Journal of Applied Psychology
1993, Vol. 78, No. 1, 22-33

0021-9010/93/$3.00

Eyewitness Identification Accuracy, Confidence, and Decision Times in Simultaneous and Sequential Lineups

Siegfried Ludwig Sporer

Eyewitness identification accuracy was investigated in simultaneous and sequential lineups. Seventy-two subjects watched a film of a robbery in a public park under incidental learning conditions and returned to the laboratory the following day to answer questions about the film. Sequential lineup procedures led to significantly fewer false identifications than the simultaneous lineup mode, with comparable performance in detecting the perpetrator in target-present conditions. Alternative methods for analyzing confidence and decision times in sequential lineups are presented which allow for more fine-grained analyses of the relationships between accuracy, confidence, and decision times both between and within subjects. Distinguishing between choosers and nonchoosers, these analyses show the predictive utility of decision times and confidence as assessment variables.

Among the variety of topics studied by eyewitness researchers, the issue of person identification has been of central concern (for reviews, see Clifford & Bull, 1978; Köhnken & Sporer, 1990; Loftus, 1979; Shepherd, Ellis, & Davies, 1982; Sporer, Malpass, & Köhnken, in press; and Yarmey, 1979). Most of the available research has been designed to demonstrate the fallibility of eyewitness testimony, thus providing useful insights into the factors that determine the likelihood of an eyewitness's account being accurate. From a criminal justice perspective, these variables have been referred to as *estimator* variables because their importance can only be retrospectively estimated in a given case (Wells, 1978). In contrast, Wells has stressed the usefulness of research on so-called *system*, or control variables, that is, factors that are under the control of the criminal investigator (e.g., lineup instructions [Malpass & Devine, 1981a], interviewing techniques [Cutler, Penrod, & Martens, 1987; Malpass & Devine, 1981b], and lineup construction and presentation [Cutler & Penrod, 1988; Lindsay & Wells, 1985]).

Although the distinction between estimator and control variables has been quite useful, estimator variables can be further broken down into *situational* variables that can only be explored post hoc by consulting objective data sources (e.g., estimating the level of illumination from meteorologists' reports of precipitation) and *assessment* variables that the trier of fact may use to assess individual witnesses' decision-making processes. Assessment variables include a variety of variables that have traditionally been investigated as estimator variables, such as personality measures (e.g., self-monitoring [Hosch, Leippe, Marchioni, & Cooper, 1984]), the accuracy or amount of detail of prior descriptions of the perpetrator (e.g., Pigott & Brigham, 1985; Sporer, 1990, 1992), and the witness's confidence in his or her decision (see the reviews by Bothwell, Deffenbacher, & Brigham, 1987; Deffenbacher, 1980; Leippe, 1980; and Wells & Murray, 1983). Because assessment variables themselves are partially under the control of the investigator (e.g., through the way in which person descriptions are elicited or the manner in which confidence is scaled), they overlap Wells's (1978) distinction between estimator and control variables.

It was the major goal of the present research to combine the control and assessment variable strategies. In particular, I sought to demonstrate that in a sequential—in comparison with a simultaneous—lineup presentation mode, additional within-subject comparisons of witnesses' confidence and decision times for individual choices would provide valuable insights into the underlying decision-making processes and might ultimately help to discriminate accurate from inaccurate witnesses on the basis of their verbal and nonverbal behavior. In the following section, I first present the rationale for using a sequential rather than a simultaneous testing procedure and then discuss the value of assessing confidence and decision times in these two lineup modes.

Sequential Versus Simultaneous Lineup Mode

The rationale for presenting lineups sequentially as opposed to simultaneously was derived from Wells's (1984; Lindsay &

Siegfried Ludwig Sporer, School of Law and Criminology, Universität Marburg, Federal Republic of Germany.

This research was supported by two grants from the Deutsche Forschungsgemeinschaft, one to D. Meurer, Director of the Institute of Criminology (Me 777/2-1 and 2-2), and one to Siegfried Ludwig Sporer (SP 262/1-2).

I gratefully acknowledge the challenging comments by three anonymous reviewers, whose views have helped to clarify various crucial points of this article.

I would like to thank Stephan Krätzler for the dedicated production of the film used in this study. He prepared the script for the event; organized, directed, and edited the entire film; and collected the data. Great thanks are also due to Felicitas Schweizer-Girod and Gudrun Rabien, arts and film teachers at the Albertinum High School in Coburg and at the Melanchthon High School in Nürnberg, respectively, who supported the production of the film with their invaluable advice, as well as to the students of the Albertinum High School, who participated as actors for the film or allowed themselves to be photographed for the photospread.

Correspondence concerning this article should be addressed to Siegfried Ludwig Sporer, School of Law and Criminology, Universitätsstr. 6, 3550 Marburg, Federal Republic of Germany.

Wells, 1985) relative judgment theory of eyewitness identifications. Presumably, in traditionally conducted simultaneous lineups, a witness compares the relative similarity of the lineup members to his or her memory of the perpetrator in order to select the most likely candidate. After all, given that the police have gone through all the trouble to set up a lineup situation with several foils (supposedly all resembling the description of the culprit), many witnesses are persuaded by the situation to become cooperative, "good" witnesses and hence are likely to make a choice. Depending on the circumstances, witnesses may or may not resist this response bias, even if they are neutrally instructed that the perpetrator may or may not be present in the lineup (Malpass & Devine, 1981a; but see also Köhnken & Maass, 1988).

In contrast, an absolute-judgment processing strategy implies that a witness attempts to construe a match between a specific lineup member and his or her memorial representation (e.g., an image) of the criminal. If a specific lineup member exceeds the internal cutoff point or threshold that the witness uses as the basis of his or her identification decision, he or she will choose this lineup member. If the fit between the witness's memorial image and the specific person being viewed does not meet this criterion, the witness will reject this member.

On the basis of this rationale, Lindsay and Wells (1985) suggested sequential presentation as a procedural means to induce witnesses to use an absolute-judgment processing strategy as opposed to the relative-judgment processing that supposedly prevails in simultaneous lineups. Lindsay and Wells exposed subject-witnesses to a staged vandalism and later had them identify the vandal from target-present (TP) or target-absent (TA) photospreads. In the simultaneous lineup condition, all six photographs were shown to the subjects at once; in the sequential lineup condition, each photograph was presented in isolation, and subjects had to decide for each photograph whether or not it depicted the vandal.

Lindsay and Wells (1985) found significantly fewer false alarms in the sequential lineup condition (18.3%) than in the simultaneous lineup condition (35.0%). Concerns that sequential presentation might lead to a concomitant reduction of correct positive identifications were not founded by Lindsay and Wells's data: In the sequential lineup condition with the target present, correct identifications (50%) were not significantly fewer than in the simultaneous condition (58%). Hence, sequential testing seems to lead to fewer false alarms without losing the power to detect the culprit if he or she is present.

Cutler and Penrod (1988) confirmed Lindsay and Wells's (1985) findings with respect to false alarms. It remains unclear, however, whether sequential presentation reduces the number of correct identifications in TP lineups (see Cutler & Penrod, 1988, Exp. 2). It was one of the goals of the present study to further test the effects of sequential and simultaneous presentation in both TP and TA lineups while also seeking to gain additional insights into the decision-making process through a more elaborate analysis of witnesses' confidence and decision times in these two lineup modes. In particular, sequential presentation allows for multiple assessments of confidence and decision times for each lineup member, which may be used for within-subjects comparisons.

Confidence as an Assessment Variable

The identification of a suspect in a live lineup or in a photospread is a binary decision. This decision, in light of the true state of the world, may be either right (a correct identification in a TP lineup or a correct rejection in a TA lineup) or wrong (a false identification of an innocent suspect in a TA lineup or the false rejection of a TP lineup). There is also the possibility of false foil identifications in both TP and TA lineups, which are generally considered forensically irrelevant (known errors), assuming a single-suspect model (Wells & Turtle, 1986).

