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Prospective Person Memory in the Case of Missing Persons: A Coffee Shop Study

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Abstract

Prospective person memory (PPM) is the process of remembering to perform some action after encountering a target individual, such as identifying and reporting a missing person sighting after viewing a missing person alert (Moore et al., 2021). Research has shown that identification rates generally tend to be low in simulated missing person studies (Lampinen & Moore, 2016b). The purpose of the current research is to determine how to improve missing person recognition rates. This project explores the potential effects of using videos in missing person reports as compared to using static images. We also consider differences between rigid and non-rigid facial movements. The study conformed to a 2 (Format: Video, Static) x 2 (Motion Type: Rigid, Non-Rigid) factorial design. Our hypotheses propose a) the video conditions will outperform the static image conditions, and b) non-rigid movements will yield greater identification accuracy than rigid movements. However, our hypotheses were not supported as our results showed the rigid-static stimulus condition had the best identification performance overall. These findings provide future researchers insight into the process of encoding and recollecting human faces and provide authorities information on the stimuli that is most advantageous to use for real-world missing person cases.

Prospective Person Memory in the Case of Missing Persons: A Coffee Shop Study

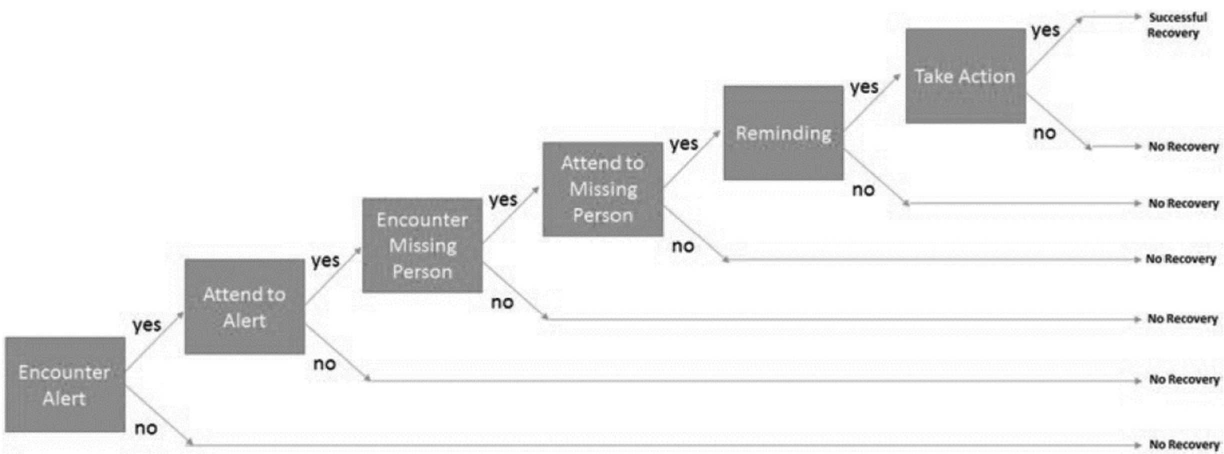
In 1975, the National Crime Information Center (NCIC) created a filing system for the purpose of recording and filing reported missing persons. The records in this Missing Persons File remain cataloged in the system until the missing subject is found or the reporting agency terminates the report. As of December 31, 2021, this file contained over 93,000 active records of missing persons in the United States. Of these, around 42% of the records were of missing children (defined as missing persons under the age of 21; NCIC, 2021). In the year 2021 alone, there were 521,705 missing person records entered into the NCIC records. Quick calculations determine that on any given day of that year, nearly 1,430 individuals were reported missing in the United States. With such high rates of individuals going missing, authorities will commonly look to the general public for help in recovering these people (Pashley, et al., 2010). In many cases, photographs, or occasional videos, of the missing person are publicized with the goal that someone will recognize them and contact law enforcement (Lampinen & Moore, 2016b).These images are shared in a variety of ways including AMBER alerts for missing children, Silver and CLEAR alerts for missing adults, news casts, missing person posters, milk carton advertisements, and others still.

