each was placed in a different target-absent lineup as an innocent suspect. Phase 2 involved the selection of a variety of foils, including good ones that matched the description of the perpetrator, and bad ones that only partially matched the description. We used this information to construct target-present and target-absent lineups that varied in lineup fairness. Phase 3 assessed the effective size of each lineup to ensure that we had indeed constructed lineups that were biased, intermediate, or fair. Finally, Phase 4 required a final set of participants to view a staged-crime video and, a short while later, attempt to identify the perpetrator from a lineup. The participants in Phase 4 viewed only one lineup that was either target present or target absent and was conducted simultaneously or sequentially at one of three levels of lineup fairness (biased, intermediate, or fair).

Phase 1—Selecting Innocent Suspects

Participants

Thirty students from the University of Oklahoma participated in this phase of the experiment.

Procedure

Twenty participants first watched a short (approximately 4-min) video on their computer depicting a mock crime (the same video used by Clark & Davey, 2005). The video starts with a female college student talking with another student in a computer lab, and then the camera follows her as she leaves the room, walks down a hallway, goes outside, and walks across a parking lot to her car. Shortly before she reaches her car she is carjacked by a Caucasian male in his early 20s. The carjacking itself lasts only a few seconds and the perpetrator’s face is only visible for about 2 s. However, the viewpoint is only a few feet from the perpetrator’s face.

Immediately following the video, participants were told

> The victim of the carjacking gave the police the following description: White male, between 5′4′′ and 5′11′′, hazel or brown eyes, brown hair, between 20 and 28 years old, and between 150 and 190 pounds. Use the description provided by the victim and what you remember about what the carjacker looked like, and search the Florida Department of Corrections database (http://www.dc.state.fl.us/activeoffenders/search.asp) to see if he is among the photos. Enter the above information as search criteria, or modify them slightly to fit your memory of the carjacker. Do not enter any search criteria not involving his physical description (i.e., criminal history, county, current location). Also, assume that the perpetrator still looks like he did during the time of the carjacking. In other words, he does not have facial hair, and his hair is still as long, and the same color, as what it looked like in the video.

The age, height, and weight ranges encompassed the perpetrator’s actual characteristics and were chosen so that a pool of approximately 1,000 photographs was extracted. The particular characteristics chosen corresponded to the possible search criteria in the Florida database. The participants’ first goal was to find several (up to 12) faces that looked like the carjacker and then to select the one that could be the carjacker (they had to pick one).

From the dozens of faces selected by the first set of participants, a second group of 10 participants chose the six individuals who best matched the picture of the perpetrator (which we provided to them). These participants never saw the crime video but instead chose from this pool of witness-selected suspects. The faces chosen from the pool of witness-selected suspects tentatively became the innocent suspects in the target-absent lineups.

Phase 2—Selecting Foils

Participants

Forty-two students from the University of Oklahoma participated in this phase.

Procedure

Participants performed the role of the police officer or technician creating the photographic lineup by selecting foils. Because they were acting in the role of police officers, they did not see the videotape of the crime and used the description of the perpetrator to search the same online database used in Phase 1.

To obtain a large number of good and bad foils for subsequent lineup construction, participants were instructed to choose faces as either a “good cop” or a “bad cop.” Good cops were told to pick people who matched the description of the perpetrator. Bad cops were told to pick people who only partially matched the description. They were told that these individuals had to match the description well enough for a judge to allow them in a lineup, but did not have to be such good matches that an eyewitness would choose one instead of the perpetrator.

Using the good and bad foils provided by the participants in Phase 2, we constructed nine lineups at each level of lineup fairness. To create the biased lineups, five bad foils were placed with the guilty or the innocent suspect. To create the intermediate lineups, three bad foils and two good foils were placed with the appropriate suspect. To create the fair lineups, five good foils were placed with the appropriate suspect. No foil was used in more than one lineup. In sum, at each level of lineup fairness the nine lineups consisted of three lineups with the perpetrator (different foils in each) and one lineup for each of the six different innocent suspects selected in Phase 1 (different foils in each). We used different foils in the target-present and target-absent lineups at each level of lineup fairness because of Clark and Tunnicliff’s (2001) finding that the same-foils design results in an underestimation of the

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number of false identifications. It is also more realistic to have different foils in target-present and target-absent lineups because the suspect around whom the lineup is built necessarily differs in the two cases.