The problem that triers of fact (police, judges, or jurors) are confronted with lies in the paucity of information they have available for judgment: All they know is whether the witness has made a choice ("Yes—Number X is the perpetrator") or not ("No—I don't think the perpetrator is in the lineup"). It seems all too natural that triers of fact attempt to gain additional information from a witness to flesh out this binary decision. There is converging evidence from various streams of research that demonstrates that both professionals and lay people (jurors) alike put particular faith in the confidence a witness displays when making a lineup decision (Brigham, 1981; Deffenbacher & Loftus, 1982; Sporer, 1983; Yarmey & Jones, 1983; cf. Wells & Lindsay, 1983, for review). This common-sense assumption that confidence should be a valid predictor of identification performance is also endorsed by a frequently cited decision of the U.S. Supreme Court, which explicitly lists witness confidence as one of the criteria on which to evaluate identification evidence (*Neil v. Biggers*, 1972; cf. Wells & Murray, 1983).

This reliance on witness confidence is fraught with problems. For one thing, most studies that have empirically examined the relationship between eyewitness confidence and accuracy have found that this relationship is either low or nonexistent (see reviews by Deffenbacher, 1980; Leippe, 1980; and Wells & Murray, 1984; but see also the most recent review by Bothwell, Deffenbacher, & Brigham, 1987). Wells and Murray reported 13 studies in which a significant positive relationship was found and 18 studies in which either no relationship or even a significant negative relationship was reported. However, Brigham (1988) showed that calculating confidence–accuracy correlations across all subjects may be misleading. Forensically, positive identifications—which can be correct or false—are most important. Brigham's reanalysis of five of his own studies, breaking down the total samples into choosers and nonchoosers, boosted the six correlations calculated for the entire samples (.27, .30, .03, .22, .25, and .16) to respectable correlations for choosers only (.42, .50, .51, .20, .44, and .20).

Hosch, Bothwell, Sporer, and Saucedo (1989) and Sporer (1992) approached the same issue differently by presenting analyses of variance (ANOVAs) with choosing and correctness of decision outcome (identification accuracy in TP or TA lineups) as classifying variables. Despite the small sample sizes, they found significant interactive effects of these variables on witnesses' confidence. Hence, choosing seems to serve as an important moderator variable that can only be observed in a paradigm that uses both TP and TA lineups (see Malpass & Devine, 1981b, 1984, for detailed discussions of the importance of choosing). In the present research, the typical outcome matrix for a study with both TP and TA lineups was rearranged to allow for a comparison between accurate and inaccurate choosers and for a comparison between accurate and inaccurate nonchoosers. One of the goals of the present study was to reexamine the accuracy–confidence relationship with a different paradigm.

To explore further the importance of choosing, I decided to measure confidence at two different points in time: (a) before subjects saw the lineup (predecision confidence, or the subjective likelihood with which a witness believed he or she would be able to identify the perpetrator) and (b) after subjects made either a positive or a negative choice (postdecision confidence). In line with previous research, it was expected that postdecision confidence would be more strongly related to identification accuracy than would predecision confidence (Cutler & Penrod, 1988; Sporer, 1992).

Decision Time as an Assessment Variable

Asking witnesses for their confidence in their decision is but one way to augment the binary identification decision. To some extent, this presumes that witnesses have access to the cognitive and memorial processes that underlie their decision-making process. An alternative to asking for a verbal statement about the witness's own retrieval processes and the likelihood of its correctness is to observe the witness's behavior while he or she is arriving at this decision. In particular, the time witnesses take to arrive at their decisions can be measured as a nonverbal predictor variable for decision accuracy (Hosch et al., 1989; Sporer, 1992, in press). This idea was implicitly stated more than 150 years ago by a German legal scholar Henke (1838, cited in Sporer, 1982, p. 324), who required that an identification be made "without hesitation." Hence, I wanted to test whether the promptness of a decision might serve as an indicator of the correctness of that decision, that is, whether accurate witnesses would respond faster than inaccurate witnesses.

The theoretical rationale for using decision time, namely, response latency, as a measure of memory performance can be derived from its prevalence in basic memory research in the study of short-term or working memory (e.g., Baddeley, 1986; Theios, 1975) or of retrieval and recognition processes in long-term memory (e.g., Collins & Quillian, 1969; Zechmeister & Nyberg, 1982). Reaction time has also been successfully used in studies of facial recognition (e.g., Bailis & Mueller, 1981; Parkin & Hayward, 1983; Sporer, 1988). In this literature, it is more or less tacitly assumed that response latency may be a more sensitive indicator of the strength of a memory trace than are performance measures, such as proportion correct. Correctly arriving at a successful match between a perceived image (a specific face in a lineup task) and a stored representation of the person previously observed (the criminal) should happen faster than deciding that the two images do not derive from the same stimulus (correct or false rejections). This line of reasoning implies that natural face recognition is best described as a holistic rather than an analytical, individual-feature-oriented process (cf. Deffenbacher, Leu, & Brown, 1981; Sporer, 1991). On the other hand, erroneously matching two images that derive from different stimuli (false identifications) should also take longer than a correct positive recognition decision, for which more matching cues will be available as a basis for this internal comparison process (Sporer, in press).

Response latency (decision time) has recently been investigated as a correlate of eyewitness identifications by Kassin (1985), Bothwell, Brigham, and Pigott (1987), Hosch et al. (1989), and Sporer (1992; for a review, see Sporer, in press). In the first three of Kassin's experiments, identification accuracy and response latency were nonsignificantly negatively related ($r = -.37$, $-.16$, and $-.10$). Only in two of four conditions of Experiment 4 were the relationships significant ($r = -.60$ and $-.50$). In the "think aloud" conditions, they were even nonsignificantly positive (.25 and .03). However, Kassin did not employ a TA lineup; thus, he could not possibly have observed the effects of choosing as a potential moderator variable. Similarly, Bothwell, Brigham, and Pigott (1987) did not address this issue.

In contrast, Hosch et al. (1989) and Sporer (1992) used TP and TA lineups. As predicted, correlations between identification accuracy and decision time were substantially larger for choosers (Hosch et al., −.48; Sporer, −.43) than for nonchoosers (Hosch et al., −.11; Sporer, −.20). In other words, subject-witnesses who picked the right person from the lineup did so on average much faster than subject-witnesses selecting an innocent foil. For correct and false rejections, no meaningful differences between these two subject groups were found. Consequently, choosing can be expected to be an important moderator variable for the relationship between identification accuracy and decision time, analogous to the effects of choosing on the confidence–accuracy relationship outlined earlier. Moreover, on the basis of the findings of Kassin (1985), Hosch et al. (1989), and Sporer (1992), confidence and decision time also can be expected to be negatively related. In fact, there is even some recent experimental evidence (Turtle, 1988) that causally links subjects' purported decision times on a lineup task to their self-attributions of confidence when feedback about decision time was manipulated.

In summary, for the present study, it was hypothesized that (a) more confident witnesses would respond faster than less confident witnesses (i.e., a significant negative correlation was expected between confidence and response latency); (b) witnesses choosing somebody would do so faster than witnesses rejecting the lineup, regardless of the actual presence of the target; and, most important, (c) among the witnesses choosing somebody in the lineup (yes responses), accurate witnesses (those making correct identifications) would respond faster than inaccurate witnesses (those making false identifications). In ANOVA terms, these latter two predictions were expected to result in a significant Choice × Decision Correctness interaction that modifies the main effect of choice predicted in Hypothesis b.

