Advances in Psychology and Law 5

Monica K. Miller
Brian H. Bornstein *Editors*

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To Sally Hollenbaugh, for your love, patience, and friendship. You helped make me who I am today.—M.M.
In loving memory of Sandra Emler.—B.B.

Preface

The first half of the year 2020 has brought much turmoil and uncertainty. Preparing this volume has provided us with some welcome comforts—working with great authors and a great publisher to produce Volume 5 of the *Advances in Psychology and Law* book series. As with the four volumes that preceded it, Volume 5 is an opportunity to reflect on changes to the legal landscape of the country—some which have brought their own turmoil and uncertainty. With issues ranging from gun policy to the death penalty to the experiences of victims, witnesses, and exonerees, the volume is filled with thought-provoking perspectives by three dozen authors with diverse experiences and interests. Each chapter reviews the statutes, case law, and procedures relevant to the topic, along with a synthesis of the relevant psychology research. Chapters conclude with suggestions for legal changes and future research directions. We hope readers find this formula a helpful way to learn about new topics and perspectives in legal psychology.

We would like to thank Springer for their continued support of our book series. A special thanks belongs to Sharon Panulla and Sylvana Ruggirello who saw us through Volumes 1–4 and the conception of Volume 5. We wish you well on your new endeavors and will always be grateful for your guidance as we started this adventure. We also would like to thank Judith Newlin and Sofia Geck for their new visions for the series; we look forward to working with you further!

This volume begins with chapters related to witnesses. In Chap. 1, Rumschik, Berman, and Cutler review the research on person-matching: the ability of a person to determine whether an image before him is of the person physically before him. For example, security personnel must determine whether an identification card matches the person presenting it; jurors must decide whether a surveillance video matches the defendant. Existing and future research have important implications for many legal settings.

Chapter 2 explores the psychological research related to informant witnesses such as co-conspirators and jailhouse informants. Wetmore and colleagues discuss how cross-examination and instructions have not tempered jurors' tendencies to believe such unreliable testimony. They present a number of psychological theories

that influence this tendency and offer safeguards that can reduce the risk of wrongful convictions.

Goldfarb and colleagues discuss the growing body of research on a different type of witness: adults who allege were victimized as children. They review the legal arguments (e.g., statutes of limitations) and implications of research relevant to victims' memories of abuse and abilities to communicate such abuse during psychological evaluations or police interviews. While some memories are flawed, many have shown to be accurate—leading to a recommendation of relaxed statutes of limitations for some "historical" abuse cases on a case-by-case basis to ensure justice for victims.

Being interviewed by police can be stressful for victims, witnesses, and suspects—especially when their language proficiency is low, as in the case of nonnative speakers. In Chap. 4, Goodman-Delahunty and colleagues discuss the legal consequences of having interpreters during police interviews. This chapter reviews relevant literature and offers some best practices to guide this practice.

Chapter 5 expands on the theme of best practices, specifically concerning safeguards about eyewitness identification evidence. Skalon, San Roque, and Beaudry discuss how education and admissibility rules are safeguards that are intended to ensure a fair trial.

Some safeguards, like careful interviewing of victims who are reporting historical abuse or suspects who do not speak English, can successfully promote just outcomes. However, when legal safeguards are absent or unsuccessful, injustice can occur. Kirshenbaum and colleagues tackle the issue of wrongful convictions—and the plight of exonerees. Chapter 6 presents an overview of factors that determine whether exonerees are able to successfully reintegrate into society after their release from prison. There are both individual-level and community-level factors that affect reintegration, along with legal policies designed to ease their transition.

Wrongful convictions are but one of many justice and ethical concerns of modern days. The next three chapters trace the history of three other ethical and justice topics: the death penalty, racial bias, and the use of courts to address social problems.

West and Miller trace the changes in the use and methods of the death penalty throughout history, noting both societal and personal influences. They also note emerging research on the experiences of death-row inmates. In doing so, they note a number of injustices that still exist, including racial bias on how the penalty is sought by prosecutors and doled out by jurors.

Chapter 8 continues the theme of racial injustices, specifically investigating historical and current public attitudes toward the police. Police have long struggled to build positive relationships with communities of color, but recent events, like those that triggered the *Black Lives Matter* movement, have impeded that progress. Cole, April, and Trinker highlight the systematic issues that promote racial disparities in attitudes toward the police, highlighting justice principles such as legitimacy and procedural justice.

Like Chap. 8, Chap. 9 discusses justice in terms of underlying justice principles (procedural justice, therapeutic jurisprudence) that are the basis of some problem-solving courts. This chapter also has a historical component, as it traces the

development of such courts in the United States and beyond. Miller, Block, and DeVault summarize the frequency with which various justice and psychological principles are used in the existing research evaluating problem-solving courts. They also discuss the range and quality of evaluations conducted, offering suggestions for courts of the future.

Evaluation will be critical for the topic of the final chapter: gun policy. Pirelli, Schrantz, and Wechsler synthesize the psychological research relevant to mental health-related gun laws. They conclude with a number of science-based recommendations that can inform gun policies in the United States, with hopes of reducing gun-related violence like homicides and suicides.

As this brief synopsis of the contents of Volume 5 highlights many fascinating topics within the field of legal psychology are worthy of attention. Some of the topics are timeless, for instance, the death penalty and race-based attitudes toward police. Others are emerging, such as video technology that "witnesses" persons or crimes and the use of psychology to create better gun policies. Many topics concern the well-being of those who come in contact with the legal system, such as victims who are interviewed, offenders who experience social issues (e.g., drug addiction), and those who are wrongfully convicted. And, many topics are designed to help us understand the effects of witnesses (including jailhouse informants), police interviewing techniques, and other safeguards designed to ensure that the legal system promotes justice. Volume 5 of *Advances in Psychology and Law* includes all these topics. We have enjoyed learning about these interesting topics, and we hope that readers do as well.

