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Recognition of Posed and Spontaneous Dynamic Smiles in Younger and Older Adults

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Abstract

In two studies, we investigated age effects in the ability to recognize dynamic posed and spontaneous smiles. Study 1 found that both younger and older adult participants were above-chance in their ability to distinguish between posed and spontaneous younger adult smiles. Study 2 found that younger adult participant performance declined when judging a combination of both younger and older adult target smiles, while older adult participants outperformed younger adult participants in distinguishing between posed and spontaneous smiles. A synthesis of results across the two studies showed a small-to-medium age effect ($d = -0.40$) suggesting an older adult advantage when discriminating between smile types. Mixed stimuli (i.e., a mixture of younger and older adult faces) may impact accurate smile discrimination. Future research should investigate both the sources (cues, etc.) and behavioral effects of age-related differences in the discrimination of positive expressions.

Keywords

Spontaneous emotion; Older Adults; dynamic

Age-related declines in emotion recognition appear to be ubiquitous for most negative emotions (e.g., McDowell, Harrison, & Demaree, 1994; Murphy & Isaacowitz, in press; Phillips, MacLean, & Allen, 2002). A meta-analysis of studies mainly employing static photographs showed that older adults are generally outperformed by younger adults on the recognition of negative facial expressions (Ruffman, Henry, Livingstone, & Phillips, 2008). While the literature consistently suggests age-related declines in recognition of negative emotions, the effect of age on recognizing positive emotions is not quite as clear. Isaacowitz

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Portions of these data were presented at the 2008 Society for Personality and Social Psychology (SPSP) conference in Albuquerque, NM; the 2008 American Psychology Association (APA) conference in Boston, MA; and the 2008 Gerontological Society of America (GSA) conference in National Harbor, MD.

and colleagues (2007) reviewed 13 studies and found no significant age difference in recognizing happiness in 11 of the studies, though possible ceiling effects were noted. Most emotion recognition studies use labels such as happy, sad, fear, anger, and disgust as the possible emotions to choose from when labeling a face. Because the only positive emotion in the option list is happy, some participants may label a face as happy only because they could discern that the face was expressing a positive emotion, not because they could discern the specific nature of the positive emotional expression.

Age Effects in Recognizing Positive Facial Expressions

In their meta-analysis, Ruffman et al. (2008) showed that older adults scored lower in recognizing happiness in comparison to younger adults across modalities (e.g., recognizing happiness in voices, faces, bodies, etc.). In analyzing the results from 16 studies that investigated age and the recognition of happiness in faces specifically, the effect size for age differences in accurate recognition was much smaller (r = .08) than the effect sizes for age differences in recognizing anger, sadness, and fear facial expressions (all rs > .26). Furthermore, the 95% confidence interval associated with the age-related effect of recognizing facial happiness included zero;[1] as the confidence interval contains zero, one may not reject the null hypothesis of no age differences in the recognition of happy facial expressions (see Shadish & Haddock, 1994). Ruffman et al. also noted that, for some particular stimulus sets of facial expressions (e.g., Matsumoto & Ekman, 1988), the significance tests of an effect size were not possible for a subset of the happy recognition studies because of ceiling effects in participants' scores. However, these results apply specifically to the recognition of static happy expressions of the face: Ruffman et al. found slightly larger age differences for the recognition in happiness in bodily expressions and moderately larger effects in happiness recognitions from voices or matching voices to faces. Thus, in contrast to the robust evidence for age-related deficits in negative emotion recognition, there is some indication that there may be smaller, or even no, age-related differences in recognizing positive facial expressions, at least in static images.