These hypotheses were tested in an experiment employing a film of the snatching of a cashier box at a refreshment stand in a public park. Recognition of the perpetrator was tested in either a sequential or a simultaneous photo-identification task in which the target was either present or not. Here, the additional hypothesis was advanced that (d) within the sequential lineup-condition with the target present, in which the presence of the target was systematically rotated at Positions 1 through 6, response times would be faster for correct identification of the target than the average time taken for the rejection of any of the foils.

Finally, it was predicted that (e) for choosers in the sequential lineup the specific response time for the correctly chosen target (a hit) would be faster than the specific response time for an incorrectly chosen foil (a false identification). This prediction can be tested only in sequential lineups when response times (and confidence judgments) for each individual decision are assessed. To the extent that postdecision confidence was mediated by witnesses' perceptions of their decision times, it was also expected that (f) among choosers the specific confidence judgment for the correctly chosen target would be higher than the specific confidence judgment for a falsely identified person. The latter two predictions were included because, if corroborated, they would lend additional theoretical support to the use of sequential as opposed to simultaneous lineups.

In summary, the present study sought to examine the accuracy of person identifications as a function of a sequential versus simultaneous lineup presentation. Sequential lineups with the target absent were expected to lead to fewer false identifications than similar simultaneous lineups, whereas the number of hits in TP lineups was expected to remain unaffected by the mode of lineup presentation. In addition, a more fine-grained analysis of the accuracy–confidence relationship was attempted for these two lineup modes by distinguishing between choosers and nonchoosers and by demonstrating the utility of repeated measurements of confidence within the sequential lineup mode. Finally, decision time, compared between and within subjects, was proposed as an assessment variable to postdict identification accuracy.

Method

Material

Filmed event. Subjects watched a 5½-min Super-8 color film that was specifically prepared for this experiment. The film depicted the robbery of a cashier box at a refreshment stand in a park. The film lasted for a total of 5 min and 28 s and featured a total of seven actors. In the film, a young male walker, one of two women sitting on a park bench, a jogger, and an older man all approach a concession stand and buy a soft drink. When the old man is at the stand, talking busily with the saleswoman, T (the perpetrator, 18 years of age) appears at the right of the scene. He watches the old man pay with a large bill and waits on the side until he leaves. During the old man's interaction with the saleswoman, T approaches the stand up to about 5 feet and looks around to see whether anybody else is coming along. The camera focuses on his face for about 20 s.[1] After the old man leaves, T walks up to the stand and requests a Coke. The camera briefly focuses on the cashier box. When the saleswoman attempts to pass T the drink, he quickly grabs the box and runs away with it.

Photo lineups. For the construction of the photo lineups, 14 young men (between 16 and 19 years of age, between 175 and 193 cm tall) were photographed in two different poses (a front view head-and-shoulders portrait and a 90° profile with the right cheek visible) in a well-lit room against a neutral white background. This choice was determined by the fact that these two views are frequently used in police procedures (on the importance of target views, see Baddeley & Woodhead, 1983).

All persons photographed were White and had dark blonde to dark brown hair and no distinctive features. All had medium length hair, no beard or moustache, wore no spectacles, and displayed a neutral, serious expression. They wore blue jeans and the same yellow sweater to exclude any cues from clothing (see Lindsay, Wallbridge, & Drennan, 1987; Sanders, 1984). On the basis of a second pilot study ($n = 9$), the six persons ranked most similar to the target person (T) and a second target person (T′), with whom a parallel version of the film was prepared (it was not used in the present study), were selected as alternates in the photo lineup.

Each pair of the photographs (color, 9 × 13 cm) was mounted on a blue card (16 × 22.5 cm). In the sequential photo lineup, six of these cards, each displaying the two poses of one person, were shown to the subject-witness one after the other in a randomized order. In the simultaneous lineup, the same six cards were presented at once in a 2 row × 3 column array.

Questionnaires. Data were collected in questionnaire format and on response sheets filled out by the experimenter. Two alternate forms were prepared for assessing identification decisions in the simultaneous and sequential conditions. Subject-witnesses were reminded that the target might or might not be present in the lineup through the provision of a special response category for this option. Similarly, for the assessment of confidence, the layout for the response forms was specifically adapted to the respective simultaneous and sequential lineup procedures.

Subjects

Subjects were 72 female students at a state institute of home economics; they were between 19 and 32 years of age ($Mdn = 21.5$) and had volunteered to participate in this study. None of them had ever participated in a psychology experiment before, and they were kept unaware of the true nature of the experiment until the second day of the study when their memory was tested. Experimental naiveté was deemed more important than a balancing of gender, for which significant differences (or interactions) have almost never been reported in this literature.

Procedure

All subjects were recruited to participate in a study in which "the artistic quality of a film had to be judged." For this purpose, they would view a short film and answer some questions about it. The film was presented in a small darkened room to small groups of subjects. They were asked not to talk about the content of the film until the following day, when they returned individually for the questioning session.

After the true purpose of the study was explained, subjects were informed that their task would be to try to identify the perpetrator in a series of photographs. They were explicitly instructed that he could be among the photographs shown but also that he might not be among them. First, subjects indicated how sure they were that they would be able to recognize the perpetrator (predecision confidence) by marking their confidence on a subdivided scale: On the left side, response options were scaled from *absolutely certain that I would not recognize him* to *believe not*; on the right, response options ranged from *believe yes* to *certainly sure to recognize him.* On either side of the scale, subjects could mark their choice on a scale ranging from 1 to 5. For statistical purposes, these two subscales were later joined to form a single variable indicating predecision confidence that was scaled from *absolutely certain not* (1) to *absolutely certain yes* (10).

This confidence rating was followed by the lineup identification task. Four versions of the lineup task were constructed: two with the target present and two with the target absent, orthogonally crossed with the simultaneous and sequential lineup modes. In the TP condi-

[1] In a first pilot study ($n = 12$), in which exposure time of the target's face was systematically varied, an exposure of about 5 s led to a deterioration of recognition rates close to chance level.

tions, the target appeared equally often in Position 1 through 6, with a different random sequence for the rest of the foils in each lineup and with the target replacing each foil equally often. In the TA condition, the sequence was identical to the TP conditions except that the respective foil left out in the corresponding TP conditions replaced the target.

In the simultaneous lineup condition, all six photograph pairs were shown at once in a 2×3 array. Subjects were told that they would have as much time as they needed but that this time would be recorded with a stopwatch. To avoid experimenter effects, the experimenter stood sideways behind the subject to record the subjects' decision times unobtrusively. After viewing all the photographs, subjects either marked the option *I believe the perpetrator was not present* or *I believe the perpetrator was the number . . .* , checking one of the six boxes that were arranged in the same manner as the lineup photographs and that were labeled 1 through 6. Then subjects indicated how certain they were of their decision, using the same response format as for the predecision confidence measure. Later, the two subscales (positively identifying a person or not) were collapsed, resulting in a single 5-point rating scale (postdecision confidence). Decision time was measured as the time elapsed between the uncovering of the lineup display in front of the subject and the subject's completion of the sentence that either indicated a positive choice or a rejection of the whole lineup.

In the sequential lineup condition, subjects had to decide for each pair of photographs whether or not they depicted the perpetrator in the film. They did not know how many persons would follow in the lineup. Although this presents a potential confound with sequential testing, which should be explored in further research, it was considered to be the optimal procedure for conducting a sequential lineup. In line with the true logic of the sequential lineup rationale, only the first positive identification choice was used for scoring whether or not a lineup decision was correct.

Nonetheless, inspection of the remaining decisions (which were not used in the analyses) showed that 4 subjects would have attempted to recant their earlier decision after seeing additional faces: Two would ultimately have arrived at a hit after seeing all six lineup members, 1 would have made a false identification, and 1 would ultimately have rejected the TA lineup. Data from another experiment conducted as a staged event at my university indicate that, of 12 out of 51 subjects in the sequential lineup condition who changed their views after an initial decision, 9 turned out to be wrong (Sporer, Eickelkamp, & Spitmann-Rex, 1990)!

