Face recognition abilities of a long-term missing female child missing for 14 years

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Millions of children go missing both nationally and internationally every year. Some are found alive and unharmed, others have horrific endings to their lives at the hands of their abductors, and then there are those still missing. In our study 363 participants agreed to participate in a simulated AMBER Alert (AA) where a 7-year old girl appeared in the AA. Participants were randomly assigned to one of seven different AA conditions where each participant was shown the missing child's original photo from the alert; plus, an additional photo of the same child at ages (e.g., 7, 10, 13, 16, 18, 19, & 21). Participants were told the abductor sent a proof of life from a non-custodial parent photo every 2–3 years. We tested participant's scores on individual personality traits of conscientiousness (IPIP) and the Basic Empathy Scale (BES) Emotional Contagion, Cognitive Empathy, and Emotional Disconnection scores. Additionally, we measured predictor variables including demographic variables of gender, ethnicity, and age. The only significant predictor variable was gender. Overall, the short-haired photo produced greater recognition as compared to the longer length hair photo when the AA showed the target at 21 years of age, while the longer hair length photo was recognised at a higher rate when the AA showed the target at 7 years of age. Practical implications of our study suggest parents should keep updated photos of their child in case their child goes missing. Other individual personality characteristics such as optimism, hope, and compassion, should be explored as well.

Keywords: face recognition; individual personality difference; metacognition; missing children; own-gender bias

Whenever a child is missing due to a suspected abduction by a stranger or perhaps a family member whom is believed to be capable of causing the child harm, an AMBER Alert (American Broadcasting Emergency Response) is posted nationwide in all of the 50 states in the US including the District of Columbia, Indian country, Puerto Rico, the US Virgin Islands, and 27 other countries (Missing Kids, n.d.). Then National Centre for Missing and Exploited Children (NCMEC) has assisted both law enforcement and families with over 29,800 cases of missing children, and NCMEC is the largest supporter of AMBER Alerts.

When an AA is posted on television and the on the radio, there is a *Breaking News Alert* announcement to inform the public of the urgency to find a child who is missing, and, is believed to be in immediate harm. The alerts may consist of photos, sometimes home-videos, as well as a detailed description of both the child and abductor (if the child has been abducted). Additionally, AAs are posted on cell phones, twitter, social media sites such as Facebook, as well as on electronic billboards strategically placed either over the interstate or alongside a heavily travelled interstate. Drivers thereby are provided with important details of the missing child, abductor, as well as the type, model, year, and colour of the vehicle. Not all missing children fit the criteria for an AA, so to clarify the criteria we have listed the official criteria below from the Office of Justice for AMBER Alerts (amberalert.ojp.gov, 2021, para. 1): (a) There is reasonable belief by law enforcement that an abduction has occurred; (b) The law enforcement agency believes that the child is in imminent danger of serious bodily injury or death; (c) There is enough descriptive information about the victim and the abduction for law enforcement to issue an AMBER Alert to assist in the recovery of the child; (d) The abduction is of a child aged 17 years or younger; (e) The child's name and other critical data elements, including the Child Abduction flag, have been entered into the National Crime Information Center (NCIC) system; and (f) NCMEC also contains links to secondary sources where parents and law enforcement contacts to post AMBER alerts once the alert is posted. (https://amberalert.ojp.gov/resources/resources)

History of AMBER Alerts

One of the most well-known kidnapping cases in the US happened on 13 January 1996 when Amber Hagerman, a nine-year old girl from Arlington, TX, was riding her bike in an empty Winn-Dixie grocery store's parking lot when a man in a truck abducted her. The case made national news with her family pleading on television interviews for the kidnapper does not harm her and allow her to come home. As of now (2021), her abductor has not been identified. When the city of Arlington, TX heard of Amber's kidnapping on January 13, 1996, there was an outraged of enraged parents nationwide, especially by parents of murdered children, such as Adam Walsh's father, John Walsh and the parents of Polly Klass (and others) pushed for a law that would allow law enforcement to have a national broadcast system for when a child under the age of 18 years of age was believed to be kidnapped and/or considered to be in grave danger. This law was named AMBER alert in Amber Hagerman's name with the acronym AMBER stands for: America's Missing: Broadcasting Emergency Response. Currently, all 50 states in the US have an AMBER alert or a similar program. It is important to state that other countries have similar programmes for missing, abducted, and exploited children. For example, England has a similar AMBER alert program called Child Rescue Alert (CRA) (Missing Persons, 2021, para. 1). According to their website, the CRA was first piloted by Sussex Police following the abduction and murder of Sarah Payne. CRA is intended to alert members of the public to the abduction or other high-risk disappearance quickly, and to provide a mechanism for policing to be able to receive and prioritise critical information' (2021, para.1). (Table 1 shows a brief history of kidnappings in the US).