Phase 3—Evaluating Lineups

This phase was divided into two parts. In Phase 3a, a group of participants evaluated the lineups from Phase 2, leading to the eventual set of 18 lineups used in Phase 4. In Phase 3b, a second group of participants provided revised effective size estimates for these 18 lineups.

Phase 3a

Participants. Sixty-nine students from the University of Oklahoma completed the initial evaluation cycle.

Procedure. The participants viewed the 27 lineups (one at a time) from Phase 2. They first read the description of the perpetrator used in Phase 1 (White male; between 5 ft, 4 in., and 5 ft, 11 in.; hazel or brown eyes; brown hair; between 20 and 28 years old; and between 150 and 190 pounds) and then viewed each lineup with the goal of picking the person who best matched the description. Participants were reminded of the description before each new lineup to prevent them from forgetting any part of it during the multiple lineup evaluations. The lineups were evaluated in the same order for all participants.

Participant choices were combined and used to calculate Tredoux's E' for each lineup (Tredoux, 1998). These results showed choosing rates for three of the six innocent suspects that were so low that we questioned whether they looked sufficiently like the perpetrator. These three innocent suspects were dropped from the experiment. Also, the results indicated that some of the Phase 2 participants in the bad cop condition did not select sufficiently low-similarity foils. This was probably because the Phase 2 participants never actually saw a picture of the perpetrator and therefore were confused about how to use the description to find bad matches. Thus, some additional bad foils were selected from the Florida database to replace foils that were chosen too often from the biased lineups in Phase 3a. Twenty new participants gave us choice data that were used to compute effective size estimates for these modified lineups to verify that they were sufficiently biased. These procedures yielded 18 lineups: three target-present lineups (same perpetrator but different foils in each) and three target-absent lineups (different innocent suspect and foils in each) at each level of lineup fairness.

Phase 3b

When participants selected foils in Phase 2, they were given the standard description that did not mention hair length. Failing to mention hair length resulted in the selection of a number of foils with shaved heads. These individuals, whom even the most jaded observer of the video in Phase 4 could likely reject, resulted in effective size estimates from the Phase 3a participants that did not accurately capture the fairness of the various lineups. In other words, the description used to evaluate effective size by the Phase 3a participants was incomplete. We did not notice this problem until all the Phase 4 data had been collected.

The problem became apparent after another group of 54 participants who never saw the video simply ranked the three innocent suspects on the basis of their similarity to the perpetrator. We found that the best-matching innocent suspect was chosen at a lower rate in Phase 4 than the next-best-matching innocent suspect. This led us to look closely at the foils in their respective lineups and realize that several of the foils in the next-best's lineup had shaved heads. As a result, the Phase 3a effective size estimates may have been inflated for the lineups that contained the shaved-head foils. Although these individuals adequately matched the standard description that failed to mention hair length, when these same lineups were considered by those who witnessed the mock crime in Phase 4, the shaved-head foils were never chosen. It is for these reasons that we undertook Phase 3b.

Participants. A new group of 40 participants provided choice data that were used to compute effective size estimates for the 18 lineups from Phase 3a.

Procedure. The only change from Phase 3a involved the addition of the descriptor—"hair: average length." When hair length was included as part of the description, the shaved-head foils were rarely chosen as matching the description. Table 2 gives the effective size estimates for each of these lineups using the description that included hair length. To assign them to level of lineup fairness, the lineups were ordered by effective size and divided into thirds: The three lineups with the lowest effective size were assigned to the biased category, the next three lineups were assigned to the intermediate category, and the three lineups with the greatest effective size were assigned to the fair category. As Table 2 shows, the differences in effective size within a category were not as homogeneous as we intended. Furthermore, for the target-absent lineups, each level of lineup fairness did not include a lineup that incorporated each innocent suspect. Nevertheless, there was still a wide range of lineup fairness across the three categories. Note that a reanalysis of the data on the basis of just two levels of T2