For each lineup person, subjects' confidence as well as the time taken for that particular decision were noted. Hence, six confidence measures and six response latencies were produced for each subject. This allowed for both between- and within-subject comparisons. For the between-subjects analyses, postdecision confidence and decision time were defined as the arithmetic mean of all six confidence judgments and all six individual decision times, respectively. In the case of a positive identification choice, within-subjects analyses could also be carried out by comparing the confidence and latency values for this choice with the other five nonchoices.

An alternative would have been to sum the decision times for individual faces in the sequential lineup to make them comparable to the simultaneous lineup. However, this might have overestimated the actual time taken because the verbalization time for each choice would enter the total six times, whereas it would enter only once in the simultaneous mode. On the other hand, once subjects had made a positive choice in the sequential lineup, they might have rejected the subsequent faces more quickly. This, of course, would depend on the position of the target, which was systematically varied from Position 1 to 6 in the TP lineups. Subsidiary analyses of individual rejection times before (M = 3.24 s) and after (M = 2.94 s) a positive selection revealed that on average the latter were shorter by only 0.3 s, $F(1, 9) < 1$, *ns*. Thus, using the average time across all six rejection times seemed justified, at least for this set of data.

However, in the case of a positive selection, the single value for this choice rather than the average was taken to render it comparable to the simultaneous condition. For the simultaneous condition, the total response time was divided by the number of persons in the lineup (six) to create a measure comparable to the time taken for an individual decision in the sequential lineup condition.[2]

Subjects were debriefed about the goals of this research and the necessity to use deception to ensure an incidental learning situation. After they promised not to jeopardize the success of the study by revealing the true purpose of the experiment to other subjects, they were thanked for participation with a present and dismissed.

Results

Overview of Statistical Analyses

First, identification accuracy was assessed as a function of lineup mode (simultaneous vs. sequential) and target presence or absence. Next, correlational analyses were carried out with predecision confidence, postdecision confidence, and decision time as predictors and identification accuracy as the predicted variable. These analyses were performed both for the total sample (N = 72) and the two subsamples of subjects who either made a positive selection from the photospread (choosers) or did not pick anybody from the lineup (nonchoosers).

These analyses were followed by a series of $2 \times 2 \times 2$ ANOVAs with pre- and postdecision confidence and decision time as measured (dependent) variables and lineup mode (simultaneous vs. sequential), choice (no choice vs. positive selection), and identification accuracy (incorrect vs. correct decision) as classifying variables. Note that the choice of a subject was used as a classifying variable, rather than target presence or absence, which was actually manipulated. This strategy was guided by the consideration that investigators in the real world have no way of knowing whether the perpetrator is truly present in the lineup (although they always believe he or she is). They do know, however, which witness is arriving at a positive decision and which witness rejects the lineup. Thus, for the trier of fact it is more informative to know whether confidence and decision time for choosers versus nonchoosers are indeed predictive of identification accuracy. Of course, either type of analysis, using target presence or absence or choice as independent variables, will result in the same four possible outcome cells when crossed with identification accuracy as a second factor: correct and false rejections and hits and false alarms.

Finally, two additional analyses of postdecision confidence scores and decision times within the sequential lineup condition were conducted to take into consideration the relative confidence and decision times for the choice, or rejection, of individual faces.

Because the results of the correlational analyses and the ANOVAs are statistically redundant, the primary focus of this section is on the latter. To make the results more comparable to the correlational analyses generally reported in the literature, the

[2] I am grateful to the anonymous reviewer who suggested this method of analysis to enhance comparability between the two lineup modes.

crucial main effects and simple main effects of the ANOVAs are supplemented with the corresponding point-biserial correlations between identification accuracy and the respective predictor variables.

Identification Accuracy

Effect of lineup mode. Table 1 shows the percentages of correct and incorrect decisions in TP and TA lineups as a function of lineup mode. Overall, recognition performance was rather low, with only 41.7% correct identifications (hits) in the TP lineups and 44.4% correct rejections in the TA lineups. Irrespective of target presence, there was a nonsignificant tendency for more correct decisions to be made in the sequential lineup condition (50.0%) than in the simultaneous lineup condition (36.1%), $\chi^2(1, N = 72) = 1.42$, *ns.*

Comparing lineup performance separately for TP and TA conditions was more revealing. Testing for the interaction between target presence and identification accuracy, using a procedure suggested by Langer and Abelson (1972) for proportions in a 2 × 2 contingency table, revealed a marginally significant effect ($z = 1.70$, $.05 < p < .10$). As long as the target was actually present in the lineup, lineup presentation led to a comparable number of correct identifications (44.4% in the simultaneous lineup condition and 38.9% in the sequential lineup condition), $\chi^2(1, N = 36) = 0.114$, *ns.* Even here, though, hits were not fewer under sequential testing than under simultaneous testing. When the target was absent from the lineup, the number of correct rejections in the sequential lineup mode was substantially higher (61.1%) than in the simultaneous mode (27.8%), $\chi^2(1, N = 36) = 4.05$, $p < .05$.

Target position and choosing. One question that may be of interest to the practitioner is whether or not some positions in a lineup may be chosen more frequently than others. Especially with sequential lineups, one could speculate that a witness might feel more compelled to make a choice the more lineup members had already been shown (and consequently the fewer still to come). Recall that in the TP lineups the target was placed an equal number of times at Positions 1 through 6 and that in the sequential lineup condition subjects did not know beforehand how many photographs they would actually be shown.

In the sequential lineup condition, the distribution of choices over the six positions did not differ from chance (2, 2, 5, 2, 1, and 5 choices at Positions 1 through 6), $\chi^2(5, N = 36) = 4.61$, *ns.* In the simultaneous lineup condition, the photographs were aligned in two rows with three columns each. The top row was numbered 1 to 3, the bottom row 4 to 6. At each position, the two views of that lineup member (one front view and one 90° profile shot) were placed together on top of each other. Surprisingly, the distribution of choices differed from chance (3, 4, 4, 4, 11, and 1 choices for the respective Positions 1 through 6), with Position 5 drawing relatively more choices than the others, $\chi^2(5, N = 36) = 14.36$, $p < .05$.

Postdicting Identification Accuracy

Descriptive analyses of confidence and decision time. Subjects used the entire range of the response scale of predecision (1 to 10) and postdecision confidence (1 to 5). Generally, subjects were more on the confident side ($M = 6.71$, $SD = 1.94$, for predecision ratings, and $M = 3.16$, $SD = 1.37$, for postdecision ratings), despite the rather low overall accuracy of identification decisions (43.1%). Total decision time varied considerably from a minimum of 8 s to a maximum of 101 s (the next highest values were 72, 66, and 62 s; all other values were below 60 s), with a mean of 30.0 s ($SD = 17.6$). Average decision time per face as used for the following analyses (see the computational details presented earlier) varied considerably, with a mean of 6.21 s ($SD = 5.09$).