Table 1
Example of famous kidnapping cases in the US resulting in new methods and laws for finding missing children

Name(s) and Date of Abductions	Method Used to Alert Public and Laws Enacted
Names: Charley & Walter Ross (4 and 6 years old) Date: 01 July 1874 – Kidnapped Date: Body was never found.	First kidnapping story published in the local newspaper. Ransoms were demanded.
Name: Charles Lindbergh, Jr. 20-months old Date Kidnapped: 01 March 1932 Kidnapped from his Bedroom on the 2nd Floor of the Families Home Date Body Found: 12 May 1932	First nationwide newspaper coverage & Multiple ransom demands First kidnapping involving the FBI resulting in the Federal government Enacting the: "Lindbergh Law" and death penalty possible. First time The Supreme Court of the State of New Jersey on upheld the verdict of the Lower Court.
Name: Etan Patz (6-years old) Date Kidnapped: 25 May 1979 walking to his school bus. Date Body Found: Never found	National Coverage in Newspapers and Television News Broadcasts President Ronald Reagan Declared 25 May, National Missing Children's
Name: Adam Walsh (6-years old) Date Kidnapped: 27 July 1981 Kidnapped from a Sear's Department Store Date Found: Adam's decapitated head was found 16-days later, Aug 12, 1981. His body was never found.	Code Adam: Store lockdown when a child is missing in a store. First started by Walmart shopping centers. President George Bush signed the Adam Walsh Child Protection and Safety Act (2006), and the Sex Offender Registration and Notification Act, was signed on July 27, 2006.
Name: Polly Klass (12-years old) Date Kidnapped: 01 October 1993 Date Found: 28 November 1993 She had been strangled to death	Internet used for the first time in a missing child's case The family created "The Polly Klass Foundation", a non-profit organisation to help families of children who are missing
Name: Megan Kanga Date Kidnapped: 29 July 1994 Date Found: Dead on 30 July 1994 – Brutally raped	President Clinton to sign into effect Megan's Law which requires known sex offenders to be publicly listed.
Name: Amber Hagerman Date Kidnapped: 13 January 1996 Date Found: Dead on 17 January 1996 – Her throat had been cut.	

In the UK, the 2021 statistics report for 2020 showed 68,944 missing children reports were made to the police in England and Wales. More males are reported missing than females, with missing incidents comprising 56% men and boys and 44% women and girls. Last year, twice as many reports of transgender individuals going missing were made than the previous year (proportionally) (CRA, para. 2, 2021). The statistics and programs available in countries other than the US are important to state as missing, abducted,

exploited, and runaway children are not unique to only one country. Our study is meant to be generalisable, overall, to all alerts of missing children, in particular to our study, long-term missing children. Before continuing the authors would like to state our study was not meant to have the focus of the length of hair of the target at seven different ages; rather, we used a real child and her photos at those specific ages to add more ecological validity to the study. We felt we needed to address the hair length question as it is an external feature other researcher have found significant in face recognition studies (Ellis et al., 1979; Hinsz et al., 2001; Lewin & Herlitz, 2002; Toseeb et al., 2012;).

Over the past two decades face recognition researchers have focused on ways enable the public's face recognition abilities with AAs. For example, Lampinen et al. (2009) questioned customers leaving a grocery store where photos of missing children were posted in plain sight. The customers were asked if they would mind looking at some photos that contained real photos of missing children. The results were alarming and sobering as the shoppers who responded to their study did not recognised the children in missing posters better than chance. Participants responded they believed AAs were very important in finding missing children; however, they gave reasons such as they were in a hurry or preoccupied and did not look at the photos that were in plain sight. Other studies by Gier et al. (2009) changed the appearance of children and presented photos of children looking either clean (as in a school photo) or looking dirty with bruises made from make-up, and created an AA embedded in an episode of *Criminal Minds*. The participants were told they would be watching the episode and to keep a record of examples of whether the actors in the show accurately depicted what a real BSU (behavioural science unit). The second "commercial" included the studies AA. Later, they were then assigned into one of four conditions where the targets (2 males and 2 females) either appeared the same or different (clean or dirty) to have four conditions of: clean/clean appearance, dirty/dirty appearance, clean/dirty, and dirty clean. They found if participants saw the child at a later time, they were more likely to recognise the child if the child's face was either clean/clean or dirty/dirty. If, however, participants first saw the child's face dirty then later clean; or, if they saw the child 's face clean then later dirty, recognition rates were significantly lower. The researchers stressed that the results of their study provide a case for parents to have multiple photos of their children in case they are ever missing. Photos, not only like school-pictures, but photos of the child when dirty, and showing other emotions as the likelihood of seeing a child that has been abducted looking like a clean, school-photograph is probably not probable due to the trauma the child has experienced. Their study emphasised the importance of having multiple photos of your child's face (happy, sad, clean, dirty, and different hair styles) just in case their child is abducted. Since most abductions occur by a stranger on their way to and from school. One can imagine how having multiple photos a child where their faces are in different states (happy, sad, scared, anxious, crying, bruised, etc) may be helpful when alerting the public of the child 's disappearance. For example, if the child was walking home from a football practice in the month of August, their appearance would be different than they would look from a school photo.

Past studies on child abductions has shown the abductors are more likely know the child as a neighbour, friend of the family, and of course, a family member, such as a non-custodian parent. The National Centre for Missing and Exploited Children website stated that "In 2020, 63% of all AMBER alerts that were issued were for family abduction cases" (2021, para.3). Therefore, in our study we tell describe a scenario of a 7-year-old target was abducted by a non-custodial parent. Julian Hernandez is an example of this type of abduction. Julian's father kidnapped his 5-year-old son from Birmingham, Al in 2002. For 13 years the boy was searched for by law enforcement, but no one recognised the little boy as he and his father moved to Cleveland, OH where his father changed both of their names. The boy discovered he had been kidnapped when applying for college in 2015 and discovered his social security number and name did not match. Julian's name had been on NCMEC network since 2002, however, due to his father changing his name, it was not until registering for college did the young Julian, now over 18 years of age, discovered his true identity (Appendix A).