Table 2
Tredoux's E′ and Suspect Bias for Each Lineup in Experiment 2 When Hair Length Was Included as a Descriptor

Effective size	Target present		Target absent	
	E'	Suspect bias	E'	Suspect bias
Biased	1.40	0.83	1.05	0.97
	1.77	0.69	1.71	0.77
	1.89	0.71	1.87	0.70
M	1.69	0.74	1.54	0.81
Intermediate	1.98	0.68	2.01	0.65
	2.14	0.59	3.22	0.33
	3.56	0.39	3.54	0.13
M	2.56	0.55	2.92	0.37
Fair	3.65	0.26	3.72	0.24
	4.13	0.21	4.78	0.16
	4.38	0.18	5.27	0.15
M	4.05	0.22	4.59	0.18

Note. The three target-present and three target-absent lineups with the lowest effective size were assigned to the biased category, the next three of each were assigned to the intermediate category, and the three target-present and three target-absent lineups with the greatest effective size were assigned to the fair category. Suspect bias is the proportion of participants who chose the suspect.

lineup fairness (Tredoux's E' less than 2.02 vs. Tredoux's E' greater than 3.5, excluding the intermediate target-absent lineup at 3.22; see Table 2) was also conducted. Our conclusions were unchanged by this analysis, and in fact they are more generalizable because of the increase in *n*s. AQ: 1

Phase 4—Eyewitness Identification Experiment

Participants and Design

Six hundred nineteen students from the University of Oklahoma completed Phase 4. Between 46 and 66 students participated in each condition of the 3 (lineup fairness: biased, intermediate, or fair) × 2 (simultaneous vs. sequential lineup) × 2 (target present vs. target absent) between-subjects design. We counterbalanced which of the three innocent suspects or which of the three target-present lineups were viewed. Multiple versions of the lineups for a given condition were used to avoid conclusions being based on the specifics of the particular photos in the lineups rather than on the independent variables of interest (Wells & Windschitl, 1999).

Procedure

Participants (in groups of up to 6) began by viewing the carjacking video. Each participant was seated separately in his or her cubicle. They were not told anything before the video, although they might have recalled that they signed up for a study involving "playing the role of police officer or eyewitness." The informed consent read just before viewing the video was vague regarding exactly what they were about to do. After watching the video, participants worked on a word-find task for 5 min. Following this task, they read instructions for either a simultaneous or a sequential lineup. The instructions were similar to those used in Experiment 1, and all participants were told that the carjacker might or might not be present in the lineup. The perpetrator or the innocent suspect was placed in a random position for each of the sequential lineups and was counterbalanced by position in the simultaneous lineups.

The photos for the simultaneous lineup were presented in a 2 × 3 matrix and were numbered from 1 to 6. Participants entered the number corresponding to the face they identified as the carjacker or pressed the *N* key to indicate none of the above. For the sequential lineup, as each lineup member was presented participants pressed the *Y* or *N* key to indicate "yes, this is the carjacker" or "no, this is not the carjacker." Regardless of their decision for each face, they always viewed the entire sequential lineup but were told that only their first yes response counted. Additionally, they did not know how many photos they were going to see.

Results and Discussion

T3 Results from Experiment 2 are shown in Table 3. Logistic regression analyses were completed for both the correct identification rates (choosing the perpetrator from a target-present lineup) and the false identification rates (choosing the innocent suspect from a target-absent lineup).

The simultaneous lineup was 1.6 times more likely to result in a correct identification than was the sequential lineup, $\chi^2(1, N = 301) = 4.08$, $p = .04$, log odds ratio effect size (ES_{lor}) = 0.16. Also, correct identification rates increased as the lineups became more biased, $\chi^2(2, N = 301) = 16.24$, $p < .001$, $ES_{lor} = 0.04$.

