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Simultaneous, Sequential, Elimination, and Wildcard: A Comparison of Lineup Procedures

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Abstract This study compared four lineup procedures: the simultaneous, sequential, elimination, and wildcard. Two hundred and sixty-nine university students (M = 20.17 years) watched a mock, videotaped crime. Then, following a brief delay, they viewed a 6-person target-present or -absent lineup using one of the four lineup procedures. For target-present lineups, correct identification rates for the four lineup procedures were comparable. In contrast, for target-absent lineups, the correct rejection rate was higher using the elimination lineup procedure compared to the wildcard and simultaneous lineup procedures. Remaining comparisons between lineup procedures found no significant differences. Also diagnosticity ratios were similar across the four procedures.

Keywords Elimination lineup · Simultaneous lineup · Sequential lineup · Eyewitness identification

Eyewitness identification is the leading cause of known wrongful convictions (Innocence Project, 2012). Police used a simultaneous lineup procedure (i.e., presenting all lineup members at one time) for identification in many of these cases. Researchers have developed a number of procedures in an attempt to reduce false positive identification. In 1985, Lindsay and Wells developed the sequential lineup procedure, in which the witness views lineup members individually. In addition, Pozzulo and Lindsay (1999) developed the elimination procedure, and, more recently, Zajac and Karageorge (2009) developed the simultaneous lineup with a "wildcard" (i.e., silhouette with a superimposed question mark) procedure (hereafter referred to as the wildcard procedure) with the aim of reducing false positive responding with children. There is ongoing debate regarding which lineup procedure elicits the most accurate identification decision. For example, while the sequential procedure has been thought to be more diagnostic of guilt than the simultaneous (Steblay, Dysart, & Wells, 2011), results from recent research using Receiver Operating Characteristic (ROC) analysis challenges the presumed superiority of the sequential lineup procedure over the simultaneous (e.g., Gronlund et al., 2012; Mickes, Flowe, & Wixted, 2012).

The justice system faces a number of difficulties when multiple procedures are available for different aged witnesses. For example, judges may deem identification evidence inadmissible if the defence challenges the use of a particular procedure, claiming it was inappropriate for the specific situation. Moreover, the amount of training and specialized personnel required to assess the witness and administer the appropriate lineup procedure may be costly and unrealistic given times of budget limitations. If one identification procedure could be used with all aged witnesses (and under all conditions), no decisions on which identification procedure to use would be required for law enforcement and court challenges could be minimized.

Each procedure has its own strengths and weaknesses. For example, it would be relatively simple and inexpensive to add a silhouette with a superimposed question mark to the simultaneous lineup, if the wildcard procedure proves effective with adult populations. The current study compared the simultaneous, sequential, elimination, and wildcard lineup procedures with adult participants under both target-present and target-absent conditions.

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The Simultaneous Lineup Procedure

In the simultaneous lineup procedure, witnesses view all lineup members at the same time. This procedure is the most commonly used lineup procedure in the United States (Police Executive Research Forum, 2013). Critics of this procedure point out that it encourages the use of a relative judgment; that is, the comparison across lineup members resulting in the selection of the person who most closely resembles the culprit (Wells, 1993). When the suspect is guilty, the use of a relative judgment is not usually a problem; the suspect will be most likely to look like the culprit in comparison to other lineup members, since the suspect *is* the culprit. On the other hand, in a situation where the suspect is innocent, a relative judgment can lead to a false positive identification.

The Sequential Lineup Procedure

The sequential lineup procedure is the most commonly used procedure in Canada (Beaudry & Lindsay, 2006). Lindsay and Wells (1985) designed the sequential lineup procedure to reduce the likelihood that a relative judgment is used and to increase the likelihood that an absolute judgment is used; that is, witnesses compare each lineup member to their memory of the culprit rather than to other lineup members. Moreover, lineup members with the sequential procedure do not appear together. Sequentially presenting each lineup member facilitates this absolute judgment. Eyewitnesses must make a decision as to whether the lineup member is the culprit at the time of presentation, and they are not able to change their decision once presented with the next lineup member. A debate exists as to whether a criterion shift, i.e., a more conservative decision threshold, is responsible for performance differences between the sequential and simultaneous lineup procedures, rather than the use of different decision-making processes (e.g., Dobolyi & Dodson, 2013; Meissner, Tredoux, Parker, & MacLin, 2005). There has been support for both sides of this argument (e.g., Gronlund, 2004; Palmer & Brewer, 2012). The focus of the present paper, however, is on the accuracy of the procedures more than the reasons for the differences between them.