Research has determined that these public alert systems rely on two central methods of memory: retrospective person memory and prospective person memory (Lampinen et al., 2009). In using the public as a resource, authorities recognize that individuals may encounter the missing target prior to seeing any publicized report or alert of the disappearance. This paradigm is referred to as *retrospective memory*. This specific memory process requires that an individual remembers to complete an action based on a previously encountered stimulus. For missing persons, this requires the individual to encounter the missing report, recall seeing the target missing person previously, and contact authorities with details of the sighting. In contrast, *prospective memory* requires the individual to recall the future intention to complete an action when exposed to a particular stimulus (Lampinen et al., 2009). For example, one may remember to mail a letter when they pass the local post office. When this prospective memory process is applied to the specific event of recollection and recovery of missing persons, it referred to as *prospective person memory* (PPM). In such missing person cases, the individual is exposed to the missing person alert initially, and then later encounters the target missing person in public. The missing person acts as the stimulus that should signal the intention of the individual to contact authorities of the sighting. This specific prospective person memory process is more frequently studied in experimental labs focused on the recovery of missing persons (Moore et al., 2021). Likewise, this prospective memory process for human faces is what my research project attempts to examine.

With prospective person memory, there are a number of steps that must occur to result in a successful recovery of a missing person (Lampinen et al., 2009; Lampinen & Moore, 2016b; Moore et al., 2021). First, the missing person alerts must be administered to the general public via some source; be it an AMBER alert, poster, social media alert, or some other form of notice. If the public does not have the opportunity to encounter a missing person alert, they will not be able to aid in the recovery of the target. Second, the member of the general public must take notice and attend to the alert so that they have the opportunity to encode the alert details into their memory storage. Following the encoding, the member of the general public must come into contact with the target missing person. Upon contact, the member of the general public must attend to the face of the target. At this point, for a recovery to occur, the viewing of the target's face must trigger the memory of having previously seen the missing person alert for that target.

Finally, the member of the general public must remember the delayed intention of contacting the authorities with details of the sighting and follow through with that intention. Failure at any one of the previous steps will result in a failure of recovery. For a graphical representation of this process, see Lampinen and Moore (2016b, Figure 11.1). In summation, each step of the process must be completed to secure the success of the following step; if at any point there is a failure in the process, this will result in a failure of identification and recovery of the target missing person.

Figure 11.1 **Preconditions for successful recovery via prospective person memory**



Note: From "Prospective Person Memory in the Search for Missing Persons." by Lampinen, J. M., & Moore, K. N. (2016) In Morewitz S., Sturdy Colls C. (Eds.) *Handbook of Missing Persons,* p.148. Springer, Cham. Copyright: James Lampinen and Kara Moore.

As mentioned previously, prospective person memory hinges on the ability of an individual to recognize a face and recall an intended action. Unfortunately, prior research has found that members of the general public perform poorly when it comes to PPM tasks for unfamiliar faces. In a study conducted by Lampinen et al. (2009), undergraduate students were shown images of mock missing persons and instructed to encode the faces. If in the event the students saw the targets, they were instructed to contact the researchers for a chance to win a cash prize. Two days after encoding, one of the targets appeared in the class and publicly greeted the students from the front of the classroom. After the sighting, only 5% of participants reported a successful sighting to the researchers. Interestingly, when participants were given a lineup, the majority could correctly identify the targets suggesting the issue was not related to the initial encoding of the target's face. In a more recent study conducted by Lampinen and Moore (2016a) the effects of alert frequency were tested. Within the study participants were shown either one or three missing person reports over the course of a week. The results showed that in the single report condition, around 10% of participants reported correct sightings, while in the triple report condition, around 5% of participants reported a correct sighting. These results indicate that not only are unfamiliar facial recognition rates low, but they are also negatively impacted by the high numbers of missing person alerts that are publicized.

While the aforementioned studies exemplify the generally poor performance on unfamiliar facial recognition tasks, it is worth noting that an individual's ability to recognize unfamiliar faces falls on a spectrum and relies heavily on the stimuli presented (Jenkins et al., 2011). On one end of this spectrum are the individuals who experience major difficulties recognizing individual faces due to cognitive impairments; these individuals are referred to as "prosopagnosics." (Duchaine & Nakayama, 2005; Jenkins et al., 2011). Within this classification, some individuals lose their ability for facial recognition due to brain trauma or disease, while others developmentally never acquire the ability. On the other end of the spectrum are the individuals who perform significantly better than average at facial recognition tasks; these individuals are classified as "super-recognizers" (Russell et al., 2009). Results of two separate studies conducted by Russel, Duchaine, and Nakayama (2009) showed that individuals within the prosopagnosia group performed two SD below average and super-recognizers performed two SD above average on facial recognition tasks. These results highlight the considerable variance that exists in the facial recognition abilities of individuals. Based on their findings, the authors go on to suggest that successful facial recognition relies not only on the presented stimuli, but also on the perception of that stimuli and the abilities of the specific observer.