Correlational analyses. Predecision confidence was related neither to postdecision confidence, $r(70) = .19$, $.05 < p < .10$, nor to decision time, $r(70) = -.06$, *ns,* and showed only a small relationship with accuracy, $r(70) = .23$, $p < .05$. Postdecision

Table 1
Identification Accuracy in Simultaneous and Sequential Lineups With the Target Present or Absent

	Lineup mode					
	Simultaneous		Sequential		Marginal M	
Target	Decision correct	Decision incorrect	Decision correct	Decision incorrect	Decision correct	Decision incorrect
Present						
%	44.4	55.6	38.9	61.1	41.7	58.3
Absolute frequency	8	10	7	11	15	21
Absent						
%	27.8	72.2	61.1	38.9	44.4	55.6
Absolute frequency	5	13	11	7	16	20
Marginal M						
%	36.1	63.9	50.0	50.0	43.0	57.0
Absolute frequency	13	23	18	18	31	41

Note. $N = 72$. Thirty-six subjects were in the simultaneous lineup condition, and 36 were in the sequential lineup condition. Thirty-six saw a lineup with the target present, and 36 saw a lineup with the target absent.

confidence did show the predicted negative relationship with decision time, $r(70) = -.33$, $p < .01$, but this relationship was not as high as to make confidence and decision time redundant. Thus, both variables can be used as separate predictors for the accuracy of lineup decisions. These and the other correlations among these four variables for the total sample and for choosers and nonchoosers separately are displayed in Table 2. As expected, the high accuracy–confidence relationship after the decision was more substantial for choosers than for nonchoosers (although even the latter correlation was statistically reliable). In contrast, decision time was negatively related to accuracy for choosers but was unrelated for nonchoosers. Because these correlational analyses are redundant with the ANOVAs reported in the following section, they are not discussed in detail.

Analyses of Variance

To find out whether witnesses who made correct lineup decisions differed systematically from those who made incorrect decisions in their mean levels of pre- and postdecision confidence and decision times, three unweighted-means ANOVAs were computed with these measures as dependent variables and with lineup mode (simultaneous vs. sequential), choice (no choice vs. choice), and identification accuracy (incorrect vs. correct decision) as classifying variables. Table 3 displays the mean values of these measures as a function of these conditions.

Predecision confidence. The only effect on predecision confidence was a significant tendency for witnesses who made an accurate identification decision to have been more confident about their ability to recognize the perpetrator in the photospread ($M = 7.23$) than were witnesses who ultimately made a wrong decision ($M = 6.32$), $F(1, 64) = 4.29$, $p < .05$, and $r(70) = .23$, $p < .05$.

Postdecision confidence. There were three significant main effects: for identification accuracy, $F(1, 64) = 24.50$, $p < .01$, and $r(70) = .53$, $p < .01$; for choice, $F(1, 64) = 6.59$, $p < .05$; and for lineup mode, $F(1, 64) = 6.31$, $p < .05$. The latter two main effects should be interpreted only in light of their significant interaction, $F(1, 64) = 8.49$, $p < .01$: Whereas choosers and nonchoosers were about equally confident in the simultaneous lineup condition, in sequential lineups, averaging over the six confidence judgments resulted in a higher confidence score for nonchoosers than the confidence value choosers had attached to their choice (see Table 3).

Although the expected interaction between identification accuracy and choosing was not reliable, $F(1, 64) = 1.21$, *ns*, the a priori contrasts for accurate versus inaccurate choosers and nonchoosers are nonetheless presented. Witnesses who picked the target correctly were more confident ($M = 3.73$) than those choosing an innocent suspect or foil ($M = 2.14$), $F(1, 64) = 24.55$, $p < .01$, and $r(42) = .58$, $p < .01$. Nonchoosers were also more confident with correct rejections of the TA lineup ($M = 4.22$) than with incorrect rejections of the TP lineup ($M = 3.47$), $F(1, 64) = 6.90$, $p < .05$, and $r(26) = .34$, $p < .05$.

Some investigators have argued that foil identifications in TP lineups should not be included in the assessment of accuracy–confidence relationships (see Wells & Lindsay, 1985). There were a total of nine foil identifications in TP lineups in this study. Removal of these cases did not change the results to command different conclusions.

Decision time. Similar to the pattern of results for postdecision confidence scores, data for decision time suggest differential effects for choosers and nonchoosers in the two lineup modes. Lineup mode and choosing showed a significant interaction, $F(1, 64) = 14.42$, $p < .01$. Choosing a face in the simultaneous lineups took much less time on average ($M = 4.75$ s) than the average rejection time per face ($M = 8.45$ s, Newman-Keuls test; $p < .05$), whereas the respective difference in the sequential condition was reversed ($M = 9.38$ s for choice; $M = 4.37$ s for average nonchoice; $p < .05$).

Overall, decision time was not reliably affected by the accuracy of the decision being made, $F(1, 64) = 3.74$, $.05 < p < .10$, and $r(70) = -.22$, $p < .05$. Most important for the hypotheses, there was a significant interaction between choice and decision accuracy, $F(1, 64) = 11.26$, $p < .01$. Witnesses who made an accurate choice did so significantly faster ($M = 3.61$ s) than subjects who chose a foil ($M = 8.06$ s), $F(1, 64) = 18.78$, $p < .01$, and $r(42) = -.36$, $p < .01$. In contrast, for the witnesses who refused to make a selection, an accurate rejection of the empty lineup tended to take slightly longer ($M = 6.20$ s) than an inaccurate refusal of a TP lineup ($M = 4.99$ s), $F(1, 64) < 1$, *ns*, and $r(26) = .17$, *ns*.

Table 2
Intercorrelations Between Pre- and Postdecision Confidence, Decision Time, and Identification Accuracy

Variable	Predecision confidence	Postdecision confidence	Decision time
Choosers only ($n = 44$)			
Identification accuracy	.20*	.58****	−.36***
Predecision confidence	—	.28**	−.15
Postdecision confidence	—	—	−.34**
Nonchoosers only ($n = 28$)			
Identification accuracy	.28*	.34**	.17
Predecision confidence	—	.08	.14
Postdecision confidence	—	—	−.29
Total sample ($N = 72$)			
Identification accuracy	.23**	.53****	−.22**
Predecision confidence	—	.19*	−.06
Postdecision confidence	—	—	−.33***

* $p < .10$. ** $p < .05$. *** $p < .01$. **** $p < .001$.

Choosers' Confidence and Decision Times in Sequential Lineups

With sequential lineups, in which postdecision confidence scores and response latencies are assessed for each of the six lineup decisions, more refined methods of analysis are possible, which take the relative confidence and decision times for the choices and nonchoices of individual witnesses into account. These measures can be compared both between and within subjects—but the latter for choosers only. For witnesses who

Table 3
Mean Levels of Pre- and Postdecision Confidence and Decision Time for Choosers and Nonchoosers in Simultaneous and Sequential Lineups

	Lineup mode					
	Simultaneous		Sequential		Marginal *M*	
Variable	Decision correct	Decision incorrect	Decision correct	Decision incorrect	Decision correct	Decision incorrect
Choosers (n = 44)						
Predecision confidence[a]	6.75	6.32	7.71	6.60	7.20	6.41
Postdecision confidence[b]	3.88	2.11	3.57	2.20	3.73	2.14
Decision time[c]	3.49	5.28	3.74	13.33	3.61	8.06
n	8	19	7	10	15	29
Nonchoosers (n = 28)						
Predecision confidence[a]	8.00	6.25	6.91	6.00	7.25	6.08
Postdecision confidence[b]	3.80	2.00	4.41	4.21	4.22	3.47
Decision time[c]	9.43	7.23	4.73	3.88	6.20	4.99
n	5	4	11	8	16	12
Marginal means						
Predecision confidence[a]	7.23	6.30	7.22	6.33	7.23	6.32
Postdecision confidence[b]	3.85	2.09	4.08	3.09	3.98	2.53
Decision time[c]	5.77	5.62	4.35	9.13	4.95	7.16
n	13	23	18	18	31	41

[a] Possible range: 1–10. [b] Possible range: 1–5. [c] Average time (in seconds) per lineup member.

positively choose somebody from the photospread, the confidence assigned to the target choice, and the time taken to make this selection, can be compared with the average confidence and the average decision time with which the other five lineup members are rejected by the same witness (i.e., as a within-subjects factor).