Simultaneous or sequential: Which is best? It is still not clear as to whether the sequential lineup increases identification accuracy in comparison to the simultaneous lineup. Sequential lineups may reduce false positive responding compared to simultaneous lineups with adults (Steblay et al., 2011). Steblay, Dysart, Fulero, and Lindsay's (2001) meta-analysis suggested that the sequential lineup was superior in almost all situations in comparison to the simultaneous lineup. In a follow-up meta-analysis, Steblay et al. (2011) also found the sequential lineup to be better at diagnosing the guilt of a suspect in comparison to the simultaneous lineup. However, as mentioned previously, recent research using ROC analysis challenges the superiority of the sequential lineup, claiming that the simultaneous lineup is at least as diagnostic, if not more diagnostic, than the sequential (e.g., Dobolyi & Dodson, 2013; Mickes et al., 2012). Wells (2014) argues the sequential lineup procedure has more probative value than the simultaneous lineup procedure, as the ratio of correct to incorrect identifications is higher with the sequential lineup procedure; however, Gronlund, Wixted, and Mickes (2014) argue that ROC analysis is the preferred method to determine which of the lineup types is superior. Regardless, the sequential lineup appears to be problematic for some populations (e.g., children) and under some conditions (e.g., multi-perpetrator crimes; Pozzulo & Lindsay, 1998). For example, in comparison to the simultaneous lineup, the sequential lineup widens the gap between children and adults' correct rejections, with children producing fewer correct rejections and adults producing more (Pozzulo & Lindsay, 1998).

The Elimination Lineup Procedure

Pozzulo and Lindsay (1999) developed the elimination lineup procedure in order to narrow the correct rejection gap between children and adults by reducing children's higher false positive rate (Pozzulo & Lindsay, 1998). The elimination procedure uses a simultaneous presentation but has witnesses make two judgments. First, witnesses pick out the lineup member who looks most like the culprit, referred to as Judgment 1. Once the witness selects a photo, the administrator removes all other lineup members. Second, witnesses are asked if the most similar lineup member is in fact the culprit (i.e., target), which is referred to as Judgment 2. Judgment 1 is relative and Judgment 2 is absolute, combining the judgments used in simultaneous and sequential lineup procedures. The elimination procedure has been found to maintain correct identification rates while increasing correct rejection rates to a level comparable to adults with child participants (i.e., even if the sequential procedure is used; Pozzulo & Lindsay, 1999). Moreover, the elimination procedure produces this pattern of identification for pre-schoolers, adults, and under various conditions (e.g., multi-perpetrators; Dempsey & Pozzulo, 2013; Pozzulo & Balfour, 2006; Pozzulo et al., 2008; Pozzulo, Dempsey, & Crescini, 2009).

The elimination procedure also allows for an additional piece of evidence, termed "survival status." The notion behind survival status is that if the suspect is guilty, it is most likely that he/she will look most like him/herself compared to the other lineup members. This notion is similar to echoic similarity discussed by Navon (1990) in that selecting a person from a lineup suggests that the person selected resembles the culprit in some way. Similarly, Wells (1993) has suggested

that a "pick" from a lineup indicates that this lineup member resembles the culprit. In the elimination procedure, if the suspect survives Judgment 1, then the likelihood that the suspect is guilty *increases*; correspondingly, if the suspect does not survive Judgment 1, then the likelihood that the suspect is guilty *decreases*. In this way, one can view identification evidence as a gradation of incriminating evidence rather than a binary decision of guilt. Should the suspect survive the relative judgment but the witness does not identify the suspect as the culprit in Judgment 2, this would warrant further investigation regarding the guilt of the suspect. On the other hand, if the witness does not select the suspect at Judgment 1 and then identifies a known innocent person (i.e., filler) at Judgment 2, this would provide information to question the credibility of the eyewitness. The fact the witness did not select the suspect at Judgment 1 also provides police with the information that the suspect's likelihood of guilt is not as high as if s/he had been selected. However, a selection at Judgment 1 is not equivalent to an identification, which occurs at Judgment 2; since Judgment 1 is a forced choice, a lineup member is always selected even when the suspect is not guilty. The Judgement 1 selection can only indicate an increase or decrease in the likelihood of the suspect's guilt.

The elimination procedure is a departure from a standard simultaneous procedure or the sequential procedure, and as such, the criminal justice system may view it with some skepticism. The system may be resistant and reluctant to adopt such an alternative procedure; however, if a simple tweak can be made to a procedure that currently is in use (e.g., simultaneous lineup), then this procedure may be more readily accepted and adopted for real world use. The simultaneous lineup with a wildcard has such a tweak for consideration.

