Paradigm shift in criminal police lineups: Eyewitness identification as multicriteria decision making

Enrique Mu⁎, Tingting Rachel Chung, Lawrence Ian Reed

⁎ Corresponding author.
E-mail addresses: emu@carlow.edu (E. Mu), RChung@chatham.edu (T.R. Chung), lreed@mclean.harvard.edu (L.I. Reed).

1. Introduction

The improvement of the criminal justice system is a continuous goal of the U.S. government. However, according to research by the Innocence Project, eyewitness mis-identification of criminal suspects using police lineups is the most common cause of wrongful convictions of innocent people in the United States (Garrett, 2012). Because of this, a considerable amount of empirical research has been conducted on ways to improve the eyewitness identification process. More specifically, lineup presentation methods have been thoroughly studied. In particular, two methods have been examined extensively in the literature, and these methods are the simultaneous (SIM) and the sequential (SEQ) presentation formats.

The simultaneous (SIM) format is the traditional method where the witness is shown a simultaneous lineup of multiple suspects. The sequential (SEQ) method, in contrast, presents one individual at a time in a serial manner. In both methods, the witness must determine a match categorically (i.e., Yes or No). The extant research literature which compares these two methods suggests that the sequential approach is superior. That is, the SEQ method produces more accurate identifications than the SIM method does, although this general conclusion is still under debate. However, more importantly, the SEQ method results in a decrease of false identification ratios (McQuiston-Surrett et al., 2006; Steblay et al., 2001, 2011).

Eyewitness identification is traditionally seen as a memory recognition problem rooted in cognitive science. The eyewitness is required to indicate with a “Yes” or “No” if the individual in the police lineup is the target suspect. Here, we propose a paradigm shift. We propose reframing the problem as a prioritization decision task. This allows the use of a Multi-criteria Decision Making (MCDM) approach to model eyewitness identification. Following this new paradigm, we present findings from the application of an MCDM approach which we call the pairwise (PAIR) approach. The proposed PAIR approach is based on the Analytic Hierarchy Process (AHP), a MCDM methodology that has been widely used in prioritization tasks (Saaty, 2001). This method requires the eyewitness to compare two suspects at a time to establish their relative priority with respect to the goal of identifying the culprit (who the eyewitness, ideally, has in mind as the reference). Once all comparisons have been completed, a calculation of the eigenvector of the pairwise comparison matrix provides the priorities for each of the individuals in the lineup. The individual with the highest priority constitutes the target suspect identified by the eyewitness.
AHP also provides a wide array of quantitative tools such as inconsistency measurement that may be used to assess the level of eyewitness logical reliability in an objective manner. Because of this re-conceptualization of eyewitness identification as a prioritizing decision task, our proposed PAIR approach has the potential to enhance eyewitness identification in novel ways. These findings may provide a breakthrough to the field of eyewitness identification research as well as the spread of behavioral operational research (Hämäläinen et al., 2013).

Our research question is: is the PAIR approach a more effective method for eyewitness identification compared to the SEQ and SIM methods?

2. Theoretical background

There is a growing body of behavioral studies in operational research (OR) and their importance in the OR field has been recognized (Bendoly et al., 2006). More specifically, the use of experiments to understand decisions in complex and ambiguous settings has been used in the OR field (Lundberg, 2004). There is a small but rich tradition of applying OR to problems of crime, justice and police work (Correa, 2005; Gorman and Ruggiero, 2008; Maltz, 1996; Pekkanen et al., 2013; Saaty and Mu, 1997). For these reasons, this study will address the issues related to eyewitness identification using police lineups from a MCDM and experimental methodology perspective.

2.1. SEQ vs. SIM lineups

A considerable amount of empirical research has been conducted on ways to improve the eyewitness identification process. Based on this body of literature, the National Institute of Justice published a guide to eyewitness evidence under then Attorney General Janet Reno’s directive: The SEQ method is recommended to law enforcement as the best practice (Technical Working Group for Eyewitness Evidence, 1999). The SIM presentation method has received significant criticism in the scientific literature for both theoretical and empirical reasons. Theoretically, it is argued that the witness makes relative judgments by comparing each individual to each other before making a definitive decision with respect to an absolute reference (i.e., the criminal suspect recalled from memory) (Wells, 1984). The SEQ method, in contrast, is designed to ensure that the witness makes absolute judgments about individual suspects which, in theory, should produce more accurate identifications, and reduce the number of false positive identifications. Empirically, at least three meta-analyses of the scientific literature have confirmed the sequential superiority effect under certain conditions (McQuiston-Surrett et al., 2006; Steblay et al., 2001, 2011).