In an attempt to rectify the general difficulties presented with recognizing unfamiliar faces, researchers have looked at the benefits of including additional diagnostic information in tandem with missing person alerts. It has shown to be more difficult for individuals to recognize unfamiliar faces if the target does not match the missing alert stimulus image (Gier et al., 2012; Lampinen & Moore, 2016b). Real world applications attempt to employ various methods to aid bridging the gap between alert stimuli and the target; however, not all of these tactics aid in facial recognition. Some evidence has found that these mechanisms can even inhibit a successful identification from occurring. One such identification inhibitor is the inclusion of age-progressed images in long-term missing person cases. An age-progressed image depicts a digitally produced image estimation of what a missing person may look like after a significant amount of time has passed since they originally went missing. These images are based on both age progressions of immediate family members as well as general public facial changes, and they tend to be used in cases in which a child goes missing and remains lost for years. However, previous research studies have suggested that forensic age progressions do not provide an advantage for viewers in facial recognition tasks (Lampinen et al., 2011; Lampinen et al., 2012). A specific study conducted by Charman and Carol (2012) found that presentation of age-progressed images or out-of-date images did not increase the overall recognition rate for missing children. Furthermore, based on their findings, the authors suggest that including age-progressed images may have the capacity to harm recognition rates, as it narrows the viewers expectations of how the target may appear.

In contrast to forensic age progression, a separate but related avenue of research has suggested that exposure to within-face variability has the capacity to aid in unfamiliar facial recognition. It is well documented that individuals are better at recognizing familiar faces when compared to unfamiliar (Ellis et al., 1979; Klatzky & Forrest, 1984). Viewers have the capacity to recognize a familiar face over a wide range of dimensions—regardless of changes in appearance (age, expression, clothing, etc.) or environmental changes (lighting, perspective, etc.). Part of this success is attributed to being familiar with the idiosyncratic variability of each individual face; that is, the more familiar you are with a face the better you are at recognizing it despite the conditions in which it appears (Ritchie & Burton, 2017). In following this logic, recent research has identified an advantage of viewing multiple images of a target missing person in an attempt to showcase some variability of how the target may appear (Andrews et al., 2015; Dunn et al., 2018; Jenkins et al., 2011; Menon et al., 2015; Ritchie et al., 2021; Sweeney & Lampinen, 2012). Results from Sweeney and Lampinen (2012) found that including multiple images on a missing child poster resulted in approximately 20% more correct target identifications, as opposed to posters with a single image. Similarly, Lampinen, et al. (2014) conducted a preliminary field study in which participants were separated into two conditional groups and shown a missing person alert that included either one image or two images of the target. Their results found that the participants who had seen two images on the alert had higher accurate recognition rates at test. Mirroring these results, Juncu et al. (2020) conducted a PPM study in which the effects of image variability and name inclusion were tested. Participants were randomly assigned to either the name or no name condition and completed four study trials: two trials depicting low image variability and two trials depicting high image variability. Their results found that associating an identity with a name and viewing alerts with high image variability both independently increase overall identification accuracy. Further, Ritchie and Burton (2017) conducted two PPM-related studies that showcased either high variability or low variability between stimulus images. Their combined results showed that participants were more accurate at making identification decisions when exposed to high-image variability of the target. This avenue of research posits that the more facial variation an observer is exposed to, the better their mental representation of the face will be; thus, the better they perform at recognition tasks.

Alongside the benefits of image variability, research has looked at the condition of using videos, as opposed to still images, in missing person alerts. Previously it has been identified that there is some advantage to viewing a face in motion when in the process of encoding (the motion advantage). The literature surrounding this phenomenon suggests two, not-mutually-exclusive hypotheses to why viewing a face in motion aids in recognition. The first is referred to as the "representation enhancement hypothesis" and it suggests that facial motion aids in facilitating a three-dimensional perception of the target face (Knappmeyer et al., 2003; O'Toole et al., 2002). That is, learning a face in motion works to build a more robust representation of the spatial and structural composition of a face. The second hypothesis is referred to as the "supplemental information hypothesis" and it suggests that facial movement is idiosyncratic and, therefore, can be used as an additional avenue for facial recognition (Knappmeyer et al., 2003; O'Toole et al., 2002) That is, the manners in which a face moves and shows expression can be distinctive for a particular individual—this information is similar to other unique, supplementary cues such as facial hair or gait. For example, in a study conducted by Butcher and Lander (2017), the researchers found that faces that were learned in motion were recognized at higher rates than faces learned using static images. The researchers reported that faces that were depicted as moving either a great deal or with very distinctive movements were encoded and recalled more accurately.