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Person-Matching: Real-Time Identifications of Persons from Photos and Videos

Danielle M. Rumschik, Garrett L. Berman, and Brian L. Cutler

On a daily basis, the real-time identification of persons from images occurs millions of times. According to the U.S. Federal Aviation Administration's website, for example, 2.6 million airline passengers fly each day. That means that, each day, security staff in the United States attempt real-time identifications of persons from their government-issued identifications, such as passports, driver's licenses, and Trusted Traveler's documents. Add to the number of flyers the number of persons requested to prove their identities to purchase alcohol, cigarettes, lottery tickets, and other controlled substances; the number who show identification cards to enter their schools, workplaces, and other protected environments; and shoppers required to prove that they are the owners of the credit cards they are using. The ubiquity of video recordings provides yet additional opportunities for real-time identifications. Surveillance cameras, body-worn cameras, dashboard cameras, and citizen journalists' cell phone cameras capture suspicious activity, providing opportunities for police and fact-finders to, in real time, determine whether a suspect in custody is the person caught on video.

Henceforth, for ease of exposition, we refer to the real-time matching of persons with presented images as *person-matching*. The sheer volume of person-matching activity and the stakes involved in getting it right would lead one to think that the task of person-matching has been mastered. Our review of the nascent research on person-matching, however, reveals that the task is far more difficult than one might expect, with accuracy rates dependent on a range of viewer and image-related

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factors. In this chapter, we review separately the research literature on person-matching from photos and person-matching from videos. Within each of these subsections, we illustrate the research methods used and identify the major conclusions to date. Following our review of these separate areas, we provide an integrative view, identifying common findings and differences between the two literatures. We end with discussions of the applied implications of the person-matching research and some directions for future research.

Psychological Theories of Person-Matching from Photos and Videos

Recognition of unfamiliar faces involves many different mechanisms of the human brain. These mechanisms and connections are present by 3–5 years of age (McKone, Crookes, Jeffery, & Dilks, 2012). Bruce and Young (1986) theorized that faces were recognized using a four-component method. Component 1 consists of the social interactions with a person that lead to the encoding of invariant configurations of features. This information is then sent to face recognition units in the brain (Component 2) that assess familiarity and resemblance of the face. Then, the representation of the face stimulates the biographical information and name retrieval by person identity nodes (Components 3 and 4). Likewise, Gobbini and Haxby (2007) proposed that two interconnected brain systems are responsible for face recognition: the core system, which encodes the visual appearances of faces, and the extended system, which contains all of one's knowledge about a person including personality traits, mental states, biographical information, and memories. These models of face recognition rely solely on the perceptual details that can be garnered from viewing a person's face. The perceptual details lead to the retrieval of biographical information about a person and that information can be used to make an identification. Bullot (2014) suggests that perceptual information is not the sole way that a person can be identified and that previous theories have disregarded any causal history that may aid in identification. According to Bullot, causal history includes things that cannot be known through physical perception but must be learned through interactions with a person. For example, facts about the person, biographical information, an ability to understand the target's mentality, and memories are all a part of a causal history. Bullot proposes the Causal-history theory of identification that states that, regardless of whether perceptual or causal evidence is prioritized, successful acts of person recognition must involve causal historical factors. Whichever theory is used to account for how persons are recognized in real time, it remains that unfamiliar PMP is a difficult task affected by many factors.

Person-matching with unfamiliar targets often proves to be very difficult. Much of the person-matching literature focuses specifically on face-matching and is done

involving photos, not live persons. Person-matching difficulty can arise from either a data-limitation or a resource-limitation. Data-limitation refers to low-quality images that provide limited information about a person's appearance (Jenkins & Burton, 2011; Norman & Bobrow, 1975). According to this view, person-matching is image-bound, and the images often provide limited information about all the potential ways that a face could look (Bruce, Henderson, Newman, & Burton, 2001; Hancock, Bruce, & Burton, 2000; Johnston & Edmonds, 2009). One theory explaining this low recognition rate is holistic configural processing (Burton, Schweinberger, Jenkins, & Kaufmann, 2015). Holistic configural processing involves encoding faces according to their spatial layouts (the distance between the eyes, the distance between the nose and the mouth, etc.). This inter-featural processing of the spatial layout determines the configuration of the face. When presented with limited representations of a face, a person's encoding of the facial configuration might prohibit transfer to different views of that face. For example, person-matchingaccuracy suffered as a result of the use of degraded images or single rather than multiple images (e.g., Bindemann & Sandford, 2011; Bruce et al., 2001). More generally, research supporting data-limitation problems has shown that when high-quality photos are used, match accuracy increases (Bruce et al., 1999; Henderson, Bruce, & Burton, 2001).

Person-matching accuracy is also affected by resource-limitation (Alenezi & Bindemann, 2013; Bindemann, Avetisyan, & Rakow, 2012; Liu, Collin, & Chaudhuri, 2000). Resource-limitation refers to individual differences in person-matching ability. Face images contain enough information to allow face matching across different time periods and viewpoints, but observers vary in their abilities to make use of the information. For example, individual differences in visual processing capacities (Megreya & Burton, 2006; Rose, Feldman, & Jankowski, 2003), facial perception abilities (Schmalzl, Palermo, & Coltheart, 2008; Wilmer et al., 2010; Zhu et al., 2010), and perceptional discrimination, memory, and mental speed (Burton, White, & McNeill, 2010; Megreya & Burton, 2006) can influence person-matching abilities. Person-matching abilities are further influenced by stimulus variables, such as appearance changes between photos (e.g., Bindemann & Sandford, 2011; Kemp, Towell, & Pike, 1997) and lighting of the photo (e.g., Longmore, Liu, & Young, 2015), as well as individual factors such as fatigue (e.g., Alenezi, Bindemann, Fysh, & Johnston, 2015) and perceptual viewpoint (e.g., Bruce et al., 1999; Longmore et al., 2015). Studies supporting resource-limitation have found that observers were better able to match faces when the image quality was degraded but were challenged when high-quality images were used but from different viewpoints (Bindemann, Attard, Leach, & Johnston, 2013). In summary, theories suggest that PMP and PMV decisions are difficult, due to individual differences with respect to abilities, the individual's mental state, and the quality of the stimuli.