Table 3
Results From Experiment 2: Target-Present and Target-Absent Lineups at Each Level of Lineup Fairness

Lineup fairness	Target present		Target absent	
	Sim	Seq	Sim	Seq
Biased				
ID suspect	.71 (.06)	.46 (.07)	.64 (.06)	.33 (.07)
ID foil	.06 (.03)	.02 (.02)	.12 (.04)	.09 (.04)
No ID	.24 (.06)	.52 (.07)	.24 (.06)	.59 (.07)
N	51	52	59[a]	46
Intermediate				
ID suspect	.43 (.07)	.24 (.06)	.30 (.06)	.38 (.07)
ID foil	.26 (.06)	.24 (.06)	.23 (.05)	.17 (.05)
No ID	.32 (.07)	.53 (.07)	.47 (.06)	.46 (.07)
N	47	51	66[a]	48
Fair				
ID suspect	.31 (.06)	.41 (.07)	.16 (.05)	.20 (.06)
ID foil	.22 (.06)	.20 (.06)	.51 (.07)	.16 (.05)
No ID	.47 (.07)	.39 (.07)	.33 (.07)	.64 (.07)
N	51	49	49	50

Note. Standard errors are presented in parentheses. Sim = simultaneous lineups; Seq = sequential lineups; ID = identification.
[a]An error during data collection resulted in more participants in these conditions.

However, these main effects were qualified by an interaction between lineup fairness and lineup presentation method, $\chi^2(2, N = 301) = 7.17$, $p = .03$. There was a simultaneous advantage for biased lineups, $\chi^2(1, N = 103) = 6.32$, $p = .01$, $ES_{lor} = 1.79$, but correct identification rates were equivalent between the simultaneous and the sequential lineups for intermediate and fair lineups. The top panel of Figure 1 shows the correct identification proportions for the simultaneous and sequential lineups at the three levels of lineup fairness. F1

For the false identification data, there was no difference between the simultaneous and sequential lineup overall, $\chi^2(1, N = 318) = 2.76$, $p > .05$, $ES_{lor} = 0.98$. False identification rates increased as the lineups became more biased, $\chi^2(2, N = 318) = 23.74$, $p < .001$, $ES_{lor} = 0.45$; however, like the correct identification data, this main effect was qualified by an interaction between lineup fairness and presentation method, $\chi^2(2, N = 318) = 9.78$, $p = .0075$. As can be seen in the bottom panel of Figure 1, the sequential lineup advantage (reduced false identification rate) was only present for biased lineups, $\chi^2(1, N = 105) = 10.46$, $p = .001$, $ES_{lor} = 1.15$; there was no advantage for either lineup if the lineups were intermediate or fair. AQ: 2

As predicted, biased lineups constructed from foils that were a poor match to the perpetrator and innocent suspects who were a good match to the perpetrator produced a sequential lineup advantage in false identification rate. However, this sequential advantage in the false identification rate was accompanied by a simultaneous advantage in the correct identification rate for biased lineups. Clearly, if a simultaneous lineup is biased, the decision criterion is affected and participants are more likely to choose. This is advantageous if the suspect in the lineup is guilty, but has negative consequences if the suspect is innocent. Examination of Table 3 reveals that both the hit and the false alarm rates for the simultaneous lineups were more affected by lineup bias than were the hit

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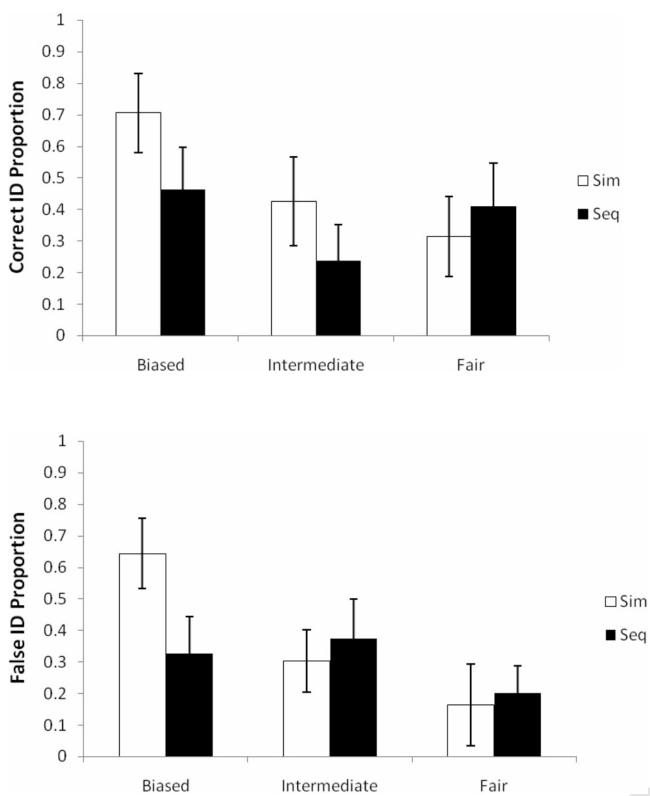