Further evidence that supports the concept of the motion advantage suggests that when viewing conditions are poor, seeing a face in motions aids in recognition. In two studies conducted by Lander et al. (2001) the researchers tested the advantage of facial movement in low and high levels of image pixelation and blurring. In both experiments, identities that were learned with facial movement, as opposed to static images, were identified at significantly higher levels. These findings suggest that facial movement can be used as supplementary diagnostic criteria when static facial information is not informative or when the viewing conditions are poor (Xiao et al., 2014). In a separate study by Lander et al. (2006), the researchers looked at the effects of natural movement compared to morphed movement when learning a face. That is, the stimuli presented either depicted a series of images taken from a clip of a person naturalistically smiling, or a set of images that were manipulated to artificially create a smile on the target. The results of their study found that identities were better recognized when they showed naturalistic smiles when compared to the artificial smile or static image conditions. The authors also found that when the movement of natural smiles was sped up, recognition ability was significantly decreased. These results support the hypothesis that facial motion can aid in facial learning and recognition by providing additional diagnostic information. However, they also suggest that natural movements, as compared to artificial movements, are processed as more identity-related information and are better for aiding in recognition.

As mentioned previously, when an individual has more exposure to a particular face and its various expressions, their representation of that face will be stronger. One aspect of this type of facial learning can be referred to as ‘ensemble coding’, which asserts that when an individual is given an array of facial exemplars, that individual will automatically filter the average identity (Davis et al., 2021; de Fockert & Wolfenstein, 2009; Murphy et al., 2015). In studies conducted by Murphy et al. (2015), the authors suggest, based on their findings, that even brief instances of facial motion (short clips) contain more unique facial exemplars as compared to stagnant images, and thus, yield better recognition performances. Interestingly, research conducted by Bennetts et al. (2015) found that studies using motion clips allowed for prosopagnosia patients to perform almost to control group levels in facial recognition tasks. As mentioned earlier, those with facial prosopagnosia show a severe deficit in facial identification ability; thus, this finding is critical to the argument that learning faces in motion provides an advantage for subsequent recognition.

It is important to note that learning a face is also determined, in part, by the total amount of time spent looking at the face. This concept is supported by the notion that the more familiar an individual is with a face, the better they will be at recognizing that face in other contexts. In support of this, research has shown that individuals who are exposed to an identity for 45 seconds outperform those who are exposed to the same identity for only 15 seconds (Memon et al., 2003). These studies implicate that both the amount of variation seen, as well as the amount of time spent viewing an identity, have practical effects on the recognizability of that identity.

It has been established thus far that movement of the face and head provides additional diagnostic information that can aid an individual when making an identification of an unfamiliar face. However, within the literature, there are different types of movements that can differentially impact performance. Specifically, the study our lab conducted looked at the effects of using rigid and non-rigid head and facial movements as compared to a control, static image condition. Rigid movements are defined as movements that encompass the entire head or mechanical movements of the face with a neutral expression—examples of rigid movements are nodding one's head or looking between the left and right directions (Knappmeyer et al., 2003; Lander & Chuang, 2005). In contrast, non-rigid movements are characterized as more naturalistic, everyday movements of the facial features—examples would include smiling, laughing, or talking (Knappmeyer et al., 2003; Lander & Chuang, 2005). Previous research conducted by Lander and Chaung (2005) found that for familiar faces, non-rigid motion was more beneficial for making identifications. Their results did not find a significant difference between the accuracy of identification made with rigid movement stimuli compared to static stimuli. Interestingly, through their research, authors Hill and Johnston (2001) suggest rigid head movements are better for when the task is to distinguish between individuals, while non-rigid movements are better when the task is to distinguish the sex of the target subject. These findings suggest that non-rigid movements are more idiosyncratic and diagnostic for a particular individual, and thus, have the potential to be more beneficial for facial identification purposes.

This project attempted to simulate the process of prospective person memory in a missing person case. Specifically, my research explored the facial motion effect via displays of brief videos in missing person reports as compared to using traditional static images. Additionally, I considered the difference between videos that show rigid versus non-rigid movement. For rigid movement condition, the videos clips depicted the target looking from left to right with a neutral facial expression, while the non-rigid movement condition depicted the target smiling and speaking (with no audio). To convey rigid or non-rigid motion in the photograph condition, three photographs from the videos displaying the sequences of motion were used in the static photo condition. The study thus conformed to a 2 (Format: Video, Static) x 2 (Motion Type: Rigid, Non-Rigid) between-subjects factorial design. My hypothesis suggested that using videos of a face in motion on a missing person report would result in greater rates of accurate identifications, as compared to using static images. Additionally, I hypothesized that non-rigid movements would yield higher sighting rates, as compared to rigid movements. Thus, I projected that the non-rigid, video stimulus condition will perform the best on this facial recognition task.