Person-Matching from Photos (PMP)

As noted above, PMP occurs millions of times per day in various security contexts. PMP has four potential outcomes. First, the agent (officer, clerk, agent, etc.) can correctly conclude that the person matches the photo, that the photo is of the person presenting himself or herself (a "true positive"). Second, the agent can correctly conclude that the person does not match the photo, that is, the agent correctly concludes that the person and photo are two different people (a "true negative"). Third, the agent can incorrectly conclude that the person matches the photo (a "false positive"). In other words, the person and photo are different people, but the agent mistakenly concludes that they are the same person. Fourth, the agent can incorrectly conclude that the person does not match the photo (a "false negative"), meaning that the photo is of the person who is presenting himself or herself, but the agent mistakenly concludes that they are different people.

The various errors (false positives and false negatives) in PMP have significant consequences. Controlled substances typically require a minimum age limit for purchase. When a clerk sells alcohol to an under-age drinker with a borrowed identification card of an older friend or sibling, the clerk has broken a law for which the clerk, the storeowner, and the under-age purchaser may suffer criminal penalties, and the purchaser is subject to various risks from drinking alcohol. As another example, the recent influx of immigrants to European countries has resulted in some refugees using "Ghost-passports" (Wirth & Carbon, 2017), or passports belonging to friends and relatives with similar-looking faces. Travel bans and other discriminatory practices have led to increases in stolen passports. Some immigrants who might not otherwise qualify as refugees are stealing passports from people from countries that would qualify them for refugee status, such as Syria (Abdul-Ahad & Kingsley, 2015). Thus, PMP errors of the false-positive type contribute to immigration under false pretenses, highlighting a global impact of PMP failures. Sometimes, false-positive PMP consequences are disastrous. For example, law enforcement officials believe that one of the suicide bombers involved in the November 2015 terror attacks in Paris used a stolen Syrian passport to enter France (Kingsley, 2015). The 19 men responsible for hijacking four commercial airlines in the September 11th, 2001 attacks on the United States passed through airport security with fraudulent identity documents (Cimons, 2001).

How accurate is PMP? Some research has found accuracy rates of about 80% under ideal lab conditions (Bindemann, Avetisyan, & Blackwell, 2010; Megreya, Bindemann, & Harvard, 2011). Under more taxing, real-world conditions, accuracy rates can plummet to chance levels (Bindemann & Sandford, 2011; Davis & Valentine, 2008; Henderson et al., 2001; Kemp et al., 1997). In the remainder of this section, we review the psychological theories associated with PMP decision processes and the current state of the research on PMP.

Laboratory research on PMP provides insights regarding PMP accuracy but with the limitation that the real-world conditions in which PMP take place depart significantly from the sterile conditions of the laboratory. Some laboratory researchers

have taken efforts to enhance ecological validity with the idea of better approximating real-world conditions, however. Perhaps more importantly, the controlled nature of the laboratory and the attendant benefits of random assignment and ability to manipulate variables provide insights into the factors that systematically influence PMP. Laboratory research is particularly appropriate for improving our understanding of the psychological mechanisms underlying PMP. Field research on PMP, discussed in the following section, informs us about PMP processes when used in a naturalistic environment.

With respect to overall PMP accuracy, Bruce (1982) found that, even though accuracy for matching unfamiliar face images (using the same picture) was high, around 90% (Hochberg & Galper, 1967; Nickerson, 1965; Yin, 1969), accuracy dropped to 60% when different images are used in the matching process. Bindemann and Sandford (2011) found that participants performed lower than expected when presented with a PMP task involving unfamiliar persons. Bindemann and Sandford (2011) compared matching rates from three different photo IDs of the same person. One of the photos was 19 months old and the other two photos were 3 months old. Participants were shown one ID at a time, and the ID remained in view while selecting the target from a set of 30 face photos. The set of photos and the ID remained visible until a decision was made. Results showed that, at best, only 67% of matching decisions were accurate. Overall performance dropped to 38% when attempting to match the target to all three of the IDs.

The emergence and popularity of security cameras in public and private areas to prevent property and personal crime have become a driving factor for PMP research because still photos are sometimes acquired from the video and then displayed to witnesses to match to a suspect. Using an image taken from security camera footage, Bruce et al. (1999) had participants compare a high-quality video still to a photo array of the target and similar-looking fillers. Errors were made on a substantial proportion of trials, even when the video stills and photo arrays were similar in the angles of view and facial expressions.

As noted above, laboratory research provides some insights into overall PMP accuracy and is particularly well suited for understanding the factors that influence PMP and providing insights to the psychological process underlying PMP. In the remainder of this section, we review research on the factors affecting PMP accuracy. These factors include image quality, base rate of PMP mismatches, familiarity, recency of photo, time pressure, expertise, and training.

Image Quality

Henderson et al. (2001) examined the impact of image quality on PMP accuracy. When participants were asked to match greyscale, low-quality stills from CCTV video to a target-present photo, the accuracy rate was about 30%. In a second experiment, participants were presented with stills from broadcast-quality footage and asked to match the photo to a photo array. Results markedly improved with higher

quality photos, yielding an accuracy rate of 64% across both target-present and target-absent arrays. Later research found that matching physically present suspects to high-quality video and images from security camera footage was also highly susceptible to error (Davis & Valentine, 2008).

