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An evaluation of lineup presentation, weapon presence, and a distinctive feature using ROC analysis☆

Curt A. Carlson*, Maria A. Carlson[1]

Department of Psychology, Counseling, & Special Education, Texas A&M University – Commerce, Commerce, TX 75429, United States

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ABSTRACT

We conducted an experiment ($N = 2675$) including both laboratory and online participants to test hypotheses regarding important system and estimator variables for eyewitness identification. Simultaneous lineups were compared to sequential lineups with the suspect presented early versus late because there is evidence that suspect position could be an important factor determining a simultaneous versus sequential advantage in guilty-innocent suspect discriminability. We also manipulated whether or not the perpetrator held a weapon or had a distinctive feature on his face, to re-evaluate recent evidence that these factors interact. Overall, the simultaneous lineup yielded higher discriminability than the sequential lineup, and there was no effect of sequential position. Discriminability was higher when the perpetrator had no weapon, but only when no distinctive feature was present. We conclude with a discussion of the importance of exploring interactions between system and estimator variables using Receiver Operating Characteristic (ROC) analysis.

1. Introduction

The number of DNA exonerations continues to increase, now exceeding 300 (www.innocenceproject.org). A figure that has remained relatively constant is 75%, the proportion of these cases involving mistaken eyewitness identification (Garrett, 2011). In response to this problem, researchers have emphasized *system* over *estimator* variables (Wells, 1978) because the former are those over which the criminal justice system has control (e.g., lineup presentation method). In contrast, estimator variables can only be estimated after the crime has taken place. However, this should not preclude research into estimator variables, as they can interact with key system variables. The present research focused on two estimator variables, the presence of a weapon and the presence of a distinctive feature on the perpetrator's face, that recent research has shown can affect eyewitness identification and could interact with a system variable of considerable interest: lineup presentation method.

Until very recently, all research comparing simultaneous (all lineup members presented at once) to sequential (members presented individually) lineup presentation has utilized probative value measures conflating two elements of eyewitness decisions: discriminability (between guilty and innocent suspects) and willingness to choose. As explained below, this can lead to misleading conclusions about the purported discriminability benefit of the sequential lineup over the simultaneous lineup because these measures can signal a discriminability difference that is, in fact, driven by a conservative criterion shift. The present research utilizes a technique, Receiver Operating Characteristic (ROC) analysis, used by the medical community to clearly establish discriminability differences (e.g., between two radiological methods, e.g., Lusted, 1971). This approach now needs to be applied in the eyewitness identification domain (e.g., Gronlund, Carlson, et al., 2012; Mickes, Flowe, & Wixted, 2012; for a review see Gronlund, Wixted, & Mickes, 2014).

1.1. Important estimator variables: weapon presence and a distinctive facial feature

Although the majority of eyewitness identification research has focused on system variables (for a review, see Gronlund & Carlson, 2013), significant research has been conducted on some estimator variables such as a difference in race between perpetrator

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* Corresponding author. Tel.: +1 903 468 8723; fax: +1 903 886 5510.
E-mail address: curt.carlson@tamuc.edu (C.A. Carlson).
[1] Tel.: +1 903 468 8723; fax: +1 903 886 5510.

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and eyewitness, stress, and duration of exposure to a perpetrator (Wells, Memon, & Penrod, 2006). The present study involved another estimator variable that has received some attention: the presence of a weapon during a crime, which can produce a Weapon Focus Effect (e.g., Cutler & Penrod, 1988; Loftus, Loftus, & Messo, 1987; Pickel, 1998). When a perpetrator's weapon is visible during a crime, eyewitnesses can focus on it, to the detriment of attention directed toward either the perpetrator's face or other aspects of the crime. This reduced attention leads to a robust finding of poor memory for visual elements of the crime scene other than the weapon (e.g., Saunders, 2009), and a less consistent finding of less accurate eyewitness identification from a lineup (see meta-analyses by Fawcett, Russell, Peace, & Christie, 2013, and Steblay, 1992). Due to the importance of mistaken eyewitness identification revealed by DNA exoneration cases, the present study involves recognition decisions from lineups rather than recall of crime details.

Recent research has connected the Weapon Focus Effect with another potentially important estimator variable: a distinctive feature on the perpetrator's face (Carlson & Carlson, 2012). Unlike weapon presence, there has been little research on perpetrator distinctiveness (Carlson, 2011; Carlson & Gronlund, 2011; Zarkadi, Wade, & Stewart, 2009). With the largest experiment ($N = 600$) on the Weapon Focus Effect conducted to that point, Carlson and Carlson replicated the weapon presence decrement by finding lower probative value of a suspect identification when the perpetrator held a gun compared to no weapon. Interestingly, however, this pattern occurred only when the perpetrator did not have a distinctive feature (a large sports sticker) on his face. One goal of the present study is to re-evaluate this finding using ROC analysis (described below), which unconfounds discriminability from willingness to choose, and which has never (to our knowledge) been applied to weapon manipulations or any research evaluating both system and estimator variables.