Figure 1. A comparison of simultaneous (Sim) and sequential (Seq) lineup correct identification (top panel) and false identification (bottom panel) proportions at each level of lineup fairness from Experiment 2. Bars represent 95% confidence intervals. ID = identification.

and the false alarm rates for the sequential lineups. Because the sequential lineup was not as vulnerable to the variation in lineup fairness and because we cannot control the fairness of the lineups created by the police, some might consider the sequential lineup a safer option if it results in less variability in responding as a function of lineup fairness.

Three three-way logistic analyses of variance (one for each level of lineup fairness) were conducted comparing the diagnosticities F2 of simultaneous to sequential lineups (see Figure 2). Diagnosticity was computed as p(chose perpetrator)/[p(chose perpetrator) + p(chose innocent suspect)]. In this way, information from both correct and incorrect identifications is combined into an overall assessment of accuracy. There was a significant simultaneous AQ: 3 advantage for the intermediate lineup, χ^2(?; N = ?) = 4.09, p = .04, but no difference between simultaneous and sequential lineups if biased, χ^2(?; N = ?) = 0.24, p = .62, or fair, χ^2(?; N = ?) = 0.06, p = .81. An examination of the correct and false identification rates for the intermediate lineup showed that the simultaneous advantage resulted from an elevated false identification rate for the sequential lineup. This may have something to do with the method we used to create intermediate lineups. Rather than choosing medium-good foils, our intermediate lineups consisted of two good foils and three bad foils. This meant that the ordering of the good and bad foils may have affected a participant's willingness to choose (see Clark & Davey, 2005). However, this turned out not to be the case. In the sequential lineup, the innocent suspect was only slightly more likely to be chosen when he followed one or more bad foils (10/24 = .42) than when he followed one or more good foils (5/13 = .38). These are conditional probabilities, such that they include only those participants who did not choose a foil before seeing the target. The low *n*s are due to the fact that the order of the members in each lineup were randomized across participants, and this makes it difficult to draw any conclusions from this comparison. Thus, this issue should be studied more systematically in the future.

Suspect Position Analyses

We also performed three analyses on the basis of the suspect's position in the lineup, the results of which are shown in Figure 3, F3
with each analysis collapsed over the three levels of lineup fairness. In addition, to stabilize the response frequencies, Suspect Positions 1 and 2 are combined, as are Positions 3 and 4 and Positions 5 and 6.

Panel A of Figure 3 shows the overall identification rates, including both suspect and foil identifications. As Clark and Davey (2005) noted, if the criterion does not vary as a function of the different orderings of lineup members, then the rejection rates will also not vary. In other words, provided that the criterion remains fixed, six lineup members will be below that criterion, irrespective of their order. The results for target-absent lineups showed this flat pattern, $\chi^2(2, N = 144) = 0.25$. However, for target-present lineups, the identification rate increased as the suspect was presented later in the lineup, $\chi^2(2, N = 152) = 7.76$, $p = .021$, $ES_{lor} = 1.51$.

Panel B of Figure 3 shows that this increase in the overall identification rate translated into an increase in correct identifications of the guilty suspect. Correct identification rates did not differ from false identification rates when the suspect was in the first two positions, $\chi^2(2, N = 86) = 0.187$, $p = .65$, $ES_{lor} = 1.51$, or in the middle positions, $\chi^2(2, 110) = 1.848$, $p = .174$, $ES_{lor} = 0.98$. However, the correct identification rate did rise significantly above the false identification rate when the suspect was placed in the last two positions of the lineup, $\chi^2(2, N = 100) = 4.30$, $p = .038$, $ES_{lor} = 0.65$.

