MUGSHOT GROUP SIZE AFFECTS EYEWITNESS MUGSHOT SELECTIONS

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When eyewitnesses examine a set of mugshots, the photos can be presented either individually or in groups. The present experiment investigated whether the selection of mugshots is influenced by group size. Participants watched a video of a mock theft, then viewed 180 mugshots either 3, 6, or 12 photos at a time. Selection of the target's mugshot was not significantly affected by mugshot group size, but participants who viewed three mugshots at a time selected more fillers. In addition, group size had only a small effect on the amount of time taken to inspect mugshots, and participants exhibited a strong tendency to select no more than one mugshot from any single group. The practical and theoretical implications of these findings are discussed.

Witnesses to crimes are often asked to examine mugshots in an attempt to identify potential suspects. Dozens of studies have looked at a variety of factors involved in mugshot procedures, such as methods for filtering mugshots prior to viewing (e.g., Levi, Jungman, Ginton, Aperman, & Nobel, 1995; McAllister, Stewart, & Loveland, 2003; Pryke, Lindsay, & Pozzulo, 2000), the effect of adding sound and video to supplement the traditional static mugshot (McAllister, Beardon, Kohlmaier, & Warner, 1997; McAllister, Blair, Cerone, & Laurent, 2000), and the impact of mugshot viewing on subsequent lineup identification accuracy (e.g., Deffenbacher, Bornstein, & Penrod, 2006; McAllister, Stewart, & Loveland, 2003).

When eyewitnesses examine a set of mugshots, the photos can be presented one at a time, or they can be shown in groups with several mugshots displayed simultaneously on each album page. If an investigator wanted a witness to examine 100 mugshots, the photos could be presented individually on 100 separate pages, 4 per page on 25 pages, 10 per page on 10 pages, and so on. The present study examined how the selection of mugshots by witnesses is affected by the size of the mugshot groups. Also, by examining mugshot inspec-

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tion time and changes in the rate at which mugshots are selected, we investigated several hypotheses about the underlying processes involved in eyewitness mugshot selection.

A large body of research on lineups shows that, compared to simultaneous presentation, sequential presentation of the individual lineup elements (photos or people) reduces false positive identifications by reducing comparisons between the elements (Lindsay & Wells, 1985; Steblay, Dysart, Fulero, & Lindsay, 2001; see also McQuiston-Surrett, Malpass, & Tredouz, 2006). Yet, because a lineup presents the witness with a much different task than does a mugshot search,[1] a procedure that improves lineup performance—such as sequential presentation of photos—may not have the same positive effect when used with mugshots. Nevertheless, given that eyewitness identification accuracy with lineups depends on whether the lineup elements are presented individually (sequentially) or as a group (simultaneously), the investigation of mugshot group size seems warranted.

In most previous studies, researchers have shown mugshots one at a time (Brown, Deffenbacher, & Sturgill, 1977, Experiment 2; Cutler, Penrod, & O'Rourke, 1986; Cutler, Penrod, & Martens, 1987; Davies, Shepherd, & Ellis, 1979; Deffenbacher, Carr, & Leu, 1981; Laughery, Alexander, & Lane, 1971; Laughery, Fessler, Lenorovitz, & Yoblick, 1974; Lee et al., 2004; Lindsay, Nosworthy, Martin, & Martynuck, 1994, Experiments 1 & 3; McAllister, Beardon, Kohlmaier, & Warner, 1997; McAllister, Blair, Cerone, & Laurent, 2000; McAllister et al., 2003; Memon, Hope, & Bartlett 2002; Perfect & Harris, 2003). This preference for displaying mugshots individually may reflect actual police practice, in part, or a methodology commonly used in face recognition studies in which test faces are shown one at a time.

Some researchers, however, have presented their participants with groups of mugshots (Brown, et al., 1977, Experiment 3; Dysart, Lindsay, Hammond, & Dupuis, 2001; Gorenstein & Ellsworth, 1980; Levi et al., 1995; Lindsay, et al., 1994, Experiment 2), and there has been considerable variation in mugshot group size across studies. In two reports, different group sizes were used within a series of studies or within the same experiment (e.g., Ellis et al. 1989; Lindsay et al. 1994), and in two studies in which mugshot albums were used (Dysart et al. 2001, Experiment 1; Memon, Hope, & Bartlett 2002) the authors reported the number of mugshots that were on each page of the album, but not whether more than one page at a time was visible during the mugshot search, as can occur if photos are placed on the front and back of each album page.

Although different mugshot group sizes have been used in different studies, no research specifically examining the effect of group size was reported until recently. In the first study of mugshot group size, Stewart and McAllister (2001) noted the apparent "lack of concern about whether to present mug book pictures one at a time or grouped" (p. 1300). These authors, in a staged crime experiment, presented mugshots either one at a time or in groups of 12. They found that their participants selected fewer filler mugshots—and were also just as likely to select the target's mugshot—in the grouped condition. Stewart and McAllister concluded that "the best practice for mug books may be the use of groups of

pictures per page rather than the one-at-a-time procedure long advocated by experts for use in lineups and photospreads" (p. 1300).