Here, confidence and decision time for a choice were compared with the average confidence assigned to (or decision time taken for) the rejected faces, both as a function of the accuracy of the selection being made, namely, a hit or a false alarm. For this purpose, two 2 × 2 mixed-model ANOVAs were performed that compared average confidence scores, or decision times, for rejections and positive identifications within subjects (repeated measures factor) as a function of the accuracy of the underlying decision (between-subjects factor). Table 4 shows the mean confidence scores and decision times for positive choices and rejections, separately for witnesses who had correctly identified the target and for those who had chosen an innocent foil.

Based on this small sample of choosers (n = 17), the two ANOVAs shed additional light on the results reported in the previous section. Among individual witnesses who made a positive selection, the confidence in this selection (M = 2.76) was generally *less* than the confidence with which the other lineup members were rejected (M = 4.13), a main effect for the repeated measures factor of choice, $F(1, 15) = 17.64$, $p < .01$. The time taken to make this choice (M = 9.38 s) was *longer* than the average time taken to reject the other faces (M = 3.22 s), $F(1, 15) = 12.52$, $p < .01$. Identification accuracy per se had a significant main effect on decision time, $F(1, 15) = 9.46$, $p < .01$, but not on confidence, $F(1, 15) < 1$, *ns*.

Here, the crucial interaction was significant for both measures: for confidence, $F(1, 15) = 9.00$, $p < .01$; and for decision time, $F(1, 15) = 6.64$, $p < .05$ (see Table 4). Post hoc analyses revealed that the major ingredient of these interactions was the difference in confidence and decision time between hits and false alarms (between-subjects comparison): Confidence for

Table 4
Within Subject Comparisons of Confidence Scores and Decision Times for the Choices and Rejections of Accurate and Inaccurate Choosers in Sequential Lineups

Decision and variable	Choice correct (n = 7)	Choice incorrect (n = 10)	Marginal *M*
Choice			
Confidence[a,b]	3.57	2.20	2.76
Decision time[b]	3.74	13.33	9.38
Rejection			
Confidence[a,c]	3.77	4.38	4.13
Decision time[c]	2.94	3.41	3.22
Marginal *M*			
Confidence	3.67	3.29	3.45
Decision time	3.34	8.37	6.30

[a] Possible range: 1–5. [b] For the individual face chosen. [c] Averaged over the five faces rejected.

the correctly identified individual face (hit) was much higher than for a falsely identified face, $F(1, 15) = 10.27$, $p < .01$, and the choice made by a correct witness was much faster than that of a witness misidentifying somebody, $F(1, 15) = 34.41$, $p < .01$. Correct and incorrect choosers did not differ in their confidence scores and decision times for the rejected lineup members, $F(1, 15) < 2.04$, *ns*, for both.

Another way to look at this interaction between chosen and rejected faces and the accuracy of these decisions focuses on within-subjects comparisons of choices versus rejections. For correct choosers, a correctly selected face was chosen with about the same confidence ($M = 3.57$) and the same speed ($M = 3.74$ s) as the average confidence ($M = 3.77$) and rejection time ($M = 2.94$ s) for the other faces in the lineup, $F(1, 15) < 1$, *ns*, for both. For incorrect choosers, the falsely identified face was picked with much less confidence ($M = 2.20$) and after a much longer delay ($M = 13.33$ s) than the average confidence ($M = 4.38$), $F(1, 15) = 43.62$, $p < .01$, and the average time taken ($M = 3.41$ s), $F(1, 15) = 25.78$, $p < .01$, for the rejection of the other faces.

Discussion

The present study compared sequential lineup presentation with the traditionally employed simultaneous presentation procedure as a control variable in eyewitness identification research. At the same time, the utility of several assessment variables (pre- and postdecision confidence and decision time) was tested for the prediction of identification outcome in these two lineup modes. In line with the experiments by Lindsay and Wells (1985), Cutler and Penrod (1988), and Sporer et al. (1990), the rate of false identifications in the TA condition was substantially less for the sequential presentation condition (38.9%) than for the simultaneous lineup condition (72.2%). At the same time, concerns that sequential lineup presentations will lead to fewer correct positive identifications, thus allowing more criminals to go undetected, seem unfounded. In fact, there was about an equal (but low) number of correct identifications in the sequential (38.9%) and simultaneous conditions (44.4%).

Taken together, all these studies that have been conducted in different laboratories with distinct methodologies (staged incident, video film, and short movie) support Wells's (1984) notion that an absolute mode of judgment, which presumably is induced by the sequential procedure, leads to fewer errors in identification procedures than the relative mode of judgment witnesses appear to use when lineup members are displayed simultaneously. The practical utility of this finding is self-evident, leading me to suggest sequential lineup procedures as the method of choice. Nonetheless, the overall high rate of false identifications (55.6%) in the present study, which occurred despite the neutral instructions that stressed the potential absence of the target, necessitate further research into additional control variables that are similarly suited to reducing the frequency of false identifications. Moreover, subject-witnesses were not informed as to the actual number of photographs they would see in the sequential lineup procedure, a factor that, strictly speaking, is confounded with the sequential presentation mode.

Additional support for the sequential lineup procedure stems from the subsidiary analyses of the choices of lineup members at different positions in the photospread. In the sequential lineup, the distributions of choices over the six positions did not differ from chance. In particular, faces shown later in the lineup were not chosen more often than the faces shown in the beginning. In contrast, significant variations were found in positive selections in the simultaneous procedure that utilized a 2×3 array; these variations cannot be explained by the choices of specific lineup members, whose positions were newly randomized for each test. Of the 27 choices made, 11 were at Position 5—the middle face pair in the bottom row. A speculative explanation[3] of this finding is that the middle position is the natural center of focus when photographs are displayed as they were in the present study. Recall that each lineup member was portrayed both in a front view and a 90° profile shot, the former always being placed on top of the latter. The central focus on Position 5 would be the front view of the lineup member at that position, which was the one most frequently chosen. In a sequential presentation mode, this type of positional bias is avoided, a fact that provides further support for this procedure.

In addition, this study has provided new methodological tools, which make possible a more intricate analysis of the relationships between identification accuracy, confidence, and decision time. Had the accuracy–confidence relationships been analyzed in the way most researchers to date have done, the conclusion would have been that identification accuracy showed only a low correlation with predecision confidence (.23) and decision time (−.22) and a fairly high correlation with postdecision confidence (.53).

However, the subsidiary analyses that focused on a distinction between choosers and nonchoosers, and the within-subjects analyses for sequential lineups, revealed quite a different picture. For choosers, the relationship between accuracy and postdecision confidence was boosted to .58, whereas it was "only" .34 for nonchoosers. For predecision confidence, the respective relationships were .20 for choosers and .28 for nonchoosers. In practical terms, witnesses who believe before an identification task that they will be able to recognize the perpetrator may or may not do so correctly (see Cutler & Penrod, 1988, and Sporer, 1992, for converging findings). However, for subjects who have made a positive selection, confidence in this particular selection may be more indicative of its accuracy than confidence among nonchoosers.

The importance of choice as a moderator variable that has recently been found to boost the accuracy–confidence relationship (Brigham, 1988; Hosch et al., 1989; Sporer, 1992) was again confirmed. Given the overall low rate of decision accuracy in this study, the data contradict Deffenbacher's (1980) optimality hypothesis. If the memory trace was too weak to permit better performance—presumably due to suboptimal encoding of the events in the film—the accuracy–confidence relationship should not have been as high as observed, particularly among choosers.