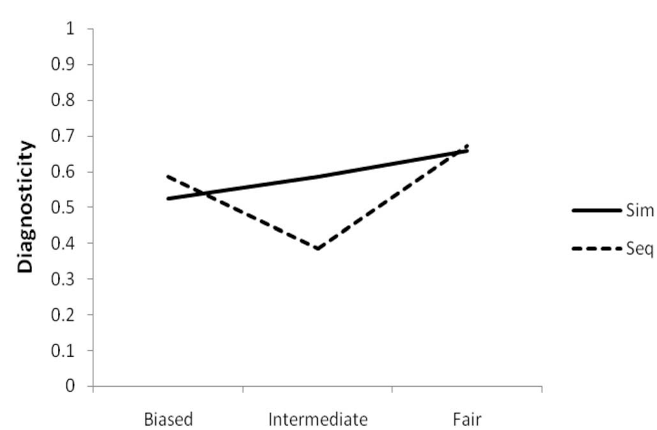

Figure 2. Diagnosticity of suspect identifications in simultaneous (Sim) and sequential (Seq) lineups for each level of lineup fairness.

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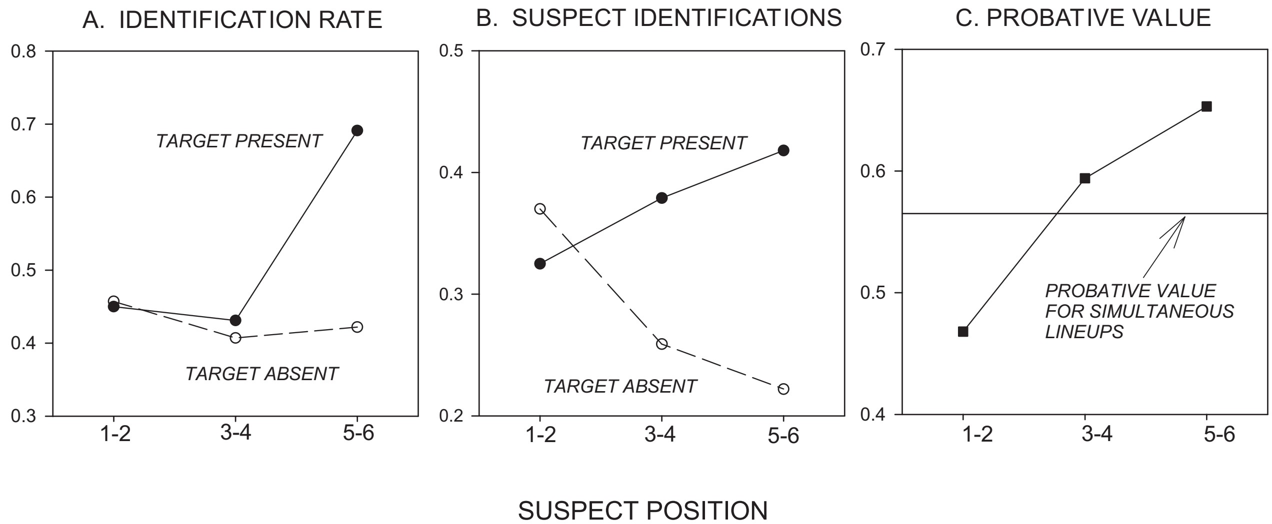

Figure 3. Identification rate (A), suspect identification rate (B), and diagnosticity as a function of target position in sequential lineup (C) collapsed over Positions 1–2, 3–4, and 5–6. The data are collapsed over innocent suspect and lineup fairness. Eighty-six participants are represented in Positions 1–2; 110 in Positions 3–4; and 100 in Positions 5–6.

The rise of correct identification rates over false identification rates with later placement of the suspect in the lineup produced a corresponding increase in the diagnosticity of a suspect identification. The diagnosticity results are shown in Panel C. The diagnosticity of suspect identifications for simultaneous lineups is shown as a flat line for comparison purposes. When the suspect was presented earlier, the diagnosticity of suspect identifications was lower in sequential lineups than in simultaneous lineups. However, when the suspect was presented later in the lineup, particularly in the last two positions, the suspect identifications were more diagnostic in sequential lineups than in simultaneous lineups.