One purpose of our study was to determine whether a participant's individual differences could contribute to recognizing a female target in "mock" AA, such as age, race/ethnicity, and gender of the participants. Additionally, we questioned whether the score on a participant's conscientiousness score, using the IPIP measure, and empathy, using the BES scale, would influence recognition of the, now adult, missing child of 14 years. Due to the target being a female, we predicted an Own-Gender Bias (OGB) for females as many face

recognition studies have shown females outperform face recognition overall, but specifically show a high OGB for female faces (Lewin & Herlitz, 2002) especially when the females hair was longer than shorter. Another study by Toseeb et al. (2012) the researchers manipulated short versus long hair on females found if in the study phase the female 's face was viewed with a short/long haircut, then later saw the target with the same hair length, face recognition was better than if the conditions were incongruent (short/long or long/short) in the researcher 's words: "It transpired that the presence of hair per se did not aid recognition. When the stimuli were kept the same between learning and test there was no significant difference in performance between faces presented with and without hair" (Toseeb et al, 2012, n.p.).

In an earlier study (1979) conducted by Ellis, Shepherd, & Davies (1979), the researchers tested the face recognition abilities of participants if show external only stimuli of a targets face, internal features, or the whole face. Past research in the field of face perception has found that external facial features (hair, ears, face contour) better facilitate recognition of unfamiliar faces, whereas internal facial features (eyes, nose, mouth) support the recognition of familiar faces. To clarify the differences between internal and external features, Latif and Moulson (2021) opening statement in their abstract stated: "Past research in the field of face perception has found that external facial features (hair, ears, face contour) better facilitate recognition of unfamiliar faces, whereas internal facial features (eyes, nose, mouth) support the recognition of familiar faces" (n.p.). In our study the whole face is displayed facing forwards; however, the face of the target at all ages in the study were unfamiliar to the participants. We purposefully used an unfamiliar face for the foils and target as most AMBER alerts are unfamiliar to the public when viewed on television, posters, cell phone alerts, or billboards along a well-travelled road.

Personality predictor variables related to prosocial behaviour

The BES Emotional Contagion, Cognitive Empathy, and Emotional Disconnection scores served as one of our predictor′s variables in our study. White (2014) defined prosocial behaviours as "voluntary behaviours that are intended to benefit or help others and include acts such as sharing and providing comfort or assistance" (in Eisenberg, et al., 2010; Zahn-Waxler & Smith, 1992). Additionally, people scoring high on empathy measures tend to contribute more to prosocial behaviour. Eisenberg et al. (2019) noted those scoring higher in empathy may exhibit more altruistic prosocial behaviours versus those people who perform an act of kindness for a more extrinsic motivational reason (e.g. pay raise or being highly regarded by a person they respect). In other words, some people have more egoistic motives for a behaviour many do not score as high in empathy as those who are more altruistic in their behaviour; whereas altruistic prosocial behaviours would include, in our study, focusing on an AA in order to be better prepared to recognition the missing child in public.

We also included the IPIP Conscientiousness score. Past studies have mostly shown those people who score high on conscientiousness were better at more elaborative retention and processing as well as being more motivated to succeed in tasks (Komarraju, et al., 2011). In Kanacri, et al.'s (2014) study they stated that "McCrae and Costa (1997) described conscientious people as reliable, responsible, and persevering, while Blasi (1980) found those who scored high in conscientious had a greater tendency to follow and adhere to moral and ethical principle" (2014, p. 701). Therefore, we hypothesized that individuals scoring higher in conscientiousness would be more motivated to pay close attention to details from the AA and would tend to follow directions more than those scoring lower on the personality trait, conscientiousness. We predicted those scoring higher on the measure would differ from those scoring lower. For example, the participants high in conscientiousness may correctly identify the female target more accurately than those who scored lower in conscientiousness.

John and Srivastava (1999) believed that the personality trait of conscientiousness results in a person being, responsible, as well as orderly and dependable. One would think of a person high in those three characteristics would perhaps pay closer to the AA photos out of a personal feeling of responsibility. Komarraju et al. (2021) found that 'conscientious individuals seemed to have higher scores on both intrinsic and extrinsic motivation, showed the lowest amotivation, and the highest achievement' (p.49). In other words, relating to our current study, those scoring higher on a motivation scale are more likely to be motivated to score higher on a mock AA of a missing child than a person scoring low on motivation.

Additionally, McCrae and Costa (1997) found in their studies that conscientious tend to be those people who can be relied on, responsible, and preserving. In the case of favourable traits of a person in the public who sees an AA, it appears that conscientious people may spend more time looking for the missing child in public than someone who gives up easily. Since many missing children are not found immediately, a conscientious person who preserves may continue looking for the missing child even after the first few weeks when the AA may be more publicized. In cases of long-term missing children, a person high in conscientious and does not give up easily on a task, such as being on the lookout for the missing child, a valuable trait to possess. Based on these studies, we hypothesized that individuals scoring higher in conscientiousness would be more likely to pay closer attention to details from the AA and would tend to follow directions more than those scoring lower on a conscientiousness measure.