The findings of Stewart and McAllister provide some evidence that it may be best to present mugshots in groups. However, because Stewart and McAllister studied the effect of only one group size—12 photos per group—the present experiment was designed to compare the effects of three mugshot group sizes (3, 6, or 12 photos per group) on witnesses' mugshot selections. Our primary applied question is whether there is an optimum group size that produces the best results—more frequent selection of the target, a reduction in the number of incorrect mugshots selected, or both.

Regarding underlying cognitive processes, how might group size affect a witness's mugshot selections? One possibility offered by Stewart and McAllister is based on their observation that witnesses who saw mugshots in groups of 12 were very unlikely to select more than one mugshot from any single group. These witnesses behaved as if they were following a rule that allowed them to select either one mugshot, or no mugshots, from each group. In the present article we refer to this as the *one-or-none decision rule*. In contrast, witnesses who saw mugshots one at a time were much more likely to select more than one out of every 12 mugshots they examined. If witnesses apply the one-or-none rule to each mugshot group, then larger groups will result in fewer selections, and in general there will be a negative association between the number of mugshots selected and group size. We tested this prediction in the present study by looking at the number of selections made by witnesses who were shown mugshots in groups of 3, 6, or 12.

Mugshot group size may influence witnesses' selections in another way. Stewart and McAllister discuss the possibility that witnesses might scrutinize mugshots more closely when photos are displayed one at a time. This *close-inspection* hypothesis predicts that mugshots presented in smaller groups will be studied in more detail—and for a longer period of time—than mugshots displayed in larger groups. As a result, the smaller the group size, the longer it should take a witness to examine a given number of mugshots. Although Stewart & McAllister made no formal time measurements in their study, they estimated that it took their witnesses about twice as long to examine the entire set of mugshots when the photos were displayed one at a time. In the present study we tested the close-inspection idea by timing how long it took our participants to complete their examination of the mugshots.

The present experiment allowed us to investigate another speculation of Steward and McAllister, namely, that the close examination of those mugshots presented in smaller groups might interfere with a witness's memory of the perpetrator. Witnesses may select more incorrect mugshots because their memory of the perpetrator becomes degraded. A related phenomenon has been found in research on identifications from lineups. Identification accuracy is reduced when eyewitnesses are exposed to mugshots before they see the lineup, and small sets of mugshots have a bigger negative effect than do larger sets (Deffenbacher et al., 2006). Smaller groups of mugshots may have a more detrimental effect if eyewitnesses examine each mugshot more closely, and if closer inspection produces more interference with the memory for the perpetrator. Similarly, interference caused by the close

inspection of photos during a mugshot search may have the unintended effect of reducing, rather than increasing, the probability that the witness will select the perpetrator's mugshot if it is present. Stewart and McAllister found that, compared to witnesses who viewed mugshots one at a time, those who saw mugshots 12 at a time were somewhat more likely (but not significantly so) to include the perpetrator's photo among their selections. In the present study, we investigated how smaller groups of mugshots—3 and 6, compared to 12—affect correct and incorrect selections.

Group size may also affect selections by altering a witness's strategy for evaluating mugshots. For example, one strategy is to sort the mugshots in each group to determine which photo matches most closely the witness's memory of the perpetrator. A very inefficient sorting method would be to compare each mugshot to all others in the group in terms of how closely they match the witness's memory of the perpetrator. The witness would then select the mugshot with the best match if its degree of similarity to the perpetrator exceeded a decision criterion. This method of paired, relative judgments would require increasingly more comparisons among mugshots as the group size increased. As an example, suppose an eyewitness is examining the first 24 photos in a mugshot album. If the mugshots are presented 6 at a time, 15 paired comparisons must be made within each group, and the witness would have to make 60 comparisons to get through the four groups of 6 mugshots. For mugshots displayed in sets of 12, each set would involve 66 comparisons, or 132 total comparisons for the 24 mugshots. Thus, the time required to inspect a given number of mugshots would increase as a function of group size. More efficient sorting methods could be employed to reduce the number of relative comparisons made within each mugshot group. In general, however, if witnesses make relative comparisons within groups of mugshots, larger group sizes will require more comparisons, increasing the average inspection time per mugshot. In contrast, if witnesses tend to judge each photo in isolation, then group size should have little or no effect on the total amount of time required to inspect a given number of mugshots.