1.2. Simultaneous versus sequential lineups

We also extended the investigation of this novel interaction between a distinctive facial feature and weapon presence to sequential lineups; Carlson and Carlson (2012) only used simultaneous lineups. In so doing, we continue in the same vein as two recent studies investigating perpetrator distinctiveness and simultaneous/sequential lineup presentation: (a) Carlson and Gronlund (2011) found a sequential lineup advantage only for perpetrators previously rated as holistically distinctive, and (b) Carlson (2011) extended this effect to perpetrators with a distinctive facial feature (black eye, scar, or mole).

The ability of sequential versus simultaneous lineups to enhance eyewitness discriminability between guilty and innocent suspects has become controversial. Historically, there has been evidence of a *sequential superiority effect*, such that the sequential lineup lowers both correct and false identification rates, but reduces the latter to a greater extent (e.g., Lindsay & Wells, 1985; see meta-analyses by Steblay, Dysart, Fulero, & Lindsay, 2001, and Steblay, Dysart, & Wells, 2011). However, recent research has found that these two methods result either in equivalent discriminability (e.g., Andersen, Carlson, Carlson, & Gronlund, 2014; Clark, 2012; Gronlund, Carlson, Dailey, & Goodsell, 2009; Gronlund, Carlson, et al., 2012; Palmer & Brewer, 2012; see review by Gronlund, Andersen, & Perry, 2012) or that the simultaneous lineup actually produces better discriminability (Dobolyi & Dodson, 2013; Mickes et al., 2012).

Wixted and Mickes (in press) presented a Diagnostic Feature-Detection Hypothesis to explain the nature of the simultaneous lineup advantage. Essentially it states that the simultaneous lineup should yield higher discriminability because the eyewitness is able to compare the lineup members' faces to each other, gathering important information about distinctive features from their memory of the perpetrator that might set the perpetrator apart from all other common features shared by lineup members (e.g., all Caucasian males in their 20s with dark hair, but guilty suspect is only one with a particular face shape). Such diagnostic information is not available to aid recognition during a sequential lineup, as the members cannot be compared simultaneously. We did not derive any predictions for the present experiment based on this theory, but we will use it to guide interpretation of some of our resulting patterns later in this paper.

In addition to comparing simultaneous and sequential lineups, we also manipulated the position of the suspect in the sequential lineup (position 2 versus 5) because this factor has recently been shown to interact with simultaneous versus sequential performance. Using ROC analysis, Gronlund, Carlson, et al. (2012) found a simultaneous lineup advantage only compared to the sequential lineup with early suspect position (position 2 of 6). They found no discriminability difference between simultaneous and sequential lineups with later suspect position (position 5 of 6). They identified this pattern in data from Gronlund et al. (2009) that collapsed over lineups at various levels of bias toward the suspect (biased, intermediate, and fair). We sought to replicate the pattern with an entirely new data set and with only fair lineups.

1.3. ROC analysis

ROC analysis, commonly used in the memory literature (see review by Yonelinas & Parks, 2007; see also Swets, Dawes, & Monahan, 2000), is changing the way psychological scientists interpret eyewitness accuracy (Carlson, 2013). Probative value measures rely on various combinations of correct identification (ID) rate and false ID rate. The two most common examples are correct ID rate/false ID rate and correct ID rate/(correct ID rate + false ID rate). These both can provide misleading estimates of discriminability, as both increase simply as a function of choosing rate. Six recent papers have illustrated this problem within the framework of simultaneous versus sequential lineups (Andersen et al., 2014; Dobolyi & Dodson, 2013; Gronlund, Carlson, et al., 2012; Gronlund et al., 2014; Mickes et al., 2012; Wixted & Mickes, 2012). We therefore constructed ROC curves as a means of identifying which lineup method yields the best discriminability between innocent and guilty suspects.

Moreover, it is important to use ROC analysis to determine whether the presence of a weapon reduces discriminability, or whether it simply makes eyewitnesses less likely to choose from a lineup. Either is possible because the majority of the Weapon Focus Effect literature includes correct, but not false identification rate. Both are required, in combination with confidence data, to produce ROC curves. Also, this analysis will help delineate the influence of a distinctive feature (on the perpetrator's face) on weapon presence and simultaneous versus sequential lineup performance.

1.4. Predictions

The present study tested three primary hypotheses: (a) in replication of recent studies, the simultaneous lineup will produce higher discriminability than will the sequential lineup, (b) the presence of a weapon will reduce discriminability, and (c) adding a distinctive feature to the perpetrator's face will eliminate this weapon effect.

2. Method

2.1. Participants

We collected data from 720 undergraduates, either online ($n = 220$) or in a laboratory setting ($n = 500$) across three