The Wildcard Lineup Procedure

Over the years, a number of researchers have attempted to modify the simultaneous procedure with the addition of a graphical representation of "Not Here" (e.g., a Mr. Nobody card, a silhouette, a silhouette with a superimposed question mark, etc.) for use with children to decrease false positive responding (e.g., Beal, Schmitt, & Dekle, 1995; Davies, Tarrant, & Flin, 1989; Karageorge & Zajac, 2011; Zajac & Karageorge, 2009; Havard & Memon, 2013). The researchers added these graphical cards as a concrete option for witnesses to choose if they did not see the target. Participants select the wildcard if they do not see the target in the lineup.

The data to date on the use of this additional card is inconsistent. Beal and colleagues (1995) concluded, albeit cautiously, that the presence of a "Not Here" card was not a major factor in a child's decision accuracy. Davies et al. (1989) also found non-significant results. However, both of these studies were underpowered with trends toward the predicted direction. Pozzulo and Lindsay (1997) created a number of modifications to the traditional simultaneous lineup, by adding both "I Don't Know" and "Not Here" response options, and tested this modified procedure with children aged 10 to 14 years. Pozzulo and Lindsay (1997) found that the "I Don't Know" response option increased choosing for both target-present and -absent lineups. In a similar study, Brewer, Keast, and Sauer (2010) examined children that were approximately 12 years of age using "Not Sure" as well as "Not There" options and found that the mere presence of the "Not Sure" option did not increase identification accuracy.

Contrary to this research, Zajac and Karageorge (2009) concluded that the presence of the wildcard did not affect accuracy when the target was present and significantly increased accuracy when the target was absent. Karageorge and Zajac (2011) conducted a follow-up study involving the wildcard lineup procedure using a biased lineup, in which the innocent suspect was more similar to the guilty suspect in comparison to the other foils used. The wildcard lineup procedure resulted in a lower rate of false positive identification than the simultaneous lineup procedure. The rate of correct identifications remained comparable between the two lineup procedures. Havard and Memon (2013) also found for children aged 5-7 and 8-11 years that when a "mystery man" (a black silhouette with a white question mark) was included, false positive identifications were reduced compared to when the mystery man was not used while correct identifications remained comparable.

Given some discrepancy of results across wildcard alternatives, possibly due to low power, the current study used the most effective form of a wildcard as reported in Zajac and Karageorge (2009) and Karageorge and Zajac (2011), and compared this procedure to the traditional simultaneous, sequential, and elimination procedure (i.e., fast elimination in Pozzulo & Lindsay, 1999) with adult witnesses. Target-present and -absent lineups were used to determine differences between correct identification and correct rejection rates.

Present Study

In an effort to help determine which procedure is the most effective when used with adults, the present study directly compared four lineup procedures: the simultaneous, the sequential, the elimination, and the wildcard. No study has compared all four of these procedures at the same time. Furthermore, no study has directly compared the elimination and wildcard procedures with each other, or examined the wildcard procedure with an adult sample. The wildcard lineup procedure used in the present study was similar to that used by Zajac and Karageorge (2009; also Karageorge & Zajac, 2011), in order to keep the comparison between the wildcard and other lineup procedures as fair as possible.

Predictions We predicted that all four lineup procedures would produce comparable correct identification rates, as this is consistent with prior research (e.g., Pozzulo & Lindsay, 1999; Pozzulo et al., 2008). Compared to the wildcard procedure or the simultaneous procedure, the elimination procedure may be more likely to encourage an absolute judgment given that it requests one explicitly, and absolute judgments may increase correct rejections (e.g., Lindsay & Wells, 1985; Wells, 1993). We predicted that the correct rejection rate would be higher with the elimination procedure compared to the wildcard procedure and the simultaneous lineup (target-absent lineups). Like the elimination procedure, the sequential lineup procedure requests absolute judgments, given only one photograph appears at a time. We predicted that the correct rejection rates for the elimination and sequential lineup procedures would be comparable, similar to results from prior research (e.g., Pozzulo et al., 2008).

Method

Participants

Two hundred and sixty-nine undergraduate students (age range: 16-50 years, $M = 20.17$ years, $SD = 3.83$) were recruited from the first year psychology participant pool at a university in Eastern Ontario. One-hundred and ninety participants were female, 80 were male, and four chose not to report their sex. All participants received partial class credit for their participation.

Design

This study was a 4 (lineup procedure: elimination vs. wildcard vs. simultaneous vs. sequential) x 2 (lineup type: target-present vs. target-absent) between-subjects factorial design.

Materials

Video All participants viewed a silent video, approximately 60 seconds in length, depicting a staged, non-violent theft occurring on the university campus. The video commenced with a young man sitting on a bench. The lens focused on this man for approximately four seconds, panned in for a closer look for 10 seconds, and then backed out. As the screen panned out a young woman sitting on a nearby bench was visible. The woman got up from the bench to deposit something in the garbage, leaving her bag unattended. The man then casually got up from his bench, took the bag and left the scene.