Methods

Participants

A total of 366 participants (M_{age}=19.07, SD_{age}=1.90) completed the experiment. University of Arkansas undergraduate participants were recruited via the SONA system and received research credit for their participation. A total of 28 participants were excluded from result analyses due incomplete data (five participants) or performance/attention difficulties (23 participants). Demographic information was collected from participants via the use of a survey at the conclusion of the study. The majority of participants identified as female (66.70%) and self-identified as White (84.70%). Table 1 depicts the full demographic breakdown of the participant pool.

Table 1. **Demographic Characteristics of the Sample**

Sample Size	**366**
Age	
Mean Age	19.07 years
Standard Deviation Age	1.90 years
Minimum Age	17 years
Maximum Age	43 years
Gender	
% Woman	66.70%
% Man	30.10%
% Non-Binary	0.50%
% No Response	2.70%
Race	
%Asian	3.60%
%Black/African American	3.30%
%Caucasian/White	84.70%
%Native American	0.50%
%Pacific Islander	0.50%
%Bi-racial/Multi-racial	3.80%
%Other or Did Not Reply	3.60%
Ethnicity	
%Hispanic	7.70%
%Non-Hispanic	89.60%
%Other	2.70%

Materials

The researchers created four mock missing person alerts (rigid static image, non-rigid static image, rigid movement video, and non-rigid movement video). Participants were randomly assigned to one of these experimental groups and were presented with the same four target missing person alerts. Alerts of each individual target appeared on the screen for a total of nine seconds. This study was coded and administered through Inquisit player.

Videos

Our lab used nine second clips of each volunteer target missing person. These video materials were created specifically for our lab and covey either rigid or non-rigid facial movement. Rigid facial movement clips depict the target looking left, center, and right with a neutral facial expression. Non-rigid facial motion clips depict the target speaking to the camera and smiling at the camera. Target videos appeared sequentially after one another in the center of a blank screen; each video clip lasting a total of nine seconds with no audio.

Images

Images of the target missing persons resulted from screen captures of the rigid and non-rigid movement clips. Rigid movement images capture the face from the left, right, and frontal viewpoints with a neutral face. Non-rigid movement images captured a frontal viewpoint of the target faces smiling, looking neutral, and mid-speech. Each image condition appeared sequentially after one another and showed the three screen captures simultaneously on the screen for a total of nine seconds.

Memory Distraction Task

This task was the “Do You Remember (Husker Du) Game” from the Millisecond test library. The distraction task comprised of an image-matching memory task. The matching game used was a three-minute-long memory game in which participants flipped tiles face-up to match image pairs. Only two tiles could be turned over at once; pairs that matched faces were removed from the board while nonmatching pairs turned face-down and remained on the board. Participants were encouraged to work quickly to match as many image pairs as possible before the task automatically ended.

Coffee Shop Task

The coffee shop task tested the recognition ability of participants. Within this task, videos of individuals approaching a counter and ordering a coffee drink were displayed in the center of the computer screen. Coffee orders included one of five drink options, and each specific coffee drink had a corresponding keyboard key the participants were instructed to press following each video clip presentation. Within the task, each participant was shown the four missing persons and 40 fillers. Thus, each participant as shown a total of 44 coffee order videos. Participants were instructed to press certain keys depending on the coffee order. Coffee orders included one five drink options: mocha ("M" key), latte ("L" key), Americano ("A" key), espresso ("E" key), or a cappuccino ("C" key). Should participants see one of the target missing persons, they were instructed to press the "H" key to signify alerting the authorities.

Demographic Survey

The demographic survey was created for the project and asked participants to indicate their age, gender, race and ethnic identities.

Procedure

This study was conducted online via Inquisit player. Participants took this study on their own devices. Upon beginning the study, participants were asked to read and sign an informed consent that detailed the supposed goal of the study and provided researcher contact information for any questions. After signing their consent, participants were randomly assigned to one of the four condition groups (rigid static, non-rigid static, rigid video, non-rigid video) and given instructions on the viewing task. The study thus conformed to a 2 (Format: Video, Static) x 2 (Motion Type: Rigid, Non-Rigid) factorial design.