Witnesses may make relative comparisons with smaller groups of mugshots such as three photos per page. However, for larger groups, it seems more likely to us that witnesses would use a different strategy in which they first reject all mugshots that do not meet certain key criteria—the perpetrator's curly hair or large chin, for example—then compare each remaining mugshot to the memory of the perpetrator and select one or more mugshots that exceed a decision threshold. This process would be consistent with the way people typically make decisions in situations that involve many choices (cf. Payne, Bettman, & Johnson, 1993). If this is the case, the number of mugshots that need to be compared within each group may be similar even for different group sizes. For example, consider two witnesses, one looking at groups of 12 mugshots and one looking at groups of 6. If both witnesses can quickly eliminate all but one or two mugshots in each group, then both witnesses are faced with the same task of deciding whether to select or reject those few photos, and the amount of time required to examine a set of mugshots would be very similar for both larger and smaller mugshot groups.

To summarize, the present study was designed to build on Stewart and McAllister's (2001) initial investigation of mugshot group size. Unlike Stewart and McAllister, who compared the effects of mugshots presented either one at a time or in groups of 12, we examined eyewitness mugshot selections for photos presented in groups of different sizes. We showed college students a video of a simulated theft, then later had them examine mugshots that were displayed in groups of 3, 6, or 12. From an applied perspective, the main goal was to discover if larger mugshot groups result in fewer incorrect selections without significantly reducing the probability of the target's mugshot being selected. From a theoretical perspective, we investigated several issues concerning the mechanisms by which mugshot group size might affect mugshot selections.

METHOD

Participants and Design

The participants were 96 college students (65 females) who volunteered for the study. The average age of the students was 18.9, and all but two were White. College students were studied to allow for a direct comparison of our findings to previous mugshot studies that also tested college students (e.g., Lindsay et al., 1994; Stewart & McAllister, 2001). The primary independent variable was mugshot group size (3, 6, or 12), the number of photos displayed on each screen by the computerized mug book. Thirty-two participants were randomly assigned to each condition. The main dependent variables were the proportion of participants who correctly selected the mugshot of the person in the video, the number of filler (non-target) mugshots selected by each participant, and the amount of time participants spent examining the mugshots.

Stimulus Video and Mugshots

All participants viewed a video of a simulated theft. The video was created for the study using a wireless color surveillance video camera (Radio Shack model 49-2535) that was mounted 2.13 m above the floor. In the video, a 21-year-old White woman is seen removing a wallet from a purse on a counter. The total length of the video was 12 seconds, and the woman's face can be seen either from the front or the side for approximately 9 seconds.

In the identification phase of the study, a custom computer program displayed a total of 180 color mugshots, with either 3, 6, or 12 mugshots per screen. Each individual mugshot, regardless of group size, was the same size on screen (6 × 6 cm). The mugshots were presented in one row of 3 photos, 2 rows of 3 photos, or three rows of 4 photos.

Below the photos at the bottom of the computer screen were "Next page" and "Previous page" buttons that the participants could click on, allowing the participant to look at the groups of mugshots as they might look at pages in a photo album. The first screen displayed by the mugshot program contained only blank gray squares in place of mugshots, allowing the experimenter to explain how to use the program before the participant started viewing the mugshots.

The mugshot of the target was taken on the same day that the video was made. In the video the target's hair was pulled back in a ponytail and she was wearing a necklace and earrings. In the mugshot the target wore different clothes than in the video, her shoulder length hair was down, and she wore no jewelry. The remaining 179 filler mugshots used in the study were all of White women between approximately 18 and 30 years of age. No attempt was made to filter the filler mugshots except to choose young adult White females. The filler mugshots were obtained from internet sites that display mugshots of actual criminals, the Minear and Park (2004) database, and a collection of photos of college students maintained in our lab.

To minimize order effects, four random orders of the 180 mug shots were used in the study, with the target mugshot appearing in a different randomly chosen position within the middle 60 mugshots of each order. The experimenters were blind to the location of the target photo. Participants were randomly assigned to conditions with the constraint of the assignment of an equal number of participants to each order within each mugshot group size.

Procedure

The participants, who were tested individually, were told that their task in the experiment was to attempt to identify a person they would see in a video. Each participant was also told that the video had been created for the study, that it simulated a situation in which an eyewitness sees a person for a brief period of time, and that he or she was to "pay close attention and do your best to remember what the person looks like."

After watching the video of the theft, the participants spent 25 minutes doing homework or reading. Next, participants described in writing what they saw in the video and what the thief looked like. Finally, the participants viewed the 180 mug shots, seeing 3, 6, or 12 photos per screen as prescribed by the condition to which they were assigned. Although the target mug shot was always one of the 180 photos, the participants were told that the perpetrator's photo may or may not be among the mug shots.

While the participant was examining the mugshots on the computer, the experimenter sat across the table facing the participant and recorded his or her selections. The experimenter was positioned so that he or she could not see the computer screen. For each group of mugshots, participants either said "none," or told the experimenter the identification number of the mugshots they wanted to select. Following the recommendation of Lindsay et al. (1994) and the procedure used by Stewart and McAllister (2001), participants also said "yes" to indicate they thought it was the target's mugshot, or "maybe" to indicate a lower level of confidence. The mugshot program recorded, to the nearest hundredth of a second, the amount of time each group was displayed on screen. Participants were not told that display time was being recorded.