2.2. The PAIR approach and eyewitness identification

The PAIR approach is based on the idea of considering eyewitness identification as a prioritization decision rather than a simplistic “Yes/No” memory recognition task. Considering eyewitness identification as a prioritization task, the goal of identifying the culprit is at the top of a decision hierarchy, and potential suspect persons \((P_1,...,P_n)\) constitute alternatives to be prioritized at the lower level of the hierarchy (Fig. 1). Next, the suspects can be compared pairwise with respect to the image of the culprit, recalled from memory, which constitutes the absolute point of reference. These comparison judgments are entered into a pairwise comparison matrix which is then analyzed in terms of their consistency (i.e. extent to which successive pairwise comparisons do not contradict each other), and finally the suspect priorities are calculated. The suspect with the highest priority constitutes the likeliest target culprit.

2.2.1. About the PAIR methodology

One useful MCDM approach for criteria prioritization follows the Analytic Hierarchy Process (AHP) developed by Saaty (2001). The process has been widely used in many different applications related to selection, prioritization and forecasting (Vaidya and Kumar, 2006). In this method, the elements that need to be prioritized are compared pairwise (PAIR) to establish their relative importance, using an intensity scale Saaty developed for this purpose (see Fig. 2).

Using this scale we will ask questions (see Appendix B for a sample comparison question) such as: With respect to the purpose of identifying the culprit, who is more likely to be the person you saw at the crime scene and to what degree? “P_1” or “P_2”? If we consider that \(P_1\) is moderately more important than \(P_2\) we are mathematically stating \(P_1/P_2=3\). Notice that this judgment automatically implies that the comparison of \(P_2\) with \(P_1\) will yield the reciprocal ratio \(P_2/P_1=1/3\). This constitutes the reciprocity rule that can be expressed mathematically as \(P_{ij}=1/P_{ji}\) where \(i\) and \(j\) are any element in the comparison matrix.

These judgments are recorded in a comparison matrix as shown in Fig. 3 which constitutes an example where there are \(n=8\) potential suspects. Notice that the judgment is diagonal, given that the importance of a criterion compared with itself will always be equal, that is 1 in the comparison matrix. Also, only the comparisons that fill in the upper part of the matrix (above the diagonal with 1’s) are needed. The judgments in the lower part of the comparison matrix are the reciprocals of the values in the upper part.

Another important consideration when completing the comparison matrix is the extent to which it respects the transitivity rule. If the importance of \(P_1/P_2=2\), and the importance of \(P_2/P_3=3\), then it is expected that \(P_1/P_3=2*3=6\). In other words, \(P_{ij}=P_{ik}*P_{kj}\) where \(P_{ij}\) is the comparison of criteria \(i\) and \(j\).

2.2.1.1. Checking consistency of judgments. Any comparison matrix that fulfills the reciprocity and transitivity rules is said to be consistent. The reciprocity rule is relatively easy to respect, whenever you elicit the judgment \(P_{ij}\) you make a point of recording the judgment \(P_{ji}\) as the reciprocal value in the comparison. However, it is much harder to comply with the transitivity rule because of the use of English language verbal comparisons “strongly more important than,” “very strongly more important than,” “extremely more important than” and so forth, as shown in Fig. 2. Deriving criteria weights in AHP only makes sense if the comparison matrix is consistent or near consistent, and to assess this Saaty (2001) proposed a consistency index (CI) as follows:

\[
CI = (\lambda_{\text{max}} - N) / (N - 1)
\]

where \(\lambda_{\text{max}}\) is the matrix maximal eigenvalue. This equation is used to calculate the consistency ratio defined as: CR=CI/RI

where RI is the random index (the average CI of 500 randomly filled matrices which is available in published tables). A CR less than 10% means that the inconsistency is less than 10% of 500 random matrices. CR values of 0.1 or below constitute acceptable consistency.

For the comparison matrix used in our example analysis, CR can be calculated as being 0.1, which constitutes an acceptable consistency.
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