Metacognitive measures

Metacognitive bias is the "overall level of confidence expressed, independent of whether the trial is correct or incorrect whereas metacognitive sensitivity refers to the ability of a person to discriminate between different levels of performance, such as correct or incorrect trials" (Fleming & Lau, 2014, p. 8). Hourihan et al. (2012) found that metamemory (awareness of our own memory processes) is more accurate for faces like our own and that relative metamemory accuracy (e.g. accuracy based on comparing faces similar to our own by race and ethnicity) was higher for own-race faces than other-race faces. Flavell (1979) described metacognition as a control process that is self-directed which contributes to and guides everyday decision-making. Nelson and Narens (1994) noted that if a person has low confidence after a memory retrieval, this can sometimes change the behaviour in order to increase the retrieval strategy (e.g. adding more study time and changing strategies for retrieval). In face recognition studies, one metacognitive strategy often used is Retrospective Confidence Judgments (RCJs) by asking the participants to give an additional evaluative response over the task they just completed. The relationship between confidence and accuracy, according to Wixted and Wells (2017), has been documented in eyewitness memory studies, in which the participants saw the perpetrator with or without a weapon, or after viewing staged crimes or photos of faces. Wixted et al., (2016) suggested that the findings in laboratory settings can extend to real-world identifications, such as in the case of a crime, or in our study, identifying the face of a missing person from a AA. Therefore, in the present study we included measures of prospective and retrospective confidence.

A person may respond that they have seen the one of the photos (either foils or target person) due to the person in the photo looking like someone that they know, referred to as recognition by familiarity (Grabman et al., 2019). Other factors, such as similar facial features (nose, eyes, hair, shape of the face), may contribute to misidentification of a person they believed they had previously seen. Therefore, in our study we included foils that were both similar and dissimilar to the target. One last variable we looked at was the length of targets hair in the seven AA conditions. We predicted males would be more likely to recall the target with longer hair for three reasons: 1) the original photo of the target showed her with long hair; 2) based on the evolutionary theory, males may consider a female attractive in her 20s who has long and thick hair as this could predict the overall health of the female and, according to evolutionary theories, would increase the odds of reproduction (Hinsz et al., 2001; Matz & Hinsz, 2018); and 3) females tend to outperform males in face recognition tasks when females only are viewed; therefore, we predicted based on the given reasons stated that females will have an Own-Gender-Bias (OGB) for the older target female (21 years old) with both short and long hair, and males will tend to score higher on the target with longer hair, especially in the condition where participants saw the original photo along with a current photo of the target (21 years old) since the mean age of the participants in our study

Face recognition biases

There are three well-known face recognition biases: Own-Gender Bias (OGB), Own-Age Bias (OAB), and Own-Ethnicity Bias (OEB) (sometimes referred to as Own-Race Bias). In the current study we did not study the OAB as the ages of the participants mean was 20.22 with very few other age ranges. Additionally, since almost 75% of the participants were white, with the next closest ethnicity being 17% Black participants, the results would not be meaningful in this study; therefore we only measured the OGB as it relates to

accurately recognizing the target's face recognition, as well as metacognitive measures: Prediction of Knowing (POK), Prospective Confidence Level (PCL), and Retrospective Confidence Level (RCL).

The OGB refers to accurately recognising a face of one's own gender relative to the other gender (McKelvie, 1987). Most studies have shown females tend to have a higher OGB than males, especially when only female faces are presented. (e.g., Lewin & Herlitz, 2002; Rehnman & Herlitz, 2006, 2007; Wright & Sladden, 2003). The results for males can vary. For example, Herlitz and Lovén (2013) found that girls and women out perform boys and men if only male faces are presented and not paired with a female face. We predicted an OGB for females, meaning females would outperform males in accurately recognising the target's face in the recognition phase of the study. We also predicted a gender difference in the length of the target's hair. As mentioned earlier, research has shown males have a preference for longer than shorter hair based on evolutionary theories relating to procreation (Hinsz et al., 2001; Matz & Hinsz, 2018). If a female has healthy, thick, long hair (versus thin and brittle), this could signal good health in the female, a possible advantage for a male interested in eventually mating to produce healthy offspring.

METHODS

Participants

Participants were recruited from a Southeastern university using SONA, a research management system that allows students to sign up for research studies online and to obtain credit for participation. A total of 540 participants signed up for the study with 377 individuals who accessed the study and completed at least 90% of the questions. We deleted data from 14 individuals who reported that they had technical difficulties (e.g., video did not play), resulting in a sample size of 363. Participants ranged in age from 18 to 49 years with a mean age of 20.22 years ($SD = 3.76$). Participants reported their gender as 239 (65.8%) female, 114 (31.4%) male, and 10 (2.8%) other. Participants identified their race or ethnicity as follows: White 271 (74.7%), Black or African American 64 (17.6%), Asian 9 (2.5%), Hispanic or Latino 9 (2.5%), American Indian or Alaska Native 4 (1.1%), Native Hawaiian or Other Pacific Islander 1 (.3%), Other 4(1.1%).