RESULTS AND DISCUSSION

The presentation of results is organized as follows. We look first at the number of participants who selected the target mugshot. Next we examine the number of other mugshots (fillers) that participants selected, and if the rate of selection changed as they progressed through the 180 mugshots. The extent to which participants' selections were consistent with the one-or-none rule is examined next. Finally, we analyze participants' reviewing of mugshot pages they had already examined, and the amount of time participants spent inspecting each page of mugshots.

Target Selections

One of our main questions was whether mugshot group size affected the selection of the correct mugshot. Out of 96 participants, 53 (55%) chose the target mugshot as one of their selections. As shown in the upper panel of Figure 1 (next page), the proportion of participants making a target selection was lowest when mugshots were displayed 12 at a time, although the differences among the three groups were not statistically significant, χ^2 (2, N = 96) = 1.35, p = .51, ϕ = .12. For all three groups, nearly all selections were made with the lower *maybe* confidence level. In the 3-, 6-, and 12-per-page groups, only 2, 3, and 2 participants, respectively, said *yes* to the target. These data are in line with Stewart and McAllister's (2001) results and extend the finding to groups of 3 and 6 mugshots. In addition, these data do not support the idea that smaller groups of mugshots will result in fewer target selections due to interference from the closer inspection of mugshots.

Filler Selections

The 96 participants selected an average of about 5 filler mugshots (M = 4.96, SD = 4.81). Put another way, participants correctly rejected, on average, 97% of the filler mugshots (174 of 179), a result similar to that reported by Lindsay et al. (1994). A one-way ANOVA on the number of filler selections was significant, $F(2, 93) = 3.67$, p = .03, η^2 = .07 (see Figure 1, lower panel). Tukey HSD paired comparisons (Tabachnick & Fidell, 2007) showed that participants in the 3-per-page condition selected significantly more filler mugshots than did participants who saw mugshots in groups of 6 (p = .03). The comparison for group sizes 3 and 12 was not significant (p = .14). The tendency for the 3-per-page condition to elicit the selection of more mugshots is also reflected in the number of participants who made many selections. In the 3-per-page condition, 14 of 32 participants (44%) selected 7 or more fillers; in contrast, only 12% and 19% of participants in the 6-per-page and 12-per-page conditions, respectively, selected 7 or more fillers, χ^2 (2, N = 96) = 9.33, $p < .001$, ϕ = .31. Figure 1 also shows that the best result (high target selection rate combined with lowest average number of fillers selected) was obtained when mugshots were presented six at a time.

In all three groups, one filler mugshot was selected more often than the target (by 22, 21, and 22 participants out of 32 in the 3, 6, and 12 groups, respectively). Very few other filler mugshots were selected by a large portion of participants. For group sizes of 3, 6, and 12, there were 4, 2, and 3 other mugshots, respectively, that were selected by at least 8 of 32 participants in each condition.