Demographic form After viewing the video, participants filled out a demographic form, which asked for the participant's age and sex.

Description form Participants completed a description form that instructed them to write down everything they could remember about the crime and everything they could remember about the culprit. The description form was a filler task to simulate a real world scenario.

Filler task Following the completion of the description form, participants filled out a hockey-team themed word search for approximately 25 minutes in order to release any potential effects from verbal overshadowing (e.g., Finger & Pezdek, 1999; Memon & Bartlett, 2002). In a real world investigation, it is uncommon that one would view a crime followed by a lineup 25 minutes later; however, due to the limited resources and time constraints experienced by many eyewitness researchers a short time delay is typical. In addition, because the same 25-minute delay occurred across all conditions, any issue (e.g., higher accuracy rate in the current study than in real life) would be consistent across conditions. There is no reason to believe that the delay would have a differential effect as a function of lineup procedure.

Photographic lineups Thirty photos resembling the target were used to construct a six-person lineup. Most police officers use this method of similarity-to-suspect when selecting foils for their lineups (Clark, Howell, & Davey, 2008). The photos were color, head and upper body photographs measuring approximately 4 x 6 inches. Two independent judges rank ordered the photos based on similarity to the target in order to determine which were best suited to be tested as foils. Six photos were chosen based on the judges' lowest total rank, indicating high similarity to the target. Five photos as well as the target's photo comprised the target-present lineup. The same five photos and a target replacement photo made up the target-absent lineup.

Ten volunteers viewed the crime video and provided witness descriptions of the target. These mock witnesses' descriptions were assimilated and used to ensure sufficient similarity/dissimilarity as per the suggestion by Luus and Wells (1991; also Wells, Rydell, & Seelau, 1993). An additional 35 volunteers were provided the assimilated description and shown the six foils and the target; they were asked to identify the perpetrator based on the description. Results indicated a fair lineup with each lineup member receiving a proportional number of identifications, proportion (*binomial probability*): lineup member 1 = .09(*.14*); member 2 = .17(*.16*); member 3 = .23(*.06*); member 4 = .06(*.08*); member 5 = .23(*.06*); member 6 (target) = .06(*.08*); member 7 = .17(*.16*); Tredoux's E = 5.65, 95% CI [4.61, 7.27].

For all lineup procedures, the location of the target or replacement photograph was randomly determined. The other lineup members appeared in the same order relative to each other. Lineups presented using the wildcard procedure also included a picture of a blacked-out silhouette with a superimposed question mark upon it, see Figure 1 (as per Karageorge & Zajac, 2011, see Figure 2).

Simultaneous lineup procedure. The lineup photographs appeared simultaneously in two rows, each of which had three photographs. Participants heard the following instructions prior to viewing the lineup: "Think back to the video. Think back to what the culprit looks like. I am going to show you some pictures. Please look at the pictures. The culprit's picture may or may not be here. If you see the culprit's picture, please place a check mark in the box matching the culprit's lineup number. If you do not see the culprit, please put a check mark in the box marked not here. Now let's look at the photos." The simultaneous identification form consisted of the simultaneous lineup instructions as well as six boxes, each corresponding to a photograph in the lineup and presented identically to the way participants saw the lineup photographs. Participants recorded their choice on the form after they made their decision.

Sequential lineup procedure. Participants viewed the lineup photographs sequentially with the following instructions: "Think back to the video. Think back to what the culprit looks like. I am going to show you some pictures. Please look at each picture. The culprit's picture may or may not be here. If the picture is of the culprit, please place a check mark next to 'yes.' If it is not a picture of the culprit, please place a check mark next to 'no.' Please note that you will NOT be able to re-examine any pictures. Also, you will NOT be allowed to move forward until you make a decision about the picture you are looking at." The sequential lineup response form provided space for nine responses, each of which asked "Is #n the criminal?" with "Yes" or "No" provided as the possible responses. Participants were not informed of the number of photographs they would be viewing, in order to prevent them from making a decision based on pressure that there were no/few photographs left to view, as recommended by Beaudry, Lindsay, and Dupuis (2006).

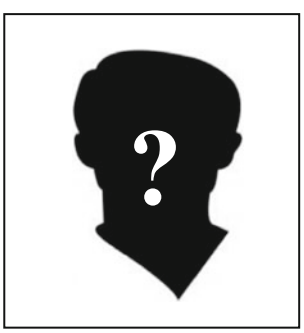

Figure 1 The wildcard used in the present study.