General Discussion

We are not questioning the reality of the sequential lineup advantage in false identification rate found in previous studies, but rather its generality and robustness. Sequential lineups are beneficial in biased circumstances (see Lindsay et al., 1991), but the present data suggest that it may be incorrect to conclude that if a sequential lineup is better in a bad situation than it is better in all situations. This article describes the results of two experiments and the identification data of 812 participant witnesses in a comparison of simultaneous and sequential lineups. Even with the statistical power afforded by 619 participants–witnesses in Experiment 2, the overall reduction in false identifications by the use of sequential lineup presentation (from .37 for simultaneous lineups to .30 for sequential lineups) was not statistically reliable. Moreover, this result must be considered in conjunction with the reduced correct identification rate for the sequential lineup (the simultaneous lineup was 1.6 times as likely to result in a hit).

In support of predictions and Clark et al.'s (in press) meta-analysis, only biased lineups produced a reliable sequential advantage in the false identification rate. There was no difference in false identification rate between simultaneous and sequential lineups when the lineup was intermediate or fair, leading to an interaction between lineup fairness and presentation method (see Figure 1, bottom panel).

If we are correct that the sequential lineup advantage in false identification rate only occurs in a restricted set of circumstances, how did those circumstances come to dominate the literature? We think there are two reasons. One was mentioned; the supposition that if a sequential lineup is beneficial in a bad situation, then it must be beneficial in all situations. That could still be true. After all, ours is only one contrarian study. However, it is one study that found both a sequential lineup advantage and its absence and identified factors that influence which will occur.

A second factor that may have unknowingly moved experimenters toward that same restricted portion of the study space (i.e., biased lineups) was the use by Lindsay and Wells (1985), and most other researchers working on this problem (see Clark & Tunnicliff, 2001), of the same-foils design. According to the same-foils design, a target-absent lineup is constructed by taking the target-present lineup and replacing the perpetrator with the innocent suspect. As Clark and Tunnicliff (2001) pointed out, this is an impossible lineup for the police to construct when they have a suspect who is innocent because the foils are chosen to be similar to a perpetrator whom the police do not have. As Clark and Tunnicliff suggested, eyewitness researchers may have adopted the practice of selecting the innocent suspect to be de facto the person in the lineup who is most similar to the perpetrator to balance the underestimation of innocent suspect identifications produced by the same-foils design.

Why does the sequential lineup advantage occur in this restricted set of circumstances? We consider three possibilities. One involves the degree of reliance on relative versus absolute decision processes. To make these decision processes concrete, we consider

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how they have been conceptualized in Clark's (2003) WITNESS model. The second involves the contributions of familiarity and recollection. The third involves the role of learning during the sequential lineup.

In a simultaneous lineup, the WITNESS model calculates a weighted sum of relative and absolute match information. To begin, the match strength is computed for each lineup member. The lineup member who is the best match to the memory of the perpetrator is chosen if the weighted sum of the best match (BEST, the absolute contribution), plus the difference between the best match and the next-best match (DIFF = BEST – NEXT, the relative contribution), exceeds a decision criterion: Choose BEST: If w_A*(BEST) + w_R*(DIFF) > CRITERION, where $(w_A + w_R) = 1.0$

In other words, a lineup member is chosen if he or she is a good match to the perpetrator or is sufficiently better than any other match. Two special cases of the model are defined by the values of w_A and w_R. If $w_A = 1$, the decision rule is based solely on the value of the best match, and if $w_R = 1$, the decision rule is based solely on the value of the best match relative to the match values of the other lineup members. In that way, absolute and relative decision rules can be instantiated within the WITNESS model.

Following Lindsay and Wells (1985), the value of w_R would be high for simultaneous lineups, but the value of w_A would be high for sequential lineups. Hence, the lineup member with the highest match to memory might be identified in a simultaneous lineup for which the BEST − NEXT difference is large, but might not be identified in a sequential lineup where BEST is below criterion. In other words, simultaneous–sequential differences are most likely to arise when BEST is not above criterion, but the BEST − NEXT difference is large. This is consistent with the circumstances that produced a sequential lineup advantage in Experiment 2: an innocent suspect who matches the description of the perpetrator in a lineup with foils, each of whom are poor matches to the description.