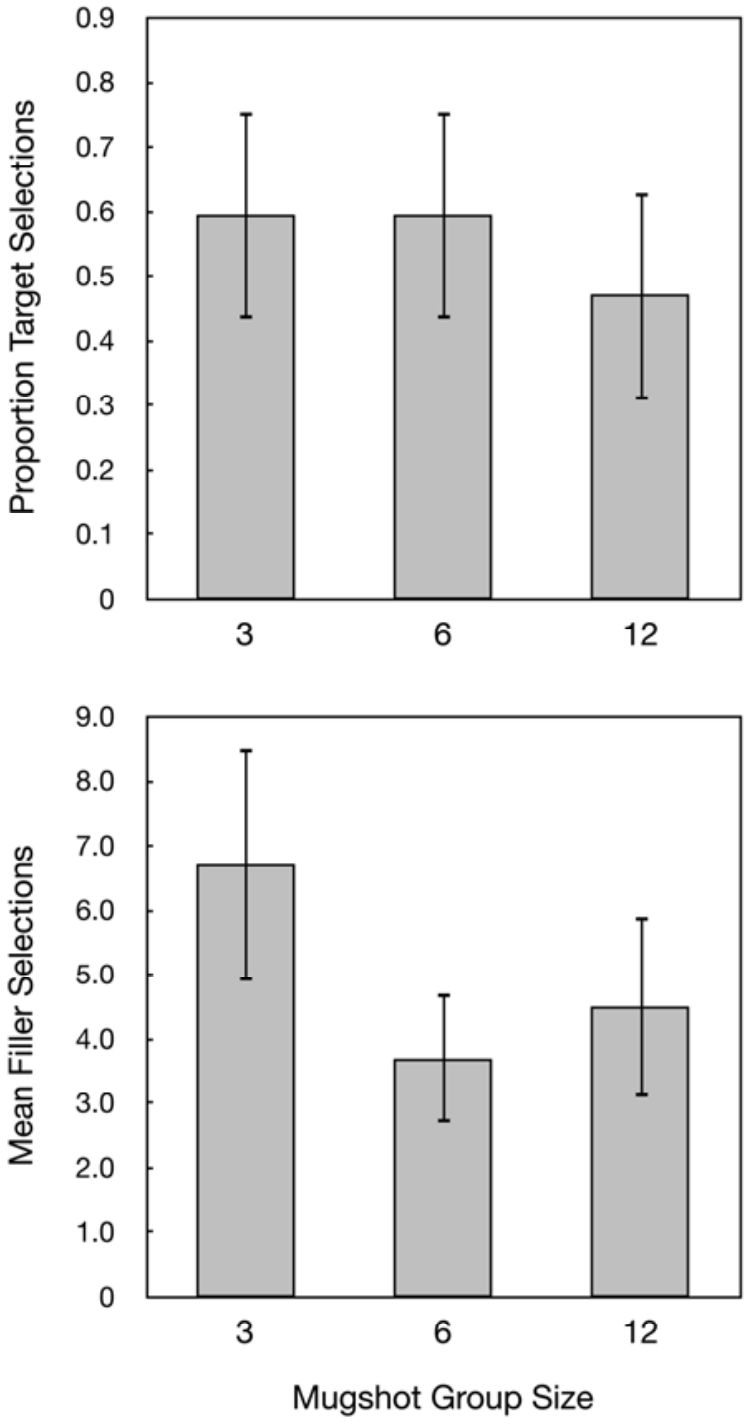

Figure 1. The proportion of participants who selected the target mugshot (upper panel), and the mean number of filler mugshots selected (lower panel), by mugshot group size. Error bars represent 95% confidence intervals.

The number of different fillers that were selected provides some information about the similarity of the filler mugshots to the target. For group sizes of 3, 6, and 12, there were 68, 41, and 50 different fillers selected at least once, respectively. Thus, although each participant on average selected only 5 filler mugshots, an average of 53 fillers in each condition were similar enough to the target to be selected at least once by at least one participant. These data indicate that not all fillers could be immediately dismissed, and that nearly 30% of the mugshots were, in the judgment of at least one participant, similar enough to the target to justify selection.

Changes in Selection Rate

Did participants in the 3-per-page condition select more mugshots because of the build-up of interference? If so, then the rate of selections might be expected to increase as more mugshots are inspected; as the memory for the perpetrator is degraded via interference, more mugshots become possible matches. To see if selection rate changed as participants progressed through the 180 mugshots, we counted the number of selections made from the first set of 60, the middle set of 60, and last set of 60 mugshots. A Group Size × Set ANOVA revealed a significant main effect for Set (see Figure 2, below), $F(2, 186) = 71.47$, $p < .001$, $\eta^2 = .43$; participants in all three group sizes made more selections from the first set of mugshots than from the middle or last sets. Although the selection rate in the 3-per-page condition decreased the most from the first to the middle and last sets, the Group Size × Set interaction was not significant, $F(4, 186) = 2.11$, $p = .08$, $\eta^2 = .04$. Stewart

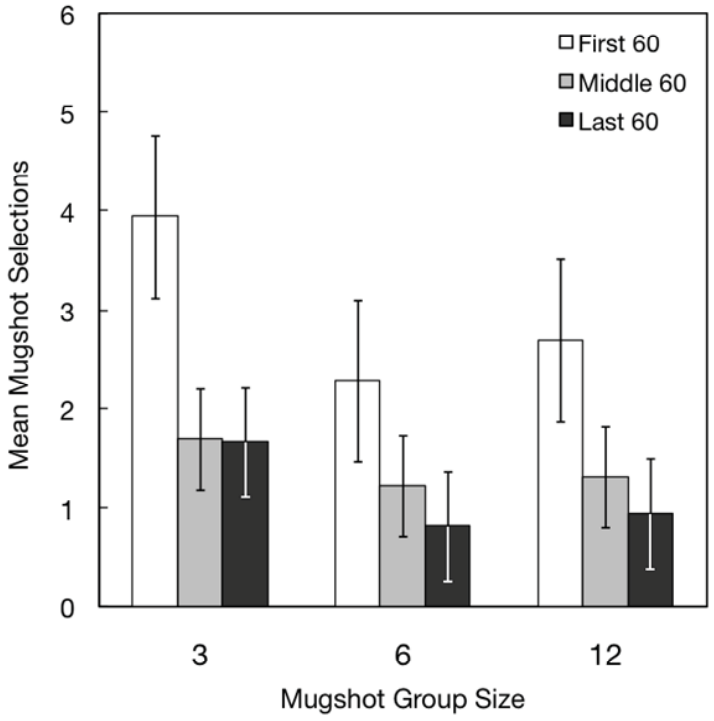

Figure 2. For each mugshot group size, the mean number of mugshots selected from the first, middle, and last 60 mugshots. Error bars represent 95% confidence intervals.