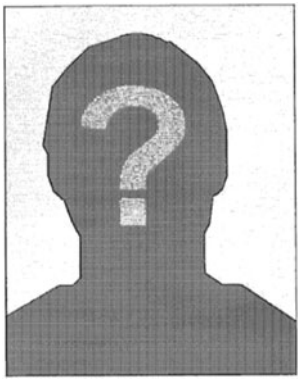

Figure 2 Wildcard used in the Karageorge and Zajac (2011) study.

While some implementations of the sequential lineup involve stopping after a photograph is identified as the culprit, participants in the present study were shown all photographs regardless of whether a "yes" was selected for any of the photographs. Lindsay and Wells (1985) used this technique when they developed the sequential lineup procedure; a great deal of subsequent research also used a sequential procedure that did not stop once a selection had been made (Carlson, Gronlund, & Clark, 2008; Gronlund, Carlson, Dailey, & Goodsell, 2009; Lindsay, Lea, & Fulford, 1991). Furthermore, this is the procedure that is used in some police jurisdictions in Canada. An advantage of not stopping at the first selection is that multiple identifications can occur when all photographs are shown, which can potentially provide information regarding the eyewitness's accuracy.

Elimination lineup procedure. Participants viewed the lineup photographs simultaneously in two rows of three and heard the following instructions prior to viewing the lineup, in order to allow for a relative judgment: "Think back to the video. Think back to what the culprit looks like. I am going to show you some pictures. Please look at the pictures. The culprit's picture may or may not be here. To start off, please pick out the person who looks MOST like the culprit. Now let's look at the photos." Participants then chose a photograph and all other photographs were removed. At this point, participants completed an elimination lineup response form.

Next, the lineup administrator provided the following instructions, in order to allow for an absolute judgment: "Try to remember what the culprit looks like. Compare your memory of the culprit to the picture you picked. Remember that this may or may not be a picture of the culprit. If this is a picture of the culprit, please place a check mark beside 'Yes, this is a picture of the culprit.' If this is a picture of someone else, please place a check mark beside 'No, this is not a picture of the culprit.'" The elimination lineup response form provided to participants included a choice of two corresponding lines upon which to place a checkmark. Participants placed a checkmark on the appropriate line at this time.

Wildcard lineup procedure. As in the elimination lineup procedure, participants viewed the lineup photographs simultaneously. However, this time there were three rows of photographs. The first row contained the first three photographs, the second row contained only the wildcard, centred, and the third row contained the final three photographs (as per Karageorge & Zajac, 2011; Zajac & Karageorge, 2009).

Participants heard the following instructions prior to viewing the lineup: "Think back to the video. Think back to what the culprit looks like. I am going to show you some pictures. Please look at the pictures. The culprit's picture may or may not be here. If you see the culprit's picture, please point to him. If you do not see the culprit, please point to this special photo in the middle. Now let's look at the photos." The wildcard identification form consisted of the wildcard lineup instructions as well as seven boxes, each corresponding to a photograph in the lineup and presented identically to the way participants viewed the lineup photographs. The box corresponding to the wildcard included a picture of the silhouette with the question mark superimposed. The experimenter retained the wildcard identification form at all times, and recorded the participant's choice on the form after he or she made a decision, in order to duplicate the wildcard procedure used by Zajac and Karageorge (2009).[1]

Procedure

Participants completed the study individually in the laboratory. Participants first viewed the video of the crime. After the video, the true nature of the study was explained to participants and they were provided the opportunity to withdraw from the study if desired, while still receiving course credit. All participants agreed to continue. Participants were then asked to fill out the demographic form and the description form, and then to complete the word search. After these filler tasks, which took approximately 25 minutes to complete, participants were presented with either the elimination, wildcard, simultaneous, or sequential lineup[2] procedure, with the target being present or absent in the lineup.

Results

Identification data were divided into target-present lineup decisions and target-absent lineup decisions given response accuracy differs across lineup type; that is, making a selection versus rejecting the lineup (Pozzulo & Lindsay, 1998). It has been postulated that cognitive factors may drive correct identification decisions to a greater degree than social factors, whereas social factors may play a greater role than cognitive factors for correct rejection decisions (Pozzulo, Dempsey, Bruer, & Sheahan, 2012). Moreover, combining correct identifications with correct rejections may obscure advantages (or disadvantages) of one procedure over another. For example, one procedure may elicit more correct rejections but fewer correct identifications or vice versa, combining data from target-present and -absent conditions may suggest a procedure produces no difference in accuracy overall.