Base-Rate of PMP Mismatches

Bindemann et al. (2010) recognized that the 50% split between matching and mismatching photo pairs typical of laboratory research was unrealistic in practice and may be distorting PMP decisions, as identity mismatches are relatively uncommon. In order to determine if the over-representation of mismatches in research skewed PMP results, they tested participants' PMP performance under low (2%) and high (50%) mismatch prevalence. Participants were presented with pairs of face photos on a screen and then asked to decide whether the two photos depicted the same person or different people. More of the identity mismatches (true negatives) were detected under 2% than 50% prevalence. The improvement of mismatch accuracy seemed to come at the expense of false positives, with observers erroneously classifying matches as mismatches on 25% of the trials.

Familiarity

As stated above, studies comparing familiar and unfamiliar faces demonstrate higher degrees of accuracy for identifying familiar individuals (Bahrick, Bahrick, & Wittlinger, 1975; Klatzky & Forrest, 1984). The familiar face matching effect is evidence that facial identification is different for familiar and unfamiliar faces (Bruce et al., 2001; Hancock et al., 2000; Jenkins & Burton, 2011; Johnston & Edmonds, 2009). Ellis, Shepherd, and Davies (1979) found that familiar faces are recognized from their internal features, such as eyes, nose, and mouth, while unfamiliar faces are recognized from their external features, like hair and face shape. Recognition of familiar faces is robust, even under difficult viewing conditions (Bahrick et al., 1975; Bindemann, Burton, Leuthold, & Schweinberger, 2008; Burton, Wilson, Cowan, & Bruce, 1999; Lie, Seetzen, Burton, & Chaudhuri, 2003). When participants were asked to make identifications of familiar video targets or comparison photos, participants were able to match or reject pairs with over 90% accuracy (Bruce et al., 2001). In contrast, ability to accurately identify unfamiliar faces was weak, even under optimal viewing conditions (Bruce et al., 1999, 2001; Henderson et al., 2001; Megreya & Burton, 2006, 2008). PMPaccuracy for unfamiliar faces increased to levels of 90% when the same image was presented for comparison (Hochberg & Galper, 1967; Nickerson, 1965; Yin, 1969). Accuracy rates dropped to 60% when different images were used (Bruce, 1982). These results suggest that recognition of unfamiliar faces may be a function of different visual

processes such as "picture recognition" more so than "face recognition" (Hancock et al., 2000). In this distinction, picture recognition refers to when a viewer's perception of a person is constrained to a single image of an unfamiliar face and when that singular image is the only cue she has to match with a target image. Face recognition processes, by contrast, elicit more cues such as matching targets using internal features (Ellis et al., 1979), comparing the target face with stored images (Longmore, Liu, & Young, 2015) or the averaging of multiple exposures (Burton, Jenkins, Hancock, & White, 2005). Even under ideal conditions (comparing two high-quality photos taken moments apart with faces in the same lighting, expression, and view), participants averaged 10–30% errors when matching unfamiliar faces (Burton et al., 2010; Megreya et al., 2011), suggesting that unfamiliar face matching relies on picture recognition and not face recognition.

Recency of Photo

Most passports in North America are valid for 10 years, while driver's licenses and ID cards may be valid anywhere from 5 years to decades (in states where there is no requirement for updating the photo on the license). Megreya, Sandford, and Burton (2013) compared matching accuracy for photos taken on the same day versus months apart. Participants were instructed to match a target face to a face embedded within a 10-face array. Results showed that participants accurately identified the correct face on 79% of occasions in the same-day picture condition. Accuracy dropped dramatically to 58% when different-day photos were displayed.

Time Pressure

Time passage and time pressure are ever-present variables confronting professionals who engage in PMP. Airport and border service security agents are expected to accurately perform tedious and repetitive PMP tasks throughout their shifts. For example, Australian and UK passport officers are expected to process about 90% of passengers in a passport queue (length unspecified) within 30 min of arriving on shift (Fysh & Bindemann, 2017). Although high efficiency is needed for consumer satisfaction, high efficiency compromises accuracy, for accuracy rates rise and fall with photo presentation duration (Chiller-Glaus, Schwaninger, & Hofer, 2007). Time pressure influences presentation duration and interferes with close scrutiny of a passport and the passport bearer. To examine the effects of time pressure on accuracy judgments, some studies used onscreen displays and prompts indicating to participants that they were behind pace to finish in the allotted time and that they needed to speed up (Bindemann, Fysh, Cross, & Watts, 2016; Fysh & Bindemann, 2017). Fysh and Bindemann (2017) examined the influence of time pressure changes on PMP accuracy in 2-s intervals between 2 and 10 s. Stimuli were composed of

high-quality photo images alongside student ID photos taken at least 3 months earlier. The base-rate of mismatches was low (7.5%). Although performance on match trials was comparable across time pressure conditions, time pressure impacted mismatch performance. Mismatch accuracy (true negatives) deteriorated as the average time target per trial was reduced. The ability to detect true negatives was worst in the 4- and 2-s conditions and at nearly chance levels (53%) in the 2-s condition. Fysh and Bindemann (2017) also found a matching response bias in each time pressure condition except the 10-s block. The bias to classify faces as matches was also found by Özbek and Bindemann (2011).