In parallel to the findings on postdecision confidence,

[3] This explanation was suggested to me by Stephan Krätzler.

choice was an even more important moderator variable for decision time: Witnesses who accurately identified the target did so much faster than witnesses falsely identifying an innocent foil. Among nonchoosers, correct rejections took longer than incorrect rejections. These data support the findings by Hosch et al. (1989) and by Sporer (1992), who have also found strong negative correlations between identification accuracy and decision time with choosers but not with nonchoosers. Confidence and decision time in this study were not as highly negatively related as in those studies. Hence, decision time may be a useful assessment variable that does not seem to be redundant with witness confidence.

Decision time emerged as an even stronger predictor variable for choosers in sequential lineups (−.60), though decision confidence (.50) was somewhat less indicative of accuracy. In fact, it seems quite remarkable that the 95% confidence interval for the time in which the individual target face was correctly identified (M = 3.74 s) showed no overlap with the 95% confidence interval of the time taken by other witnesses to falsely identify a foil (M = 13.33 s). Decision time may even be indicative of accuracy in a dual sense: A positive identification choice that is not made quickly is likely to be wrong, but a rejection decision that takes a long time is likely to be correct.

This finding also provides some support for Wells's (1984) theory of relative versus absolute judgments in lineup decisions. In the sequential lineup, witnesses who had a strong memory trace of the perpetrator apparently knew immediately that "this is the person." They arrived quickly at a decision and were quite confident about this particular choice. In stark contrast, choosers who falsely identified an innocent foil took much longer, indicating a much weaker fit between their memorial representation of the perpetrator and the image of the particular face in front of them. Taking longer to arrive at this false decision seemed to affect their confidence judgment for this particular decision, which was significantly lower (M = 2.20) than the one for individual hits (M = 3.57).

Lineup members were rejected with suprisingly high average confidence and short average decision times. Here one might assume a relatively strong mismatch between the memorial representation and each face presented. Apparently, within the sequential lineup mode, accurate and inaccurate nonchoosers made their individual decisions fairly quickly and with fairly strong confidence. Consequently, neither decision times nor confidence judgments are of help in assessing the likelihood of the accuracy of a nonchooser's lineup rejection.

This line of reasoning regarding the decision processes in sequential lineups was also supported by the within-subjects comparisons of choosers' choices and rejections (see Table 4). Correct choosers made both their positive selection and their rejections quickly and with fairly high confidence. Witnesses who falsely identified a foil made this selection after relatively long deliberation and with low confidence while rejecting the other lineup members swiftly and with high confidence. These witnesses' memory traces were perhaps not strong enough to prevent them from arriving at a wrong positive selection but nonetheless cast enough doubt to prolong the decision time relative to the average rejection time for the other lineup members. These relative time differences are also reflected in the differences in confidence these witnesses attributed to their falsely selected face and the rejected lineup faces. These fine-grained within-subjects analyses lend support to the notion that it is theoretically possible to assess identification accuracy on the basis of witnesses' decision times and the confidence expressed for individual decisions.

Nonetheless, reliance on witness confidence (and decision time)—even if it could be shown to be more closely related to identification accuracy among witnesses who make a positive lineup choice—may still be problematic in forensic practice. For one thing, witness confidence in a forensic setting is not assessed with the same type of rating scales that social science researchers generally use in their studies. Instead, the trier of fact may have to rely on his or her attribution of confidence to a witness during trial examination by the prosecution or defense attorneys. At that point in time, however, witness confidence may be inflated as a consequence of repeated questioning and coaching, which is a common form of witness preparation. One potential solution would be to have witnesses videotaped at the time of the lineup decision and to introduce this videotape into evidence. This way, the trier of fact would have more direct access to the verbal and nonverbal behaviors that may be helpful in evaluating the evidentiary value of an identification decision. My colleagues and I recently completed such a study to further explore this possibility.

Furthermore, the verbal and nonverbal behaviors accompanying an identification decision may themselves be determined by other variables, which will only be understood as research on assessment variables continues. More troublesome, these factors may not simultaneously influence the verbal and nonverbal behaviors in the same way as they determine identification accuracy. There are a host of moderator variables that may affect the confidence in an identification decision but not identification accuracy and vice versa (see Leippe, 1980, and Wells & Murray, 1983, 1984, for detailed discussions of these variables). For example, higher confidence–accuracy relationships may be expected when viewing and retrieval conditions are considered optimal (Deffenbacher, 1980; see also Bothwell, Deffenbacher, & Brigham, 1987; Hosch et al., 1989), although the present data do not seem to support this notion. These same variables may or may not affect decision time as well. Nevertheless, decision time may be a parameter that more closely reflects the memory retrieval processes that discriminate between accurate and inaccurate identification decisions. Ultimately, a multivariate research strategy (e.g., employing multiple discriminant analysis) should be followed that would allow study of the discriminative power of a variety of assessment variables under different conditions (e.g., target distinctiveness, opportunity to view) that are also likely to be influential in real criminal cases.

References

Baddeley, A. D. (1986). *Working memory.* London: Oxford University Press.

Baddeley, A. D., & Woodhead, M. (1983). Improving face recognition ability. In S. M. A. Lloyd-Bostock & B. R. Clifford (Eds.), *Evaluating witness evidence* (pp. 125–136). Chichester, England: Wiley.

Bailis, K. L., & Mueller, J. H. (1981). Anxiety, feedback, and self-reference in face recognition. *Motivation and Emotion, 5,* 85–96.

Bothwell, R. K., Brigham, J. C., & Pigott, M. A. (1987). An exploratory study of personality differences in eyewitness memory. *Journal of Social Behavior and Personality, 2,* 335–343.

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

Brigham, J. C. (1981). The accuracy of eyewitness evidence: How do attorneys see it? *Florida Bar Journal, 55,* 714–721.

Brigham, J. C. (1988). Is witness confidence helpful in judging eyewitness accuracy? In M. M. Gruneberg, P. E. Morris, & R. N. Sykes (Eds.), *Practical aspects of memory* (Vol. 1, pp. 77–82). Chichester, England: Wiley.

Clifford, B., & Bull, R. (1978). *The psychology of person identification.* London: Routledge & Kegan Paul.

Collins, A. M., & Quillian, M. R. (1969). Retrieval time from semantic memory. *Journal of Verbal Learning and Verbal Behavior, 8,* 240–247.

Cutler, B. L., & Penrod, S. D. (1988). Improving the reliability of eyewitness identifications: Lineup construction and presentation. *Journal of Applied Psychology, 73,* 281–290.

Cutler, B. L., Penrod, S. D., & Martens, T. K. (1987). Improving the reliability of eyewitness identification: Putting context into context. *Journal of Applied Psychology, 72,* 629–637.

Deffenbacher, K. A. (1980). Eyewitness accuracy and confidence: Can we infer anything about their relationship? *Law and Human Behavior, 4,* 243–260.

Deffenbacher, K. A., Leu, J. R., & Brown, E. L. (1981). Memory for faces: Testing method, encoding strategy and confidence. *American Journal of Psychology, 94,* 13–26.

Deffenbacher, K. A., & Loftus, E. F. (1982). Do jurors share a common understanding concerning eyewitness behavior? *Law and Human Behavior, 6,* 15–30.

Henke, E. (1838). *Handbuch des Criminalrechts und der Criminalpolitik (Vierter Teil)* [Handbook of law and criminal politics (Part 4)]. Berlin: Nicolai.

Hosch, H. M., Bothwell, R. K., Sporer, S. L., & Saucedo C. (1989). *The accuracy of a witness' choice: Facial recognition ability, confidence, decision time and person descriptions.* Manuscript submitted for publication.

Hosch, H. M., Leippe, M. R., Marchioni, P. M., & Cooper, D. S. (1984). Victimization, self-monitoring, and eyewitness identification. *Journal of Applied Psychology, 69,* 280–288.

Kassin, S. M. (1985). Eyewitness identification: Retrospective self-awareness and the accuracy–confidence relationship. *Journal of Personality and Social Psychology, 49,* 878–893.