Target-present Lineups

In order to examine differences in correct identification rates between the four lineup procedures a chi-square test was performed. Results indicated that there was no significant difference in accuracy rates between the lineups overall, $\chi^2(3, N = 137) = 7.47$, $p = .06$, Cramer's $V = .23$, 95% CI [0.15, 0.40]. See Table 1 for correct identification rates as a function of lineup type.

Target-absent Lineups

In order to examine differences in correct rejection rates between the four lineups a chi-square was calculated. Correct rejection rates differed significantly across the four lineup procedures, $\chi^2(3, N = 137) = 8.09$, $p = .04$, Cramer's $V = .24$, 95% CI [0.15, 0.40]. See Table 1 for rejection rates as a function of lineup type.

In order to determine how these groups differed in terms of correct rejection rates, follow-up chi-square tests were completed. All possible pairwise comparisons, six in total, were completed using a Bonferroni corrected alpha level ($\alpha = .008$).

Table 1 Identification Accuracy (n) as a Function of Lineup Procedure

	Lineup Type			
	Simultaneous	Sequential	Elimination	Wildcard
Target-present	(*n* = 35)	(*n* = 32)	(*n* = 35)	(*n* = 35)
Correct Identification	0.65 (23)	0.38 (12)	0.46 (16)	0.63 (22)
Foil Identification	0.14 (5)	0.19 (6)	0.09 (3)	0.26 (9)
False Rejection	0.20 (7)	0.44 (14)	0.46 (16)	0.11 (4)
Target-absent	(*n* = 35)	(*n* = 32)	(*n* = 35)	(*n* = 35)
Correct Rejection	0.46 (16)	0.59 (19)	0.77 (27)	0.51 (18)
*False Positive	0.54 (19)	0.41 (13)	0.23 (8)	0.49 (17)

**Note*: False positive rate is the rate of identification for all lineup members collapsed.

[1] As can be seen in Figures 1 and 2, there are differences between the two wildcards. We attempted to make the wildcard used as close to that used by Karageorge and Zajac (2011) as possible; we do not believe the differences that do exist are sufficient to influence results.

[2] Data for the sequential lineup procedure were collected after the other procedures. As a result, this procedure was not randomized with the others. All other aspects of data collection for this procedure were followed in-line with the other procedures.

Use of the elimination lineup resulted in a significantly higher rate of correct rejection (.77) compared to use of the simultaneous lineup (.46), $\chi^2(1, N = 70) = 7.30$, $p = .007$, odds ratio (OR) = 4.01, 95% CI [1.43, 11.25]. Furthermore, while participants presented with an elimination lineup were not significantly more likely to correctly reject the lineup (.77) compared to participants presented with the wildcard lineup procedure (.51), $\chi^2(1, N = 70) = 5.04$, $p = .02$, OR = 3.19, 95% CI [1.14, 8.93] using the Bonferroni-correct alpha level, there was a trend in the expected direction.

The remaining comparisons produced non-significant results. Use of the elimination lineup (.77) did not significantly differ from use of the sequential lineup (.59), $\chi^2(1, N = 67) = 2.45$, $p = .12$, OR = 2.31, 95% CI [0.80, 6.65]. Similarly, use of the sequential lineup procedure (.59) resulted in non-significant differences in correct rejection rates in comparison to the wildcard lineup procedure (.51), $\chi^2(1, N = 67) = 0.43$, $p = .51$, OR = 1.38, 95% CI [0.52, 3.63], and the simultaneous lineup procedure (.46), $\chi^2(1, N = 67) = 1.25$, $p = .26$, OR = 1.74, 95% CI [0.66, 4.58]. Participants presented with the simultaneous or wildcard lineup procedures produced comparable correct rejection rates (.46 vs. .51), $\chi^2(1, N = 70) = 0.23$, $p = .63$, OR = 0.80, 95% CI [0.31, 2.03].

Survival Rates

The survival rate refers to the rate that a lineup member is selected during the relative judgment phase (Judgment 1) of the elimination lineup procedure; i.e., the lineup member *survives* to be the only member examined in the absolute judgment phase. This information is not applicable to the simultaneous, sequential, or wildcard lineup procedures, as there is only one judgment phase for these procedures. For the elimination lineup procedure, it is suggested that if the survivor in Judgment 1 is not the suspect then the likelihood that the suspect is guilty decreases (Pozzulo & Lindsay, 1999).

For target-present lineups, the guilty suspect (i.e., thief) survived Judgment 1 at a rate of .80. A binomial test indicated that this rate was significantly higher than the survival rate of the other lineup members combined, $p < .001$. See Table 2 for survival rates and identification rates as a function of lineup member and lineup type. For target-absent lineups, the most frequently chosen lineup member (i.e., #3) survived Judgment 1 at an unexpectedly higher rate than the other lineup members, $p < .001$.