Participants were encouraged to attend to the four individuals shown as they are considered missing persons and may appear in a later task. The four missing person appeals were shown to participants. Each appeal was shown on a blank screen for a total of nine seconds. The appeals were shown sequentially with a five second rest interval between stimuli. After viewing all four appeals, participants were informed that the individuals were not truly missing persons, but that participants should continue to look for the targets in subsequent tasks.

Participants were then given instructions on the distractor matching task, which lasted for three minutes. This task required participants to flip over image tiles and attempt to match pairs of images together. Only two tiles could be flipped over at a time—matching image pairs were removed from the board while non-matching pairs turned face down and remained on the board. The tile board included approximately 50 total image pairs. At the end of the three minutes, the distractor task automatically closed itself.

Following this task, participants were given instructions on the following coffee shop task. Within this task, participants functioned as a barista in a coffee shop fulfilling mock coffee orders from a variety of patrons. Participants were instructed to watch each video clip and press a keyboard key corresponding to the coffee order of the individual. Additionally, participants were instructed to press the "H" key if they recognize one of the previously shown target missing persons. Each participant was shown a total of 44 coffee videos—4 target missing persons and 40 filler videos. At the end of the coffee shop task, the participant was given a demographic survey in which they provided their age, gender, race, and ethnic identities. Before being released, participants were debriefed and told the true purpose of this research was to study the ability of adults to recognize the unfamiliar faces of missing and wanted persons. Participants were again informed that the individuals used in the study were volunteers posing as mock missing persons specifically for our lab, and if they were seen outside of the lab, do not contact the authorities.

Results

This research was conducted with the intent of identifying the effects of utilizing video clips, as compared to traditional pictures, in missing person alerts. Previous research has identified a possible advantage to using such stimuli; referred to as the 'motion advantage' there has been evidence that facial motion can provide additional identification cues to aid in facial recognition. Additionally, this research studies the difference in participant performance when rigid movements versus non-rigid movements are depicted in missing person announcements. Previous studies have suggested that non-rigid, naturalistic facial expressions allow for better facial processing, and thus have the potential to yield higher recognition rates. Based on these assertions, my research specifically compares participant performance on a missing person facial recognition task. Participants were randomly divided into four conditional groups (rigid video, non-rigid video, rigid static image, or non-rigid static image) and were asked to attend to the missing person alerts and complete the facial recognition task. Based on the theories of the benefits of the 'motion advantage' and non-rigid facial expressions, my hypothesis suggests that the non-rigid video conditional group will outperform all other conditions. That is, this group will have the highest correct 'hit' rate and the lowest incorrect 'false alarm' rate when completing the facial recognition task.

A hit occurs when a participant correctly pressed the 'h' key when one of the 'missing persons' appeared in a video. The hit rate was defined as the proportion of hits out of four possible. The mean proportion of hits for each condition can be found in Table 2. A 2 (Format: Video, Static) X 2 (Motion Type: Rigid, Non-Rigid) was performed on the hit rate. There was no significant main effect of Format, $F(1,362) = 2.39$, $MSE = .74$, $p = .12$, nor Motion Type, $F(1,362) = 0.11$, $MSE = .74$, $p = .75$. The interaction between Format and Motion Type was only marginally significant, $F(1,362) = 3.63$, $MSE = .74$, $p = .057$. To explore this marginally significant interaction, I compared the effect of Format within each level of Motion Type.

***Table 2*. Mean proportion of Hits and False Alarms as a Function of Condition.**

	Non-Rigid Static	Non-Rigid Video	Rigid Static	Rigid Video
Hits	.67(0.78)	.70(0.86)	.87(1.06)	.56(0.68)
False Alarms	0.0242(0.0015)	0.0242(0.0012)	0.0237(0.0023)	0.0244(0.0015)
Difference Score	.65(0.78)	.68(0.86)	.85(1.06)	.54(0.68)
n	91	95	93	87

Note: Standard deviations in parentheses

Because the interaction was not significant, this comparison was conducted for exploratory purposes and should not be considered definitive. For non-rigid motion, there was not a significant difference between presentation of videos and presentation of static photos, $t(184) = 0.27$, $p = .79$. For rigid motion, static photos were associated with a significantly higher hit rate than were videos, $t(178) = 2.33$, $p = .02$.