Issues associated with the time pressure experienced by PMP professionals can also be exacerbated by the divided attention demands posed by the additional tasks they are required to perform, such as checking and verifying personal details included on identity documents and whether the documents are valid. Lee, Vast, and Butavicius (2006) examined the effects of the cognitive load on PMP accuracy by having participants complete 400 face-matching trials in a factorial design in which they independently manipulated time pressure (6 vs. 15 s per trial) and the presence of an additional task (required to answer a question about the details of the ID card vs. no question). Participants in the additional task conditions mistakenly rejected more than half of the actual match pairs (false negatives) while mistakenly accepting 10% of the mismatched pairs (false positives). McCaffery and Burton (2016) also found increases in false positives and false negatives when participants were tasked with assessing additional biographical information. Additionally, they found a bias toward classifying photos as matching when participants were tasked with assessing the biographic information.

In an effort to mitigate the impact of time pressure on PMP judgments, Alenezi et al. (2015) tested two different strategies to reduce fatigue and mistakes in long PMP trials. Their first experiment consisted of 1000 face-matching trials with 5-min breaks after each block of 200 trials. Results showed an inverse relationship between number of trials and overall accuracy, mostly due to a tendency to classify true matches as false positives. In their second experiment, participants were moved into a new room after each 5-min block. Similarly, accuracy declined across trials, with the largest decline for mismatch accuracy. Their two experiments found that neither enforced rest through a required break nor moving rooms eliminated the accuracy decline during long matching tasks.

Training in PMP

Training participants in facial identification has been examined as a way to increase PMP accuracy, but the research findings are mixed. Multiple training methods have been employed. One method is to focus the participant's attention on features, such as internal feature focus training (e.g., Paterson et al., 2017) and face shape classification (e.g., Towler, White, and Kemp (2014). Another approach is to provide trial-by-trial accuracy feedback (e.g., Alenezi & Bindemann, 2013; White, Kemp,

Jenkins, & Burton, 2014) and overall accuracy feedback (e.g., Alenezi & Bindemann, 2013). Davis, Forrest, Treml, and Jansari (2017) found that controls familiarized with the decision-making process made slightly fewer false positives and slightly more true negatives than untrained controls. In contrast, Lee, Wilkinson, Memon, and Houston (2009) found no accuracy differences between individuals experienced in facial identification, those who were partially trained, or those who were untrained. Training does have some implications for PMP when facial features change, for example, as a natural result of aging (Paterson et al., 2017). Training individuals to attend to internal features of unfamiliar faces may improve identification accuracy when external features have been changed but may also lead to higher rates of false negatives when features are unchanged (Paterson et al., 2017). Using the approach of focusing participants on facial features, Megreya and Bindemann (2018) found both improvement and decline in PMP accuracy when participants were instructed to focus on specific facial features and make comparisons across the two photos. PMP accuracy increased when participants focused on the eyebrows but decreased when participants focused on the ears. Research conducted by Rumschik and Cutler (2019) found that instructions to compare the noses in photos reduced false positives when compared to other feature instructions, but not significantly more than holistic comparisons.

Feedback is an important aspect of any training program but is often nonexistent or delayed in the context of real-world PMP decisions. Receiving feedback allows trainees to learn from their mistakes and to reassess the standards they are using to make match or mismatch decisions. Alenezi and Bindemann (2013) conducted a series of experiments to examine the effects of feedback type on PMP accuracy. In one experiment, immediate feedback did not improve performance but was effective for maintaining accuracy and reducing false positives. In another experiment, participants were provided with overall performance feedback instead of trial-by-trial feedback. Overall feedback was not effective in helping participants to maintain accuracy, suggesting that trial-by-trial feedback may be necessary for maintaining accuracy. In general, Alenezi and Bindemann showed that accuracy declines throughout a matching task, especially for true negatives, and that trial-by-trial feedback is useful for reducing this decline in accuracy.

Expertise in PMP

The training research discussed above examines the effects of training in laboratory studies. Some research has also examined expertise as an individual difference variable. Expertise can be obtained through some combination of training or experience. Police and forensically trained identifiers are often called upon to make identification decisions after a civilian has identified a suspect. Police officers and trained identifiers have more experience than civilians in making these types of decisions, but experience may not increase accuracy. Papesh (2018) examined individual differences in face matching as a function of age and occupational

experience. Participants were either students, notaries, or bank workers. Participants were presented with 30 different photo pairs (15 matched and 15 mismatched pairs). One student ID photo was embedded into a mock driver's license while the other photo was derived from a digital photo. Photos were taken an average of one-and-a-half years apart. Results showed similar performance for both professional groups and student participants, indicating that experience in the field might not influence PMPaccuracy. White, Kemp, Jenkins, and Burton (2014) tested passport officers to determine the relationship between job experience and their abilities to make same or different identity judgments in person–photo pairs and photo–photo pairs. The person-to-photo test yielded a false-positive rate of 14% for fraudulent photos and a false-negative rate of 6% for valid photos. In the photo–photo pairs, accuracy rates were 71% for true positives and 90% for true negatives. These results were similar to findings from student populations, suggesting that expertise might not be predictive of PMP accuracy. By contrast, Towler et al. (2017) compared PMP performance between students and facial examiners and found that examiners performed more accurately than students with both upright and upside-down stimuli. Ali et al. (2015) found that forensic facial examiners (police officers) typically used a feature-based approach when identifying suspects. This means that each part of the face is compared separately, and a conclusion is reached by observing similarity and differences. A feature-based approach is in direct contrast with the holistic approach typically used by civilians.