Diagnosticity

The diagnosticity of a lineup can be determined by calculating a diagnosticity ratio or a conditional probability; Wells and Lindsay (1980) identified both of these methods. Note that lineup diagnosticity values are inherently dependent on what the base-rate probability of the suspect being guilty is (Wells & Olson, 2003); however, given that the diagnosticities and conditional probabilities of different lineups are being compared to each other, the relative differences are still valid even without knowing this base rate.

The diagnosticity ratio (DR) indicates the likelihood of selecting a guilty suspect versus the likelihood of selecting an innocent suspect. In order to calculate a DR, one usually divides the number of correct identifications under target-present conditions by the number of false identifications of the suspect (as opposed to foil identifications) under target-absent conditions (i.e., correctID/ falseID). Due to the fact that there was not a foil in the target-absent lineup that was designated specifically as the innocent suspect, falseID was estimated to be the total number of false identifications divided by 6, i.e., the number of lineup members in total in the TA lineup (Clark et al., 2008). The DR was 7.26 for the simultaneous

Table 2 Survival Rates and Identification Rates as a Function of Lineup Member and Lineup Type

	Lineup Member					
	1	2	3	4	5	6
Target-present						
Simultaneous ($n = 35$)	.00	.06	.09	.00	.00	.65*
Sequential ($n = 27$)	.04	.15	.00	.00	.00	.44*
Elimination ($n = 35$)	.03 (.00)	.09 (.03)	.09 (.06)	.00 (.00)	.00 (.00)	.80 (.46)*
Wildcard ($n = 35$)	.03	.09	.14	.00	.00	.63*
Target-absent						
Simultaneous ($n = 35$)	.06	.17	.26	.00	.00	.06
Sequential ($n = 29$)	.07	.00	.14	.03	.00	.03
Elimination ($n = 35$)	.09 (.03)	.20 (.06)	.57 (.06)	.09 (.06)	.03(.00)	.03 (.03)
Wildcard ($n = 35$)	.00	.17	.31	.00	.00	.00

Note: Identification rates at Judgment 2 are in parentheses.

* guilty lineup member

lineup, 9.43 for the sequential lineup, 12.00 for the elimination lineup, and 7.76 for the wildcard lineup. Bootstrapped samples for these DRs were computed and 95% confidence intervals were then calculated. These indicated that the four lineups' DR's were not significantly different from each other.

A worst-case scenario DR was also calculated, using the false ID rate of the most-selected member at Judgement 1, rather than averaging it out across the 6 members of the target-absent lineup. The worst-case DR was 2.56 for the simultaneous lineup, 3.00 for the sequential lineup, 7.62 for the elimination lineup, and 1.45 for the wildcard lineup. Bootstrapping indicated that the elimination lineup's DR was significantly higher than the wildcard lineup's DR, 95% CI [0.45, 49.93], $p < .05$. The difference between the elimination lineup's DR and simultaneous lineup's DR approached significance, 95% CI [-0.67, 50.00], $p < .10$.

Conditional probability (CP) refers to the likelihood that a suspect is guilty if he has been identified from a lineup. This can be calculated by the formula: correctID/(correctID + falseID) (Clark et al., 2008). The CPs for the four lineups were comparable; the CP was .88 for the simultaneous lineup, .90 for the sequential lineup, .92 for the elimination lineup, and .89 for the wildcard lineup. For the elimination lineup, these diagnosticity measures only apply to Judgment 2; however, the survival status for Judgment 1 also supplies diagnostic information. The diagnosticity ratio that makes sense in this situation is to compare the likelihood of a guilty suspect surviving Judgment 1 (guiltySS) versus an innocent suspect surviving Judgment 1 (innoSS). Again, the likelihood of the innocent suspect was estimated by dividing by the total number of members in the TA lineup, as no lineup member was specifically designated as the innocent suspect. Using this estimated value, innoSS was calculated to be 0.17. In the current study, this ratio (guiltySS/innoSS) was 4.8, meaning the guilty suspect was 4.8 times more likely to be selected at Judgment 1 than an innocent suspect. The likelihood that a suspect was guilty once he survived Judgment 1 was guiltySS/(guiltySS + innoSS), or 0.83. This means that once a suspect was selected at Judgment 1, there was an 83% chance that he was guilty.

Discussion

The purpose of the present study was to compare the identification accuracy of the simultaneous, sequential, elimination, and wildcard lineup procedures. The procedures were compared against each other under both target-present and target-absent conditions. An adult sample was used to examine the robustness of procedures designed for child witnesses namely the elimination and wildcard procedures.