Materials

We used SONA at our university, which is a recruitment system online allowing students to sign up to participate in research studies. To collect the data online, we used Qualtrics XM to create a between-subjects design study. 'Qualtrics is the premier Experience Management (XM) platform' (https://www.qualtrics.com/) that can be used as an online survey/experimental program allowing researchers to conduct both qualitative and quantitative research. We designed seven conditions of AAs using Qualtrics to randomly assign the conditions automatically. A consent form was used in the study, also presented in Qualtrics. The program was used to collect our data which was then transferred to SPSS for analysis. We also used a 7-second video of three little girls (one being the target female in the study) talking to two relatives (See Appendix B). The video would serve as part of the AA in the study. The target in our study was a 7-year old girl. Additionally, a video of a real long-term missing boy who had been missing for 13 years presented on CNN for 3 min and 13 seconds. Seven additional photos of the missing target were also used for the seven AA showing her at one of the following ages along with the original photo of her in the AA (ages 7, 10, 13, 16, 18, 19, & 21 years of age). The recognition phase consisted of 20 foil photos of females around 21 years of age, and two photos consisted of the missing target: one with short hair and one with long hair.

We also used the International Personality Item Pool (IPIP, Goldberg et al. 2006) to measure the participant's level of conscientiousness. The participants were asked to rate 20 items on a 0 to 100 very inaccurate to very accurate scale. Scores for positively and negatively worded items were each averaged, then the overall conscientiousness score was calculated as the difference between the positive and negative scores. Cronbach's alpha for this scale ranges from .79 to .87 (Goldberg et al., 2006). We measured empathy using the Basic Empathy Scale in Adults (BES-A) (Jolliffe & Farrington, 2006) which consists of 20 items using a 5-point Likert-style scale ranging from very inaccurate to very accurate. Reliability using the Cronbach alpha coefficient was reported by Jolliffe and Farrington (2006) to be .87. We also used a CNN YouTube video over a real boy who was missing for 14 years as both an educational video and distractor between viewing the AA and the recognition phase of the study.

Procedure

Participants were recruited from SONA and signed up for a time slot (at their convenience as the study was online). Once they began the study, participants read the consent form then click on the continue icon if they chose to participate in the study. If, after reading the consent form the participant opted not to participate in the study, they exited the study. Immediately following the consent form the participants read the following statement: "You are now going to view a very short video. Please pay close attention to the children in the video." The video appeared for 7-seconds followed by a Prediction of Knowing (POK) scale from 0-100 where the participants moved their cursor to the exact number representing how well they thought they could recognise any of the three young girls in the study. After they made their POK, the participants immediately responded to a Prospective Confidence Level (PCL) scale, on a visual analogue scale from 0-100. Following the video, the participants were randomly assigned into one of seven AA. Every condition showed the original 2006 AA of the missing 7-year-old child; however, they also viewed a photo of the same child at ages: 7, 10, 13, 16, 18, 19, and 21. Participants were told in the AA that her non-custodial parent had abducted her at age 7 years of age. In order to explain a second photo in the AA, we said the non-custodial would occasionally send a current photo of their daughter as proof-of-life (Appendix C for the POK and CL scale).

After watching the AA, participants first responded to the IPPI Conscientious scale consisting of 20 questions, and a 5- point Likert scale from: Very Inaccurate, Moderately Inaccurate, Neither Accurate nor Inaccurate, Moderately Accurate, Very Accurate. Following the IPPI conscience scale the BES Empathy scale was administered. This measurement also consisted of 20 questions using the same 5-point Likert scale. Following the BES empathy scale, demographic information was collected including the age, race, ethnicity, gender, and a question on whether they experienced any computer difficulties with the videos shown earlier in the study.

The recognition phase followed showing 22 photos that were in random order. Twenty of the photos were of similar and dissimilar foils, and two photos were of the 21-year-old target (one with short hair and one with longer hair). After viewing the photo sequentially, participants were asked "Was this person in the AMBER Alert?" Yes/No. Following the forced-choice response, the participants were asked to respond to an RCL measurement on a scale of 0-100% confidence. Following the RCL scale, the participants read the debriefing form and were dismissed from the study by closing the Qualtrics program.

RESULTS

Effect of age as shown in the AMBER Alert

We conducted a chi-square test of independence measuring the relationship between the seven ages of the target as shown in the AA and whether the participant recognised (responded 'yes') to the target photo in the recognition phase. We omitted data for participants who did not respond to the target photo. We conducted separate chi-squares for the short-haired and longer -haired recognition photos.