Another group, known as Superrecognizers (SR), further complicates the differences between police and civilians in terms of PMP performance. A superrecognizer is a person who scores high on tests assessing "face perception, simultaneous face matching, and familiar and unfamiliar recognition, while performing about the same as controls on object recognition" (Durova, Dimou, Litos, Daras, & Davis, 2017, p. 1). Superrecognizers have shown improved accuracy as compared to civilians in PMP and facial identification (Bobak, Hancock, & Bate, 2016). Superrecognizers seem to perform similarly to police in PMP tasks, and some are employed with the London police department specifically for identification decisions (Keefe, 2016). Even though accuracy of decisions may be similar between police and civilians, the way the two groups make identifications is different. Forensic facial examiners typically use a "feature-based" approach to identify a suspect, while civilians typically use a holistic face approach (Ali et al., 2015). When forensic facial examiners identify suspects, each part of the face is compared separately, and conclusions are based on the different facial features and their relative importance. In fact, guidelines set forth by the Netherlands Forensic Institute suggest that face comparison by examiners should be based on "morphological anthropological facial features" (Ali et al., 2015), such as the shape of the mouth, eyes, nose, ears, and eyebrows; relative distance among different relevant facial features; contours of the cheek- and chin-lines; and lines, moles, wrinkles, and scars on the face.

The laboratory research on PMP informs us about psychological processes underlying PMP and factors affecting PMP accuracy. Some laboratory research reviewed above attempts to approximate the real-world conditions in which PMP is

practiced. There are also field studies of PMPaccuracy that give a high priority to approximating working conditions. For example, Kemp et al. (1997) conducted one of the earliest field studies by manipulating credit card identification photos to determine if customer use of credit cards with affixed photos would reduce fraud. The study was conducted in a supermarket, with authentic credit cards, employed cashiers, and real transactions with confederates posing as customers. The photos on the credit cards were full-face portraits with neutral expressions. Each cashier processed 44 transactions in less than 90 min and viewed a random selection of the four types of cards with approximately half of the cards being valid. Results showed a pattern to avoid rejecting credit cards with only 30% of credit cards being rejected, indicating low sensitivity rates across mismatched conditions.

White et al. (2014) compared passport officers' PMP accuracy in person–photo pairs and photo–photo pairs. Passport officers were tested at their desks using laptops to display the photos. For each trial, the officer viewed either the target's ID photo or a foil chosen to be most similar to the target. Passport officers viewed each photo for 10 s and then determined if the photo was a match or a mismatch to the person standing in front of them. In the photo–photo pairs, officers viewed a target image on the left side of their monitor and simultaneously viewed either a two-year-old photo or an official ID photo on the right side of the monitor. Passport officers exposed to the person–photo pairs wrongly accepted 14% of fraudulent photos (false positives) and wrongly rejected 6% of the valid photos (false negatives). Matching accuracy for passport officers exposed to the photo–photo matched pairs was much lower, with officers wrongly rejecting about 30% of valid photos (false negatives) across conditions. Accuracy for photo–photo mismatches, however, was higher than person–photo pairs, with officers wrongly accepting only 10% of fraudulent photos (false positives) across conditions. PMP accuracy rates for passport officers were similar to those found in student samples, indicating that experience making PMP decisions may not improve accuracy. Additionally, these results highlight the difficulty associated with person–photo pair testing, a common task for airport security and border agents. While few in number, the existing field studies offer invaluable insights into job site-specific factors that can affect accuracy, such as the type of comparison material (picture vs. person; White et al., 2014) and appearance change over time (Kemp et al., 1997).

In summary, research shows that PMP can be an extremely difficult task with significant cognitive demands and risk. PMP accuracy is challenged by the use of unfamiliar faces (which is how it is normally used in practice), low base-rate of mismatches, compromised quality of the photos used in the matching process, the use of dated photos, and time pressure on the individual tasked with PMP. In an effort to combat issues of dated photos, some researchers have suggested using multiple IDs with photos taken at different time periods (Bindemann & Sandford, 2011), while others and some governments have advocated moving toward using biometrics such as height, fingerprints, and eye scans to verify identity (Benabdelkader, Cutler, & Davis, 2002a, 2002b). Consistent with the general finding that training in face recognition has not been effective at enhancing performance (e.g., Woodhead, Baddeley, & Simmonds, 1979), PMP training shows, at best,

mixed effects on PMP performance. With respect to expertise, research indicates that field professionals have similar performance in PMP tasks compared to untrained civilians.

Person-Matching from Videos (PMV)

The process of PMV resembles PMP paradigms but for the obvious distinction that videos are used rather than photos. One of the primary distinctions between the use of PMV and PMP is context. Whereas PMP is most commonly used to prevent crimes, as in airport and border security checks and ID checks to prevent the illegal purchase of controlled substances, PMV is often used during investigations to solve crimes caught on surveillance video. PMP and PMV identifications differ in significant ways. First, PMP paradigms rely on lay participants or experts attempting to identify faces from matching static images. In contrast, PMV studies examine video identifications that include additional target cues such as varying distances, gait, clothing, and body shape (Hahn, O'Toole, & Phillips, 2016).

The first commercially available closed-circuit television (CCTV) system was released by an American company in 1949 (Draper, 2018). In the 1980s, video technology became relatively inexpensive, and small businesses and citizens began installing their own surveillance systems (Dailey, 2013). Since then, implementation and availability of CCTV and surveillance systems have grown, with an estimated 245 million professionally installed video surveillance cameras globally in 2014 (Jenkins, 2015). This translated to approximately 125 surveillance cameras per 1000 people in the United States (Statista, 2015). In the United States alone, an estimated 30 million surveillance cameras are recording 4 billion hours of footage per week (Vlahos, 2009). As of 2016, about 20% of US homes used security cameras (Honovich, 2016). We do not have more recent estimates, but the growing use of surveillance video and rise in citizen journalists with cell phones that record video leads us to believe that Vlahos's (2009) 10-year-old estimate grossly underestimates the number of surveillance videos used to investigate and solve crimes today. Similar to any type of technology, surveillance formats have evolved over the decade, for example, from analog to digital formats. Now, perpetrators can be captured on video using a variety of video recording technology, such as mounted surveillance cameras in public places, body-warn cameras worn by police officers responding to incidents, dashboard cameras in law-enforcement and citizen-owned vehicles, and cell phone video captured by the general public (so-called citizen journalists). In fact, videos from citizen journalists and victims of crimes have been used to identify and arrest perpetrators, such as in a road rage case in Raynham, Massachusetts (Quiroga, 2016) and a murder in Colorado Springs, Colorado (Miller, 2019). For ease of exposition, we will not attempt to distinguish between the uses of the various technologies and refer generally to surveillance video and PMV.