A second possible conceptualization of the sequential lineup advantage derives from dual-process models of recognition memory and the distinction between familiarity and recollection (Humphreys, 1976; Jacoby, 1991; Mandler, 1980; see Yonelinas, 2002, for a review). Familiarity is akin to the computation of match values in the WITNESS model, whereas recollection involves the retrieval of specific content from memory. If one individual in the simultaneous lineup stands out sufficiently from the others on the basis of a considerable familiarity advantage, participants may feel no need to further interrogate their memory. This might be what happens in a biased simultaneous lineup. However, this is less likely to happen in a sequential lineup for two reasons. First, the sequential nature of the presentation hinders the degree to which the perpetrator or the innocent suspect stands out. Second, because recollection requires more cognitive resources than does familiarity (e.g., Craik, Govoni, Naveh-Benjamin, & Anderson, 1996) and the sequential lineup allows a decision to be made about one face at a time, more resources are available to interrogate memory in a sequential lineup (Gronlund, 2005). Furthermore, this dual-process perspective is consistent with the finding that the simultaneous disadvantage in false identification rate disappears in fairer lineups: In a fair simultaneous lineup, the innocent suspect no longer stands out, and further interrogation of memory is necessary to distinguish among the foils. Moreover, it is possible that the relative–absolute conceptualization and the familiarity–recollection conceptualization are not theoretical competitors (Gronlund, 2005): Relative decision processes may be implemented by a familiarity process, and an absolute decision process may rely on a contribution from recollection.

Another consideration regarding simultaneous–sequential comparisons is the prospect that witnesses, in the course of sequential lineups, may learn from their exposure to foils presented before the suspect. Our position analyses showed that correct identifications increased when the (guilty) suspect was presented later in the lineup, false identifications of the innocent suspect remained constant, and consequently the diagnosticity of suspect identifications increased. Over the course of sequential testing, witnesses may learn something about the pool of photographs or may have optimized the positioning of their decision criterion. A deeper understanding of the role of such learning mechanisms remains for future research.

Legal and Policy Implications

Experiment 2 was consistent with previous experiments in showing lower overall identification rates for sequential lineups than for simultaneous lineups (Steblay et al., 2001). However, in Experiment 2 the simultaneous lineup was twice as likely to result in an identification attempt compared with the sequential lineup, $\chi^2(1, N = 619) = 20.05$, $p < .05$, $ES_{lor} = 1.24$. This was most extreme for biased lineups, which resulted in a 76% choosing rate for simultaneous lineups compared with a 50% rate for sequential lineups (intermediate, 61% vs. 51%; fair, 60% vs. 49%). Choosing rate (criterion placement) is an important factor to consider as we unravel the effects of sequential and simultaneous lineups. Although a reduced choosing rate protects the innocent suspect in a target-absent lineup, it can result in a guilty suspect failing to be identified from a target-present lineup.

To fully understand the impact of lineup presentation method and lineup bias on witness accuracy, we need to examine how memory and decision processes interact in these situations. Clark's (2003) WITNESS model provides an excellent place to begin this effort. McQuiston-Surrett et al. (2006) echoed this view. They argued that one of the important factors to consider when research results are used to develop public policy recommendations like the move to sequential lineups is the provision of a definitive theoretical understanding for the recommendations. Specifically, additional research could distinguish among the three explanations outlined above, on the basis of distinctions between decision rules (absolute vs. relative judgments), memory processes (familiarity vs. recollection), and the possible role of learning during the sequential lineup.

As a practical matter, the present results showed a sequential lineup advantage only when lineups were biased or when the suspect was presented later in the sequential lineup. Sequential lineups showed no advantage in Experiment 1 when false identification rates were low. When the innocent suspect was at less risk (Experiment 1; intermediate and fair lineups in Experiment 2), the sequential lineup offered no additional protection, and sometimes resulted in a lower rate of correct identification of the perpetrator. Of course, law enforcement cannot know a priori whether their suspect is innocent or of high similarity to the actual perpetrator or whether their lineup is biased (although that could be assessed), and the sequential lineup may provide protection for the innocent suspect in such worst-case scenarios.

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