For recognition of the short-haired photo, the chi-square was significant, χ^2 (6, N=348) = 31.53, $p < .001$. There was also a significant relationship for the longer length haired photo, χ^2 (6, N=347) = 20.22, $p < .001$. As shown in Figure 1. Overall, the short-haired photo produced greater recognition as compared to the longer length hair photo when the AA showed the target at 21 years of age, while the longer hair length photo was recognised at a higher rate when the AA showed the target at 7 years of age.
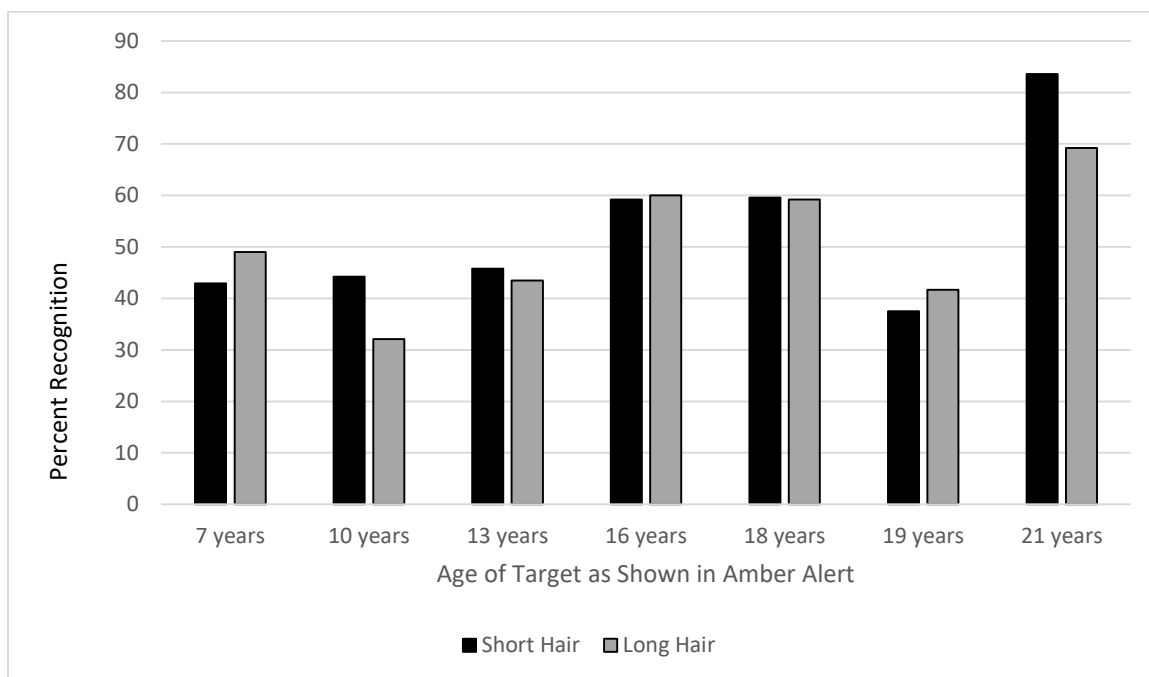
Figure 1
percentage recognition of target individual in relation to age as shown in amber alert and appearance in recognition photo (short compared to the longer length hair).

The mean false alarm rate (percentage of 'yes' responses to foils) was 16.2% (*SD* = 15.93). False alarm rate did not vary significantly across age conditions as indicated by a non-significant one-way between-subjects ANOVA, $F(6, 356) = 1.02$, $p = .410$, $_p^2 = .017$. We conducted one-way between-subjects ANOVAs comparing the seven age conditions on POK, Confidence in POK, and Retrospective Target Confidence. Each of these ANOVAs indicated no significant effect of age condition on the metacognitive measure: For POK, $F(6, 338) = 1.44$, $p = .199$, $_p^2 = .025$; For Confidence in POK, $F(6, 345) = 1.44$, $p = .197$, $_p^2 = .025$; for Retrospective Target Confidence (short-haired photo), $F(6, 292) = 0.81$, $p = .560$, $_p^2 = .016$; for Retrospective Target Confidence (middle-length haired photo), $F(6, 293) = 0.55$, $p = .769$, $_p^2 = .011$.
Recognition in relation to individual difference variables

In order to investigate possible relationships between target recognition and the measures of conscientiousness and empathy, we conducted a logistic regression predicting recognition of each of the two target photos. We included the demographic variables of gender, ethnicity, and age, along with IPIP Conscientiousness score and BES Emotional Contagion, Cognitive Empathy, and Emotional Disconnection scores as predictors. We omitted data from the 10 individuals who identified a gender other than female or male. Participant ethnicity was recoded as White, Black/African American, and all other reported ethnicities, to reduce the number of categories. We used the Backward Wald method to determine which of these variables, if any, would emerge as significant predictors of target recognition.

For predicting recognition of the short-haired version of the target, all variables except for gender were eliminated from the model. The final model, including only gender as a predictor, was significant, χ^2 (1, *N*=353) = 6.66, $p = .010$, Nagelkerke $R^2 = .027$. Recognition rates were 59.4% for female participants and 43.1%

for male participants. For predicting recognition of the longer-length-haired version of the target, all variables were eliminated from the model.

DISCUSSION

We hypothesised recognition of the target at 21 years of age would be higher in the condition where participants saw the missing target at age 7 (all conditions saw the original AMBER alert photo) with the second photo of the target at 21 years of age.

Indicated a significant effect of age as shown in the AA photo, with the best recognition for a most recent photo (21 years of age), providing support for this hypothesis. This was the case for both the shorter-haired and longer-haired versions of the target recognition photo. The results provide shorter-haired and longer-haired versions of the target recognition photo. The results provide support for the usefulness of using a recent photo of a missing person in updated alerts if such a photo is available or maybe produced via age-progression software support the usefulness of using a recent photo of a missing person in updated alerts if such a photo is available or maybe produced via age-progression software.