Lineup Procedure Performance when Target is Present

The present study found no significant difference for correct identification rate as a function of lineup procedure. These results are consistent with other studies comparing simultaneous and elimination lineup procedures with 10- to 14-year-olds (Pozzulo & Lindsay, 1999), adults (Pozzulo et al., 2008), and 3- to 6-year-olds (Pozzulo et al., 2009). Humphries, Holliday, and Flowe (2012) conducted a study comparing identification accuracy using simultaneous, sequential, and elimination video lineups with 5- to 6-year-olds, 9- to 10-year-olds, and adults. They did not find a difference in accuracy between the simultaneous and elimination lineups in target-present conditions, with both being superior to the sequential lineup. It should be noted that, unlike the present procedure, Humphries et al. (2012) used video lineups rather than static photographic lineups. Their results are encouraging for the use of the elimination lineup procedure with video lineups; however, prior research by Beresford and Blades (2006) found that while the elimination procedure produced as many correct rejections as the simultaneous lineup procedure, it had a lower correct identification rate than the simultaneous in target-present conditions. Further research with video lineups is required, due to the dearth of research for the elimination and wildcard procedures in this area.

Perhaps most intriguing with the elimination procedure is the notion of survival status; that is, the rate at which the suspect survives the first judgment, the relative judgment. This information is not applicable to the simultaneous, wildcard and sequential lineup procedures, as there is only one judgment phase for these lineups. Examination of the survival rate of the culprit using the elimination lineup procedure demonstrated that the culprit was more likely than other lineup members to survive Judgment 1. Survival rate of the suspect increases the likelihood that the suspect is guilty. A calculation of the diagnosticity of the survival status confirmed that selection of a suspect during Judgment 1 greatly increases the chances of that suspect being guilty. If guilt were conceptualized on a continuum, the survival of the suspect would increase their guilt, i.e., place them closer to the "definitely guilty" end of the continuum; the identification of the suspect at judgment two would even further increase this guilt rating.

An examination of the diagnosticity of each lineup type suggested that the elimination lineup might be better at providing information about the likely guilt or innocence of the suspect in comparison to the simultaneous and wildcard lineups, which were virtually identical in diagnosticity to each other. The chances of a suspect being guilty when selected using the elimination lineup also appeared to be slightly higher than for the other three lineup procedures.

It is important to note that there was a large drop in suspect selections from Judgement 1 (80%) to identifications in Judgment 2 (46%). This decrease from selection of the guilty

suspect to identification may suggest that the lineup procedure is violating the expected norms of a lineup identification for adult witnesses. Witnesses may perceive that a request for a second decision indicates that an error was made and hence, the correct response is to reject the lineup member. A similar notion is found when witnesses are faced with repeated questioning, more false information is provided (Sharps, Herrera, Dunn, & Alcala, 2012). Future research may want to examine whether the drop per se is a reflection of identification norms not being met.

Lineup Procedure Performance when Target is Absent

It was predicted that the elimination procedure would produce a higher correct rejection rate compared to the wildcard or simultaneous lineup procedures given that both are based on a simultaneous presentation and hence possibly lend themselves more easily to the use of relative judgment. Previous research has indicated that the elimination lineup produces a higher rate of correct rejection in comparison to the simultaneous lineup procedure (Pozzulo & Lindsay, 1999; Pozzulo et al., 2008; Pozzulo et al., 2009). It was predicted that the elimination and sequential lineup procedures would have comparable rates of correct rejections, which is consistent with the findings of previous research involving adult participants (e.g., Pozzulo et al., 2008).

As predicted, the elimination lineup procedure produced a significantly higher rate of correct rejections compared to the simultaneous lineup procedure; it also produced a higher rate of correct rejections compared to the wildcard lineup procedure, trending towards significance. No difference between the simultaneous and wildcard lineups was found, nor between the sequential and elimination lineup procedures. The elimination lineup procedure may be more likely to produce a correct rejection over the simultaneous based lineups because of its explicit request for an absolute judgment. This higher rate of correct rejections is what led to the higher diagnosticity of the elimination lineup procedure. The sequential lineup procedure performed similarly to the elimination lineup, as predicted.

Conclusion

The elimination lineup is similar in diagnosticity to the sequential lineup. The elimination procedure also provides survival status that can be helpful for investigative purposes. If a suspect survives the first judgment, police have some indication the suspect may be guilty. Conceptualizing guilt on a continuum rather than as a dichotomy may ultimately lead to outcomes that are more accurate in the criminal justice system. The present study provides impetus for continued research examining alternative methods for identification evidence. As mentioned previously, future research should include the use of video lineups. Future studies should also examine the four lineup procedures with children and older adults.

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