Following a reported crime, police investigators gather information including the presence of any surveillance videos. Police may include in their search for videos

body-worn camera footage from responding officers and cell phone videos captured by witnesses. Surveillance video provides investigators with information about the alleged crime and the identity of the perpetrators (Bruce et al., 2001). Additionally, surveillance videos have the potential for removing the need to rely on witness memory to establish and identify suspects (Bruce et al., 2001; Lee et al., 2009). Surveillance video and images have been used to identify suspects in high-profile cases including those involved in the 2005 London bombings, the 2013 Boston Marathon bombing, and the 2011 London riots following the death of Mark Duggan (Shaw, 2019). Identifying people from surveillance videos, whether by professionals or lay people, requires using person-matching or PMV.

While the idea of capturing a suspect on video may seem, at first glance, iron-clad evidence against a suspect, the reality of PMV is more complex than it appears. The visual representation of people in PMV varies tremendously as a function of such factors as PMV quality, ambient lighting, distance between the perpetrator and camera, viewing angle, exposure duration, and what the perpetrator is wearing (e.g., hoodies covering the hair, hairline and part of the face; sunglasses; and even masks). Put simply, the task is not simple. Errors in PMV have significant costs. False positives (that is, mistakenly identifying innocent persons as perpetrators) lead to wrongful detainment, prosecution, and even imprisonment. When an innocent person is prosecuted for a crime, by definition, the guilty person is also free to commit more crimes. Similarly, false negatives, or the failure to identify the perpetrator, in a PMV attempt leaves the perpetrator free to commit more crimes. The growing use of surveillance video for investigating and adjudicating crimes suggests the need to examine PMV accuracy and the factors that affect it.

Most of the research conducted using surveillance for identification purposes has examined surveillance videos or photos taken from surveillance videos at the time of the incident. PMV research uses laboratory research like PMP research, which has similar strengths and limitations. Also like PMP research, the outcome variables are overall accuracy rates and occasionally derivative measures such as true and false positives and negatives. Laboratory studies typically follow the same general methodology as PMP research when testing identification accuracy from surveillance videos. A clip or a video showing the target is taken from a surveillance video stream. Participants view the original video of the target followed by the presentation of a test stimulus and are asked to identify the target. The test stimulus can consist of target-present or -absent additional surveillance video (e.g., Lucas, Kumaratilake, & Henneberg, 2014), a photo array (e.g., Lie, Seetzen, Burton, & Chaudhuri, 2003), or live lineup. Using a photo array or some type of photo lineup procedure is the most common way to asses PMVaccuracy. We were unable to find field research on PMV performance.

Each person seems to have a "distinctive, idiosyncratic way of walking," referred to as gait (Benabdelkader et al., 2002a, p. 1, 2002b, p. 1). Gait could be an important factor in body identification because it is an "emergent behavioral biometric" (Benabdelkader et al., 2002a), is non-invasive, and can be measured at a distance. Research examining gait as a primary identification tool has revealed accuracy rates at or below chance performance (Cutting & Kozlowski, 1977; Stevenage, Nixon, &

Vince, 1999). Davies and Thasen (2000) exposed participants to a 25-min surveillance video and then performed an identification test. The video contained whole-body shots of the person with no facial image close-ups. Accuracy was only 30% when making identifications with access to a still-frame image of the target. Other research, by comparison, has shown that gait—as represented through biological motion point-light displays (Johansson, 1973)—can be used to identify particular actions (Dittrich, 1993), such as the walker's sex (Barclay, Cutting, & Kozlowski, 1978), and can be used to identify a familiar person (Cutting & Kozlowski, 1977; Stevenage et al., 1999). Despite inconclusive evidence, gait identification by police or experts remains admissible identification evidence and was used as the primary identification in the landmark case in Noerager, Denmark, in 2004 (Birch et al., 2013) in which two surveillance cameras recorded a bank robbery. Videos of the perpetrator and the suspect walking were analyzed and judged to reveal positive matches between the two. During the trial, gait testimony from the analysts was used as evidence to convict the suspect (Larsen, Simonsen, & Lynnerup, 2007).

Even though laypeople are not very good at identifying people based on body type, results from gait analysts show more promise. Birch et al. (2013) analyzed the abilities of seven participants, each with a minimum of 5 years of experience in observational gait analysis in several different fields such as podiatry, physiotherapy, and biomechanics, as well as some participants having experience making forensic gait analysis decisions. Participants were shown targets walking in two different planes. Experts were able to correctly identify the suspect as the target about 71% of the time. When targets and suspects were shown walking in the same angle, analysts were 79% accurate. When targets and suspects were shown in different angles, analysts were 69% accurate. Among the factors examined in this research, in addition to viewing angle, are number of actors in the frame, video quality, distance from the perpetrator depicted on video, and expertise.

For example, the quality of surveillance video can vary widely, depending on such factors as the quality and age of the equipment. Keval and Sasse (2008) asked untrained participants to identify a face across four different video quality bit rates (32, 52, 72, and 92 kilobits per second, or Kbps). Video bit rates are similar to image resolution, in that they describe the compression and quality of the video, with more Kbps indicating higher levels of quality. They found that PMVaccuracy decreased by 18% when the video quality decreased from 92 to 32 Kbps. The researchers recommended a video quality of at least 52 Kbps for PMV purposes. More recent research examined the bit rate needed to maintain usefulness to different types of professionals (Tsifouti, Triantaphillidou, Bilissi, & Larabi, 2013). Police officers, surveillance officers, and officers trained specifically in analyzing CCTV footage from buses viewed key scenes from London bus footage at varying levels of compression and rated the usefulness of the footage for identification. Police officers had the highest criteria, accepting less compression than bus analysts and surveillance officers. These findings suggest that video quality influences PMV and that the criteria for what is believed to be sufficient video quality and resolution for PMV vary across different classes of professionals.