A false alarm occurs when a participant incorrectly pressed the ‘h’ key in response to a person who was not one of the ‘missing people.’ The false alarm rate was defined as the proportion of false alarms out of forty possible. The mean proportion of false alarms for each condition can be found in Table 2. False alarms were quite rare, occurring only about 2% of the time across conditions. A 2 (Format: Video, Static) X 2 (Motion Type: Rigid, Non-Rigid) was performed on the false alarm rate. The effect of Format was marginally significant with video presentation resulting in somewhat more false alarms than static photographs, $F(1,362) = 3.866$, $MSE = 2.82$ X 10-6, $p = .05$. There was not a significant effect of Motion Type, $F(1,362) = .71$, $MSE = 2.82$ X 10-6, $p = .40$. The interaction between Format and Motion type was not statistically significant, $F(1,362)$, $MSE = 2.82$ X 10-6, $p = .11$.

To control for guessing rate, prior research has computed a difference score (Lampinen, et al., 2012). The difference score is computed for each participant by taking their hit rate and subtracting their false alarm rate. The mean difference for each condition can be found in Table 2. A 2 (Format: Video, Static) X 2 (Motion Type: Rigid, Non-Rigid) was performed on the difference scores. There were no significant main effects of either Format, $F(1,362) = 2.41$, $MSE = .74$, $p = .12$, or Motion Type, $F(1,362) = 0.11$, $MSE = .74$, $p = .75$, on the difference scores. The interaction between Format and Motion Type was marginally significant, $F(1,362) = 3.65$, $MSE = .74$, $p = .057$. To explore this marginally significant interaction, I compared the effect of Format within each level of Motion Type. Because the interaction was not significant, this comparison was conducted for exploratory purposes and should not be considered definitive. For non-rigid motion, there was not a significant difference between presentation of videos and presentation of static photos, $t(184) = 0.27$, $p = .79$. For rigid motion, static photos were associated with a significantly higher hit rate than were videos, $t(178) = 2.33$, $p = .02$.

In summation, the results of this study found that the rigid, static photo condition group performed the best at the recognition task. Despite an overall low prevalence of false alarms, the two video conditions appeared to produce more false alarms in comparison to static images. Additionally, there was no significant difference in non-rigid motion scores based on presentation; however, there was a marginally significant difference for rigid motion, such that static images produced a higher hit rate as compared to video clips.

Discussion

The data analyses of this study found that there was no significant difference in facial recognition performance between the video and static image participant groups. However, when specifically comparing the two rigid motion groups, the static image condition outperformed the video condition. Interestingly, for non-rigid motion, there was no significant difference in task performance between the two groups. The group that had the best performance, recognized as having the highest hit rates and the lowest false alarm rates, was the rigid-static image condition. These results can be referred to as showing a 'mirror effect' which asserts that this conditional group performed positively on all performance measures (more correct responses and less incorrect responses). These results are contrary to my original hypothesis which expected the non-rigid video condition to perform the best. In contrast, my results showed that the video conditions were marginally related to an increase in incorrect false alarm rates.

The main hypothesis of this study relied heavily on the assertions of the 'motion advantage' which suggests that learning a face in motion can aid in later recognition at testing. Previous research has found support that this motion advantage can be seen when the stimulus faces are familiar to the participants and there is some manner of viewer impairment (e.g., the images are degraded or blurred). The theory suggests that when viewing conditions are difficult, the participant may utilize facial movements as a supplementary diagnostic cue for facial recognition (Bennetts et al., 2015; Butcher & Lander, 2017; O'Toole et al., 2002; Xiao et al., 2014). Our results may differ from those previous due to our study utilizing unfamiliar identities in our facial recognition task. Perhaps when an individual is familiar with a target, they have the advantage of picking up on the subtle nuances that occur when the target moves or shows a facial expression. If this is the case, it can be understood that these distinctions are not focused on if the entire identity is new and unfamiliar. Our results could also indicate that perhaps the type of videos we used did not capture any movements that were advantageous or added any additional information beyond that of the static image conditions. The video conditions objectively added more information, but not necessarily helpful, diagnostic information.

Additionally, these studies differ in that there was no manipulated degradation in the stimuli; the viewing conditions all had significant lighting and a clear picture. In their research, Albonico et al. (2015), suggest that facial motion can be used as a diagnostic recognition tool under difficult viewing conditions, but that it unlikely aids facial recognition under normal, opportune conditions. Alternatively, Bruce and Lander (2021) suggest that the motion advantage may still have an effect on facial recognition; however, the benefits of the facial motion may be more difficult to parse out when using non-degraded stimulus images. Considering our study utilized optimal viewing conditions, our results may have been affected due to the participant not needing to rely on the facial movement details as the internal physical features of the face were clearly visible.