Köhnken, G., & Maass, A. (1988). Eyewitness testimony: False alarms on biased instructions? *Journal of Applied Psychology, 73,* 363–370.

Köhnken, G., & Sporer, S. L. (Eds.). (1990). *Identifizierung durch Augenzeugen: Psychologisches Wissen, Probleme und Perspektiven* [Eyewitnesses' identification: Psychological knowledge, problems, and perspectives]. Göttingen, Federal Republic of Germany: Hogrefe.

Langer, E. J., & Abelson, R. P. (1972). The semantics of asking a favor: How to succeed in getting help without really dying. *Journal of Personality and Social Psychology, 24,* 26–32.

Leippe, M. R. (1980). Effects of integrative memorial and cognitive processes on the correspondence of eyewitness accuracy and confidence. *Law and Human Behavior, 4,* 261–274.

Lindsay, R. C. L., Wallbridge, H., & Drennan, D. (1987). Do the clothes make the man? An exploration of the effect of lineup attire on eyewitness identification accuracy. *Canadian Journal of Behavioral Science, 19,* 463–477.

Lindsay, R. C. L., & Wells, G. L. (1985). Improving eyewitness identifications from lineups: Simultaneous versus sequential lineup presentation. *Journal of Applied Psychology, 70,* 556–564.

Loftus, E. F. (1979). *Eyewitness testimony.* Cambridge, MA: Harvard University Press.

Malpass, R. S., & Devine, P. G. (1981a). Eyewitness identification: Lineup instructions and the absence of the offender. *Journal of Applied Psychology, 66,* 482–489.

Malpass, R. S., & Devine, P. G. (1981b). Guided memory in eyewitness identification. *Journal of Applied Psychology, 66,* 343–350.

Malpass, R. S., & Devine, P. G. (1984). Research on suggestion in lineups and photospreads. In G. L. Wells & E. F. Loftus (Eds.), *Eyewitness testimony: Psychological perspectives* (pp. 64–91). New York: Cambridge University Press.

Neil v. Biggers, 409 U.S. 188. (1972).

Parkin, A. J., & Hayward, C. (1983). The influence of trait and physical-feature-based orienting strategies on aspects of facial memory. *British Journal of Psychology, 74,* 71–82.

Pigott, M. A., & Brigham, J. C. (1985). Relationship between accuracy of prior description and facial recognition. *Journal of Applied Psychology, 70,* 547–555.

Sanders, G. S. (1984). The effects of context cues on eyewitness identification responses. *Journal of Applied Social Psychology, 14,* 386–397.

Shepherd, J. W., Ellis, H. D., & Davies, G. M. (1982). *Identification evidence: A psychological examination.* Aberdeen, Scotland: Aberdeen University Press.

Sporer, S. L. (1982). A brief history of the psychology of testimony. *Current Psychological Reviews, 2,* 323–339.

Sporer, S. L. (1983). Allgemeinwissen zur Psychologie der Zeugenaussage [Common sense knowledge about the psychology of eyewitnesses]. In H. J. Kerner, H. Kury, & K. Sessar (Eds.), *Deutsche Forschungen zur Kriminalitätsentstehung und Kriminalitätskontrolle* (pp. 1191–1234). Köln, Federal Republic of Germany: Heymanns.

Sporer, S. L. (1988). Long-term improvement of facial recognition through visual rehearsal. In M. M. Gruneberg, P. E. Morris, & R. N. Sykes (Eds.), *Practical aspects of memory* (Vol. 1, pp. 182–188). London: Wiley.

Sporer, S. L. (1990). Psychologische Aspekte der Personenbeschreibung [Psychological aspects of person descriptions]. In G. Köhnken & S. L. Sporer (Eds.), *Identifizierung durch Augenzeugen: Psychologisches Wissen, Probleme und Perspektiven* (pp. 53–83). Göttingen, Federal Republic of German: Hogrefe.

Sporer, S. L. (1991). Deep—deeper—deepest? Encoding strategies and the recognition of human faces. *Journal of Experimental Psychology: Learning, Memory and Cognition, 17,* 323–333.

Sporer, S. L. (1992). Post-dicting eyewitness accuracy: Confidence, decision-times and person descriptions of choosers and nonchoosers. *European Journal of Social Psychology, 22,* 157–180.

Sporer, S. L. (in press). Decision-times and eyewitness identification accuracy in simultaneous and sequential lineups. In D. F. Ross, J. D. Read, & M. P. Toglia (Eds.), *Adult eyewitness testimony: Current trends and developments.* New York: Cambridge University Press.

Sporer, S. L., Eickelkamp, A., & Spitmann-Rex, D. (1990). Live Gegenüberstellungen vs. Lichtbildvorlagen: Ein experimenteller Vergleich unterschiedlicher Präsentationsmodi zum Zwecke der Personenidentifizierung [Live lineups versus photospreads: An experimental comparison of different modes of presentation for eyewitness identifications]. In D. Meurer & S. L. Sporer (Eds.), *Zum Beweiswert von Personenidentifizierungen: Neuere empirische Befunde* (pp. 48–105). Marburg, Federal Republic of Germany: Elwert.

Sporer, S. L., Malpass, R. S., & Köhnken, G. (Eds.). (in press). *Psychological issues in eyewitness identification.* Hillsdale, NJ: Erlbaum.

Theios, J. (1975). The components of response latency in simple human information processing tasks. *Attention and Performance, 5,* 418–440.

Turtle, J. W. (1988, June). *Does eyewitness-identification behavior provide cues to improve judgments of identification accuracy?* Paper presented at the North Atlantic Treaty Organization Advanced Study Institute, Maratea, Italy.

Wells, G. L. (1978). Applied eyewitness research: System variables and estimator variables. *Journal of Personality and Social Psychology, 36,* 1546–1557.

Wells, G. L. (1984). The psychology of lineup identifications. *Journal of Applied Social Psychology, 14,* 89–103.

Wells, G. L. (1985). Verbal descriptions of faces from memory: Are they diagnostic of identification accuracy? *Journal of Applied Psychology, 70,* 619–626.

Wells, G. L., & Lindsay, R. C. L. (1983). How do people infer the accuracy of eyewitness memory? Studies of performance and a metamemory analysis. In S. Lloyd-Bostock & B. R. Clifford (Eds.), *Evaluating witness evidence* (pp. 41–55). Chichester, England: Wiley.

Wells, G. L., & Lindsay R. C. L. (1985). Methodological notes on the accuracy-confidence relation in eyewitness identifications. *Journal of Applied Psychology, 70,* 413–419.

Wells, G. L., & Murray, D. M. (1983). What can psychology say about the *Neil v. Biggers* criteria for judging eyewitness accuracy? *Journal of Applied Psychology, 68,* 347–362.

Wells, G. L., & Murray, D. M. (1984). Eyewitness confidence. In G. L. Wells & E. F. Loftus (Eds.), *Eyewitness testimony: Psychological perspectives* (pp. 155–170). New York: Cambridge University Press.

Wells, G. L., & Turtle, J. W. (1986). Eyewitness identification: The importance of lineup models. *Psychological Bulletin, 99,* 320–329.

Yarmey, A. D. (1979). *The psychology of eyewitness testimony.* New York: Free Press.

Yarmey, A. D., & Jones, H. P. T. (1983). Accuracy of memory of male and female eyewitnesses to a criminal assault and rape. *Bulletin of the Psychonomic Society, 21,* 89–92.

Zechmeister, E. B., & Nyberg, S. E. (1982). *Human memory: An introduction to research and theory.* Monterey, CA: Brooks/Cole.

Received January 22, 1990
Revision received April 30, 1992
Accepted May 7, 1992 ■