and McAllister (2001) reported a similar finding: compared to 12-per-page presentation, one-at-a-time presentation led to a higher selection rate (about 7% vs. 2.5%) from the first 132 mugshots, but in the last 83 mugshots selection rates for the two conditions were very similar (about 3% & 2%). These results are not consistent with the hypothesis that interference with the memory of the perpetrator builds up as more mugshots are inspected. One possible explanation for the decrease in selection rates is that participants raise their decision criterion as each new mugshot is selected, so that a mugshot is not selected unless it is a better match for the perpetrator than all previously selected mugshots.

One-Or-None Decision Rule

Stewart and McAllister found that 12-per-page grouping led a large portion (88%) of their participants to select, at most, one mugshot per group. In contrast, only 19% of their participants who saw mugshots one at a time selected no more than one mugshot out of every 12. Our results extend this finding to different group sizes. In the 12-, 6-, and 3-per page conditions, 72%, 88%, and 91% of the participants, respectively, selected no more than one mugshot from any single group, and there were no significant differences among these percentages, χ^2 (2, N = 96) = 4.65, p = .10, ϕ = .22. As expected, participants who saw smaller groups of mugshots tended to be less likely to deviate from the rule, because in smaller groups there is a lower probability that more than one mugshot will be similar enough to the perpetrator to be selected. In order to make comparisons with the 12-per-page condition, the selections made by participants in the 3-per-page and 6-per-page conditions were examined for groups of 12 mugshots. In other words, we looked at the number of selections made out of every four pages in the 3-per-page condition, and every two pages in the 6-per-page condition. In the 3-per-page and 6-per-page conditions, 50% and 63% of the participants, respectively, selected no more than 1 mugshot out of every 12. As noted above, the 12-per-page result was 72%. There were no significant differences among conditions, χ^2 (2, N = 96) = 3.25, p = .20, ϕ = .18. Thus, in all three conditions, most participants' selections were consistent with the one-or-none rule.

Further evidence for our participants' strong tendency to use the one-or-none decision rule can be seen by looking at the participants whose selections violated the rule. In the 12-per-page condition, 6 of the 9 participants who selected more than one mugshot from a single page did so only once. In the 6-per-page condition, all four rule breakers did so only once, and in the 3-per-page condition, just one participant selected more than one mugshot from a page once. In all, across the three group sizes, 80 of 96 participants (83%) selected no more than one mugshot from all pages they saw, and of the 16 people who broke the one-or-none rule, 11 did so only once. These data support Stewart and McAllister's (2001) hypothesis concerning the one-or-none decision rule. It appears that larger group sizes result in fewer selections (and thus fewer incorrect selections) because witnesses are reluctant to select more than one mugshot from any single group.

Reviewing Mugshot Groups

Recall that participants were allowed to go back and forth through the pages of mugshots. This feature of the computerized mug book allowed us to examine the possibility that group size influences reviewing of previously inspected photos. If close inspection

reduces the need to review mugshots, and if smaller group sizes encourage closer inspection, then we might find a positive association between group size and the number of times that our participants went back to review previously seen mugshots.

Out of 96 participants, 80 went through the mugshots from beginning to end without returning to previously viewed pages. Participants who did go back to review pages did so only a few times (*Mdn* = 1) and went back to review, on average, 2 pages of mugshots. Only 2 participants in the 3-per-page condition went back to review pages, while there were 9 and 5 reviewers in the 6- and 12-per-page conditions, respectively, $\chi^2(2, N=96) = 5.55$, $p = .06$, $\phi = .24$. Although participants who saw mugshots in groups of 3 were the least likely to review previous pages, the 12-per-page condition did not lead participants to review more than the 6-per-page condition. These data do not offer a clear message concerning the relationship between group size, close inspections of mugshot, and the review of mugshots. However, because 80 of the 96 participants did not go back to review mugshots, it appears that the effect of group size on reviewing is, at most, a small one.

Mugshot Inspection Time

Another question we addressed in the present experiment concerns the amount of time participants spent inspecting the mugshots.[2] Figure 3 (below) summarizes these data. The longest average inspection time occurred in the 3-per-page condition, where the mean was just over four minutes (*M* = 241.8 s, *SD* = 73.64). For participants in the 6-per-page condition the mean was 202.6 s (*SD* = 53.29), while the 12-per-page mean was 203.2 sec-