Across all conditions, the false alarm rates were quite low. Results showed that these incorrect responses occurred approximately 2% of the time. These results are in line with previous PPM studies which uniformly find that false alarm rates are quite low (Lampinen et al., 2009; Lampinen & Moore, 2016; Moore et al., 2021). The caveat to this result can be found in a study conducted by Moore and Lampinen (2019) in which the study utilized two target missing persons and two distractor confederates. These distractor confederates were selected specifically due to their physical appearance being similar to that of the target. In this research, the false alarm rates were, expectedly, higher than usual for PPM research due to more participants mistakenly identifying the distractor confederate as the target missing person.

The results presented in this study suggest that there may not be any significant advantage to using videos in missing person reports. This finding is important to note because the current methods used by law enforcement when presenting missing person alerts utilize static images. While it is possible to create alerts using videos, these means can be both difficult and expensive to create. Further, a missing person poster or milk carton advertisement would be unable to use a video as a target stimulus. Perhaps, due to the number of hurdles and the overall lack of significant aid, it is best for law enforcement to continue to use images in missing person reports. However, there is a potential benefit to using multiple images, as compared to a single image, when advertising a missing person alert. Based on previous research (Menon et al., 2015; Richie & Burton, 2017; Ritchie et al., 2021; Sweeney & Lampinen, 2012), it has been noted that viewing multiple images of a face may facilitate better learning due to greater exposure to the within-person variability. Our results found support for this theory as the rigid, static image condition performed the best on the facial recognition task. This conditional group was presented with three simultaneous images of the target, each image depicting the same facial expression but from different angles. Despite showing a lack in facial expression variability, viewing the face from different angles may still have facilitated a more three-dimensional view of the face, thus allowing for the participant have a better representation stored for the supplementary recognition test.

There are a few limitations for the research presented here. As this study was conducted on a university campus using undergraduate students, there is an issue with the ecological validity of the results. Specifically, this study was designed to be completed in a half an hour time frame with only a five-minute distractor task between viewing the stimuli and performing the recognition task. This short retention interval is not accurate to real-world missing person cases. Oftentimes, a person may view a missing person alert and then experience a retention interval of days, weeks, months, or even years. Researchers have found that the longer a retention interval spans, the identification accuracy on facial recognition tasks plummets. With this said, our results are most likely positively inflated due to having such a short-term retention interval. Additionally, this research was conducted using a simulated missing person alert and participants were reminded multiple times of this. Due to this aspect, the stakes in this study were relatively low which may have resulted in participants being not as invested as they would in a real-world setting. In a real-world missing person case, the stakes are high as there is a life in danger and there is most likely added pressure from law enforcement. The general public may feel more inclined to attend to missing person reports or to actively seek out the target person if there is a greater sense of pressure or urgency. Since this study did not emulate these higher stakes, a lack in participant investment or attention could lead to a lower prevalence of accurate hit rates. Additionally, this particular study did not utilize a single image control group to compare the four conditional groups to. Due to this, the results fail to find any significant advantages or disadvantages to using these means of stimuli on missing person alerts.

In the future, psychologists interested in continuing this line of research should aim to include a single-image comparison group to the conditions. Including such a condition would provide a baseline for comparing the results of the additional variables. Without this single image group, there is no manner in which to designate the best possible means to use when creating missing person alerts. Further, it may be beneficial to research the role that attention plays in this line of research. In this study, we did not have a designated attention check point, but we did exclude participants who performed three SD or more below the average for the general coffee orders. These low performance scores suggest that perhaps participants were not actively engaging or giving their full attention to the task simulation. To combat this suggested deficit, future research should look to employ some means of measuring the participant attention, whether those measures entail using eye tracking technology or including a subjective attention measure in the performance survey. Including an attention variable would allow for researchers to identify which conditional groups paid the most attention to the task at hand and allow an additional avenue for comparing facial recognition accuracy.

In conclusion, the research presented here was conducted with the goal of identifying the stimuli that is most beneficial to use when alerting the public of a missing person. Based on previously conducted research on prospective person memory and unfamiliar facial recognition, we considered the specific, differential effects of showing facial movement—either rigid or non-rigid—through either video clips or static images when broadcasting missing person alerts. Our results found that the rigid movement, static image condition had both the highest hit rate for correct identifications and the lowest false alarm rate for incorrect identifications. While the data failed to support our original hypotheses, the results nevertheless provide valuable insight for both the psychological and law enforcement communities.

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