In summary, research on PMV, though less mature than research on PMP, paints a somewhat more encouraging picture for person-matching performance. Moderate error rates are still found in PMV, but research suggests that the use of gait as an identification cue can improve accuracy rates. Gait is a helpful identification cue because people tend to have idiosyncratic ways of walking, providing diagnostic cues for recognition. As one would expect, surveillance video quality is an important factor.

Future Research Directions and Practical Applications

Although PMP and PMV have been in practice for decades, research on these topics is relatively nascent, with PMP receiving more research attention than PMV. PMP and PMV have much in common with respect to the underlying psychological processes and the factors that influence performance. Note that in our review of the extant research, overall accuracy rates, the impact of image quality, and the roles of expertise were commonly studied factors. The similarities between PMV and PMP lead us to some common research directions. The differences between PMV and PMP also lead to distinct research questions, as we discuss next. With respect to similarities, we need a deeper understanding of the psychological processes underlying PMP and PMV and the factors that affect performance on the two tasks. Both areas of research would benefit from a more nuanced understanding of performance metrics, such as signal detection methods, with separate analyses on sensitivity, decision criteria, and area under the curve. As reviewed above, some of the research (e.g., Alenezi et al., 2015; Alenezi & Bindemann, 2013; Bruce et al., 2001; Fysh & Bindemann, 2017; Megreya et al., 2013) provides such nuanced analyses, whereas others (e.g., Bindemann et al., 2010; Bindemann & Sandford, 2011; Bruce et al., 1999) focus on global accuracy rates. Additional measures such as confidence in PMP and PMV judgments would also be informative (e.g., Bruce et al., 2001; Kemp et al., 1997). Analyses of overall accuracy rates alone sometimes mask interesting and important effects. Both research areas would benefit from more realistic field studies as well as research aimed at the use of training methods to improve accuracy (e.g., Alenezi & Bindemann, 2013; Paterson et al., 2017; Towler et al., 2017; White et al., 2014).

There are important differences between PMP and PMV, however. Besides the obvious difference in the media used in the research (photos versus video), the two tasks differ in how they are used, and that difference has implications for research directions. As explained earlier, PMP is typically used to prevent crime, and many professionals engaged in PMP make a high volume of judgments in a short period of time. In contrast, PMV is typically used to solve crimes that have already occurred. Once in the possession of surveillance video, officers are not under the levels of cognitive load and time pressure in making PMV judgments as are officers who make PMP judgments. Officers can easily seek second opinions on PMV judgments. Thus, cognitive load variables, such as time pressure, distractions, and

emotions, are more fertile research grounds for PMP judgments than for PMV judgments.

PMV judgments can be made by a wider variety of parties than PMP. For example, police, lawyers, judges, and juries may view surveillance footage and have to make judgments about whether a suspect or trial defendant is the person caught on surveillance video. Thus, research should be conducted to examine how factfinders make PMV judgments and how they value those judgments.

PMV sources, as mentioned above, are quite variable. They can include fixed, mounted surveillance cameras, body-worn cameras, dashboard cameras, and citizen-operated cell phone cameras. Each type of camera produces different types of video, and the variable of image quality alone might not capture these differences. Thus, PMV research would benefit from an examination of the different cameras that produce video footage for PMV judgments.

PMP and PMV have some typical and unique implications for practice as well. Federal and state authorities are increasingly utilizing face-matching procedures when attempting to confirm the identity of a suspect using either a still photo taken from surveillance video or by showing the surveillance video to witnesses (layperson and police) who may have been in the area or exposed to the witness at an earlier time. As a result, the ubiquity of digital images impacts, to some extent, the way crimes are investigated, and ultimately how suspects are identified and prosecuted. In the research discussed above, we identified factors that increase and decrease PMP and PMVaccuracy and attempts to improve PMP and PMV performance. That research has direct implications for the practice of PMP and PMV as well as how PMP and PMV judgments can be evaluated.

Another promising direction for research is the investigation of how jurors evaluate PMP and PMV evidence. There is a growing understanding of how jurors evaluate eyewitness evidence (Benton, Ross, Bradshaw, Thomas, & Bradshaw, 2005; Brigham & Bothwell, 1983; Cutler, Penrod, & Dexter, 1990; Kovera, Park, & Penrod, 1991; McCloskey & Egeth, 1983; Semmler, Brewer, & Douglass, 2012), but no knowledge of which we are aware about how they evaluate real-time identifications in PMP and PMVcontexts. This becomes increasingly important, as these types of identifications are becoming commonplace in court as identification evidence. Jurors might be asked to make real-time identification decisions when presented with digital evidence of the perpetrator during a trial and asked to compare the person in the photo or video with the defendant sitting in the courtroom. Thus, jurors might not only be tasked with evaluating PMP and PMV evidence offered by eyewitnesses but might be making such judgments themselves. Trial simulation methods therefore provide yet another venue in which PMP and PMV performance can be studied.

PMP and PMV also have applied implications with respect to experttestimony. Two of the authors have considerable experience in offering expert testimony in cases involving eyewitness identification. With increasing frequency, both encounter cases in which identifications are made from pictures or videos rather than on memory for a perpetrator. PMP and PMV share some likeness to eyewitness identification, in that an eyewitness identifies a suspect as a perpetrator in all of these