However, recognition did not increase linearly with age of the target as shown in the AA photo. This finding may be a result of a number of appearance factors that can change in different photos as a child's age. In some cases, appearance may be like how the child (or young adult) appears at a later age despite the difference in age. These results suggest, consistent with recommendations from Gier and Kreiner (2009) that the use of a variety of photos in missing person alerts may be the best strategy, as it is often not possible to predict how the missing person's appearance may have changed.

In terms of appearance, we found no overall difference in recognition rate for the longhaired vs short-haired photos. However, the results showed differences in the pattern of recognition by age as shown in AA for short- and long-haired appearances in recognition photos. The results imply that the effect of age as shown in AA may vary depending on other appearance factors.

We observed a lack of differences in metacognitive measures across different ages shown in the AA. This is an interesting result given that the recognition rates did vary across the age conditions, as it indicates that metacognition might not reflect difficulties in actual recognition. For example, we might expect retrospective confidence ratings to be lower when there was a larger difference in age at encoding vs. recognition, as participants might have realised that the photos, they were seeing were of individuals older than the child shown in the AA. However, we found no such difference in retrospective confidence ratings. For prospective metacognitive measures, such as POK, it is reasonable that these would not vary across age conditions, as participants had not yet seen the recognition photo and could not have known how it might differ from what they saw in the AA.

In terms of individual differences, the results partially supported an advantage in recognition for female participants, but this was only the case for the short-haired version of the target. Previous research has shown that males tend to have a preference for women with longer hair than shorter hair as long, healthy hair is a sign of overall health. Additionally, based on research of external facial features versus internal facial features for unfamiliar faces, females may have used the target's internal facial features (such as in Wright & Sladden, 2003) to recognise similarities between the target in the AMBER alert and the target with the short hair in the recognition phase of the study; whereas males may have been focusing more on the external features, such as the hair, consistent with findings from the Toseeb et al. (2012) study. Females may have shown an OGB in the short hair condition because they were more focused on mentally comparing the internal facial features to the target in the short hair photograph.

Contrary to our hypotheses, participant scores on measures of empathy and conscientiousness did not predict recognition. These results may suggest that individual differences in variables such as empathy and conscientiousness may not be particularly important in motivation to attend to the AA or to the

opportunities to recognise the missing person or that differences in motivation are not consequential in actual recognition rates. However, we should keep in mind that these findings may not generalize well to real-world scenarios, in which individual differences related to motivation may play a more important role as individuals have the option to engage in recognition attempts, whereas the experimental procedure used in the present research required participants to (at least nominally) engage in the recognition task.

Another limitation was the use of online administration, which limited the opportunity to ensure that participants followed instructions and maintained focus throughout the study. However, these characteristics may describe how individuals are likely to view AA outside the laboratory context. We should also note that the recognition phase may not fully represent real life opportunities for recognition, as we used static photos, whereas members of the public may encounter a missing person in a variety of contexts in which they see the individuals' entire body, possibly from different angles, and while in motion.

The results of the present study add to the literature on face recognition as it relates to face recognition in relation to AAs. For example, Gier and Krenier (2009) found that face recognition is more accurate when the face of a missing child in an AA is similar to the appearance of the child if seen at a later time (e.g., school-type photo versus dirty-sad photo). Lampinen et al. (2012) found that current photos of a missing child were more effective than outdated or age progressed photos. Additionally, Lampinen et al. (2012) compared four photographs of missing children to 12 photos of missing children and found prospective person memory was reduced when viewing 12 missing children posts versus viewing 4 posters of missing children. The researcher pointed out the main difference was false alarm rates with the foil photos in the study; and, in real missing children's cases, false alarms can lead to more time and money, as well as the emotional effect on the family; however, if more leads result in finding a child it is worth the time and money. Similarly, long-term missing children are sometimes found due to the tenacity of the parents and law enforcement. According to the Office of Justice Programs (2021), "as of April 2021, 1,064 children have been successfully recovered through the AMBER Alert system " (para. 2). It is important to remember that not all children who are missing are in AMBER alerts. Many children who are missing are found quickly (e.g. a child goes to a friend's house after school without telling his/her parents). For a child to be considered for an AMBER alert the child must be in grave danger.

The results of the present study add to the literature on face recognition as it relates to face recognition in relation to AAs. For example, Gier and Krenier (2009) found that participants were more accurate at recognizing a child if the child appeared in the same state when the participant saw them in the recognition phase. The researchers only used the same age of the missing child as it was not related to long-term missing children. We hypothesised that recognition would be greatest when the photo shown in the AA showed the missing child at an age closest to her appearance in the recognition stage. The results indicated a significant effect of age as shown in the AA photo, with the best recognition for the most recent photo (21 years of age), providing support for this hypothesis.

Hopefully, our current study will encourage other researchers to conduct studies to help long-term missing children. One can only imagine what the child is experiencing, but we know the parents are suffering from ambiguous loss (Acharya & Relojo, 2017; Tubbs & Boss, 2000), which is said to be the worst possible grief to experience. According to Kevin Gosden, whose son has been missing for almost 14 years, he stated "The best I feel is a day in which I do not wish I were dead." (Yorkshire Post, 2018). Our hope is that the research conducted on missing children will help in finding long-term missing children, like Andrew Gosden whose parents are still fighting to bring him home.