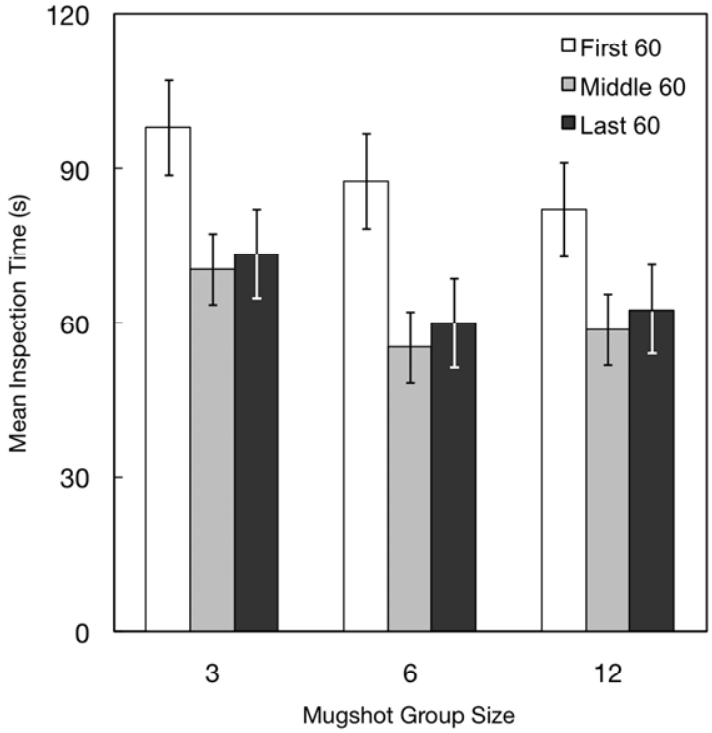

Figure 3. For each mugshot group size, mean inspection time in seconds for the first, middle, and last 60 mugshots. Error bars represent 95% confidence intervals.

onds (*SD* = 56.12). Participants who viewed 3 mug shots per page took significantly longer than the other two groups to go through all 180 photos, $F(2, 93) = 4.23$, $p = .02$, $\eta^2 = .08$. However, the largest average difference between groups (3- vs. 12-per-page) was only about 40 seconds, or an average of about one-fifth of a second per mugshot. This outcome contrasts with the report of Stewart and McAllister (2001), who estimated that their participants who viewed single mugshots took about twice as long to view all mugshots as participants who viewed 12 per page. This discrepancy may be due to differences in the degree of similarity of the fillers mugshots to the target, or it may be that one-at-a-time presentation takes longer than one would predict from the group sizes used in the present study.

Did inspection time change as participants went through the mugshots? As Figure 3 shows, there was a significant main effect for set, $F(2,186) = 113.5$, $p < .001$, $\eta^2 = .55$. Participants in all three mugshot group sizes took longer to inspect the first 60 mugshots ($M = 89.2$ s) than the middle ($M = 65.3$ s) or last 60 mugshots ($M = 61.4$ s). For the first 60 mugshots, participants averaged about 23 seconds longer, or about four-tenths of a second per photo on average. Although this is a small difference per mugshot, it may indicate that our participants spent a few additional seconds examining a small proportion of mugshots more closely, while most were evaluated much more rapidly. To learn more about the decision processes witnesses employ while searching through mugshots, future research might examine how witnesses distribute their inspection time among individual photos.

SUMMARY AND CONCLUSIONS

In summary, the main findings of the present experiment were: (a) mugshot group size did not significantly affect the rate at which the target mugshot was selected; (b) participants made more incorrect selections when mugshots were presented 3 to a page; (c) mugshot selection rate decreased as more mugshots were viewed; (d) most participants' selections were consistent with the one-or-none decision rule; (e) most participants did not go back to previous pages to review mugshots, and group size had very little effect on mugshot reviewing; (f) mugshot group size had only a very small effect on inspection time.

These results are consistent with the discovery of Stewart and McAllister (2001) that larger mugshot group sizes reduce the rate of incorrect selections without significantly reducing target selections. In terms of underlying processes, our results do not lend support to the idea that interference develops from a closer inspection of mugshots displayed in smaller groups. Instead, our findings, like those of Stewart and McAllister (2001), support the hypothesis that the higher rate of incorrect selections seen with smaller mugshot groups can be explained in terms of the one-or-none decision rule. When witnesses exhibit a strong tendency to select no more than one mugshot from any group, larger groups will result in fewer selections. In addition, the fact that group size had only a small effect on inspection time suggests that participants engaged in very few relative comparisons among mugshots—instead, they appear to judge most mugshots individually, in an absolute fashion.

The results of the present study are limited in several important ways. One limitation is that we used a relatively small set of 180 mugshots. Researchers are investigating

methods to reduce the size of mug books (e.g., Levi et al., 1995; McAllister et al., 2003; Pryke et al., 2000), but actual witnesses may still be required to inspect many hundreds of mugshots. Both the present study and that of Stewart and McAllister (2001) found that selection rates fell as more mugshots were examined, suggesting that even very large mug books may not lead to a large increase in incorrect selections. However, as selection rates drop, so too may the probability of selecting the correct mugshot if it is present. An important question for future research is whether the reduction in incorrect selection rates found for grouped presentation will also occur with very large numbers of mugshots. A second limitation is that our results are based on a brief target exposure (9 s) and a short retention interval of approximately 30 minutes. Although police may be more likely to ask a witness to view mugshots when the perpetrator was seen under suboptimal conditions (such as after a brief exposure), retention intervals in real cases are commonly longer than those used in the present study. Future research might investigate how mugshot group size affects witnesses' selections after different exposure durations and when retention intervals are longer.