The practical implications of our study suggest parents should keep updated photos of their child as much as possible in case their child goes missing. Today, with many children abducted and/or missing right before or after school should suggest to parents to take daily photos/short videos of their children as they are leaving for school. According to NCMEC (2021), 38 percent of attempted abductions occurred while a child was walking to or from school, riding a school bus or riding a bicycle. In a time where almost everyone has a cell phone taking a quick photo could become a ritual in preparing for the day. As our research has shown the more current photos of the missing child resulted in better our research has shown the more current photos of the missing child resulted in better recognition than older, outdated photos; therefore, taking a quick

photo of your child and saving it until they return home from school is a proactive measure in case of a kidnapping. Additional research is needed on methods of improving identification of long-term missing children. Very few studies have addressed this topic other than Lampinen et al. (2012). Since 2012 there may be more advanced techniques in face age progression that should be investigated.

Our study involved only one target child, a 7-year old Caucasian female; therefore, more research needs to be conducted on the recognition of individuals differing in multiple ways, such as different genders (including transgender children) and different ethnicities. Further, it would be useful to conduct research manipulating the appearance of hair in the AMBER alert photo and/or at recognition including length, colour, and texture (e.g., thick and full hair compared to very thin hair).

Education is also suggested for the family as well as school faculty and staff. Because so many long-term missing children are kidnapped walking or on a bicycle to and from school, having a yearly educational program for those related in any way to children during that time period on safety suggestions in preventing kidnappings may be useful.

Education is important not only for the parents but also for the children. More programmes need to be created for communities to become involved if a child is missing. After school programs at school as well as at YMCA, boys' and girls' clubs, and church groups need to be vigilant of vulnerable children in their care. AAs appear on TV, cell phones, Facebook, and postings in the community, yet we rarely hear of programs in the community to prepare parents in case of a kidnapping. We suggest preparing in advance with current photos, and videos saved in multiple places, as well as a detailed description of each child. That information should be shared with extended family members and updated information every few months as children can change in appearance over short periods of time.

In the present study, we did not find any individual personality traits that were related to face recognition in an AA. However, perhaps a study of people who have recognised children in an AA would help us identify personality traits that relate to paying close attention to an AA. Research using divided attention could be useful as well, as many people who see an AA on television could be distracted by multiple events going on in the household. Any child who goes missing is a heart-rending event. A missing child can cause extreme stress, anxiety, and grief to the family of the missing child. As time passes and the child is not found the horrific anxiety only increases. No family or child should go through this agony, but if it does happen, we need to make sure that the family, community, and law enforcement use every finding from research in their search for the missing child.

One last comment on AMBER Alerts that needs mentioning. Some researchers state AA are not very successful as not all AA children are recovered. Remember always that any life saved from the hands of an abductor is reason enough to continue to find better ways to educate the population on face recognition of children from AA. One of the authors of this study was abducted at 7 years of age. Doubters of the success of AAs should contact us from the perspective of the missing child and the negative effects it had on her throughout her life. We applaud all researchers from all countries and disciplines that are also driven to save as many lives as possible through missing people research. Do not focus on the name 'AMBER Alert' as we only use this particular program as an example of a program seeking to save children's lives.

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Appendix A
Screenshot of a recovered AMBER Alert boy after missing for 13 years

You will now watch a short YouTube video about a real missing child who was found 13 years after he went missing.
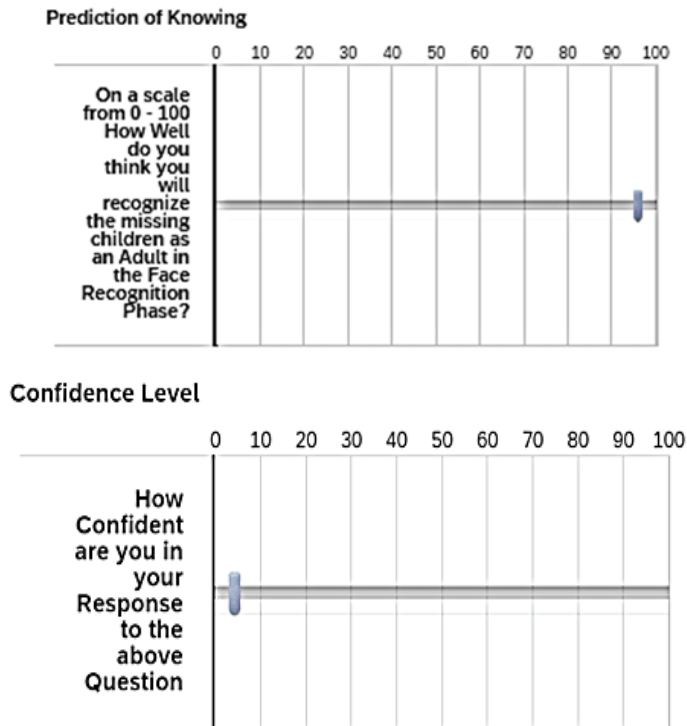

Appendix B
Screenshot of the 7-second video of the target with two of her relatives

Appendix C
Prediction of Knowing (POK) Scale Following Video and the Confidence Level Following the POK Question

Appendix D

Participants were randomly assigned to one of seven different AMBER Alert conditions. Two photos of the target female: Original photo (7-years old) that appeared in the AMBER ALERT, and a second photo of her at 7, 10, 13, 16, 18, 19, and 21 years old.