On the basis of the present findings, we can suggest several other directions for further research. Many questions remain concerning the decision processes used by witnesses as they examine a set of mugshots. Although witnesses seem to be very reluctant to select more than one mugshot from any group, this one-or-none decision rule does not explain the decrease in selection rate as more mugshots are viewed. Because very few (7 out of 96) of our participants ever selected a mugshot they were certain was the target, the drop in selection rate shown in Figure 2 did not happen because participants stopped making selections after finding the target. One possibility, noted above, is that witnesses adjust their decision criterion with each new mugshot selection, so that later mugshots must meet or exceed earlier mugshots in terms of their degree of match to the memory of the perpetrator.

A more applied question concerns the most effective mugshot group size. In the present study the target was selected at the lowest rate in the 12-per-page condition (although it was not significantly lower than the other two groups). If the presentation of mugshots in large groups causes an increase in the selection criterion—or raises the criterion more rapidly as the witness progresses through the mugshots—then very large groups may lead to an excessively strict selection criterion. A strict criterion has the benefit of reducing incorrect selections, but if the perpetrator's mugshot is present it may be less likely to be selected. As Lindsay et al. (1994) noted, "For mug shots to be useful as an investigative tool, it is critical that the criminal's photo be selected, but it is not essential that witnesses select only the criminal" (p. 121). Our finding of fewer correct selections in the 12-per-page condition, although not statistically significant, suggests that it may be better to display mugshots in smaller rather than larger groups. Even a small decrease in target selection rates—we found a 12% reduction in the percentage of participants who selected the target in 12-per-group—would be important if it occurred consistently over a large number of investigations. In contrast to the present study, Stewart and McAllister (2001) found slightly more correct selections with grouped presentation. Clearly more research is needed to determine how mugshot group size affects target selection rates. In addition, future research should investigate if even larger mugshot groups—such as 20 or 40

per page—might further reduce incorrect selections without producing a corresponding drop in target selections. One direct way to attempt to maintain target selection rates with grouped presentation would be to explicitly inform the witness that more than one mugshot can be selected from a group. Research is needed to determine if directly encouraging witnesses to break the one-or-none rule increases target selections without a substantial increase in filler selections.

The research of Lindsay et al. (1994) suggests another approach to improving mugshot procedures. After examining a set of mugshots, witnesses can be asked to review their selections and choose those that are most likely to be the perpetrator. Lindsay et al. found that this kind of review eliminated many incorrect selections from consideration with almost no reduction in target selections. Additional research might examine the degree to which this finding holds for different mugshot group sizes. If large groups cause witnesses to adopt an excessively strict decision criterion, then the target will be less likely to be selected, and fewer incorrect selections may be eliminated after review. Reviewing selected photos may be most effective when the mugshots are presented singly or in small groups during the initial examination.

In conclusion, the results of the present study, combined with other studies (McAllister et al., 2008; Stewart & McAllister, 2001), underline the importance of considering group size in mugshot procedures. Although many studies have looked at the mugshot inspection process, much of the work has been aimed at understanding how mugshot viewing affects subsequent identification accuracy from lineups (Deffenbacher, Bornstein, & Penrod, 2006). Additional research is needed to learn more about the effect of group size and other factors on mugshot selections. Such research will improve our understanding of the decision processes used by witnesses as they select mugshots, and increase the effectiveness of mugshots as an investigative tool.

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ENDNOTES

1. The differences between lineup identifications and mugshot searches include: (a) a set of mugshots is typically much larger than the number of photos or people used in a lineup; (b) a set of mugshots may contain many potential suspects, whereas a lineup should contain only one suspect; (c) mugshots may or may not be filtered according to certain criteria, whereas known innocent lineup members (fillers) should be carefully selected; (d) more than one person may be selected from a set of mugshots, but that is usually not the case with a lineup; (e) a lineup is usually conducted in order to obtain evidence of identification, whereas a mugshot search is an investigative tool used in an attempt to find potential suspects (cf. Lindsay et al., 1994; Wells, Small, Penrod, Malpass, Fulero, & Brimacombe, 1998).

2. The results we report here for inspection time are based on all 96 participants. If a participant went back to review pages of mugshots, we added together the amount of time for each separate viewing, so that inspection time for each page is the total amount of time the page was displayed on screen. The pattern of results for inspection time was the same when we excluded participants who reviewed pages.

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