Dynamic Positive Facial Expressions

Considering the growing body of research on aging and emotion recognition described above, it is notable that almost none of it has employed dynamic stimuli. Dynamic stimuli have a number of advantages over static stimuli in terms of assessing emotion recognition. Empirical evidence suggests that video stimuli would allow for more accurate emotion discrimination. Previous research suggests that dynamic stimuli can provide additional cues to emotion expression that may contribute to better emotion recognition of the expression being displayed and static cues may lack important cues for the discrimination of emotions (Del Giudice & Colle, 2007; Harwood, Hall, & Shinkfield, 1999; Wehrle, Kaiser, Schmidt, & Scherer, 2000). On the whole, dynamic stimuli are more ecologically valid, as the skill of assessing emotions in others would generally take place in naturally occurring social interactions with active participants (as opposed to evaluating static images). In terms of age effects, the use of static rather than dynamic faces in emotion recognition work may thus be underestimating the abilities of older adults.

In terms of accurately assessing positive emotions from dynamic facial expressions, discriminating between different types of smiles may be an effective way to assess positive emotion recognition abilities. Ekman (1994) speculated that different types of smiles may be one of the few, or even the only, way to discriminate between various positive emotional

[1]The 95% CI for this mean effect size was calculated using data reported Ruffman et al. (2008) with Rosenthal's (1995) formula for confidence intervals around a mean ES in a random effects model. (The random-effects model was used by Ruffman et al.)

expressions such as happiness, contentment, pride, or relief, “I am convinced that no further facial signal will be found that differentiates among these positive emotions” (p. 16). Thus, studying dynamic smiles may be one of the only ways to investigate how individuals differentiate between various positive expressions.

A large body of research has shown that spontaneous and posed smiles can be distinguished based on the activation of certain facial muscles. Both types of smiles involve the contraction of the zygomatic major muscles (i.e., the lifting of the cheekbones) but only spontaneous smiles involve the contraction of the orbicularis oculi muscles (i.e., the muscles around the eyes that, when contracted, form crows’ feet) (Ekman, Davidson, & Friesen, 1990). Spontaneous smiles are associated with the experience of positive affect whereas posed smiles are generally associated with social norms or social markers (Bonanno et al., 2002; Papa & Bonanno, 2008). Importantly, dynamic smiles may better reveal the distinction between posed and spontaneous smiles because timing differences between the smiles, such as duration and symmetry in the onset and offset of expression (Hess & Kleck, 1997; Hager & Ekman, 1985; Schmidt, Amadar, Cohn, & Reed, 2006). The mapping of spontaneous and posed smiles using systems such Ekman and Friesen’s Facial Action Coding System (FACS) (1978) and electromyographic recordings show consistent discriminating temporal cues between the two types of smiles (Hess, Kappas, McHugo, Kleck, & Lanzetta, 1989; Schmidt, Cohn, & Tian, 2003). Krumhuber and Kappas (2005) found that perceivers were sensitive to the temporal cues (i.e., dynamic) that reveal smile-genuineness.

Yet, very few studies have investigated age-related effects in positive emotion recognition using dynamic stimuli. Two studies showed no age differences in recognizing happy facial expressions from computerized morphs of posed faces (Calder et al., 2003 Study 2b; Sullivan & Ruffman, 2004, Study 1). Both studies had ceiling effects in happiness recognition accuracy. We are aware of no study that specifically asked younger and older adults to discriminate between posed and spontaneous smiles in younger and older adult targets.

Discriminating Dynamic Smiles: Should There Be Age Effects?

Individuals may smile for many different reasons. For example, individuals may smile when distressed (Ansfield, 2007) or embarrassed (Edelmann, 1982; Zaalberg, Manstead, & Fischer, 2004), in addition to when happy. Spontaneous smiles are associated with the subjective experience of enjoyment (Ekman et al., 1990), can be used to distinguish between truthful and untruthful experiences of positive emotions (Ekman, Friesen, & O’Sullivan, 1988), and can help individuals feel better when discussing an emotionally distressing topic (Keltner & Bonanno, 1997). Smiles can serve as a function of expression and emotion regulation, but more relevant to the present study, smiles serve a communicatory function in social interaction (e.g., Yamamoto & Suzuki, 2006). The ability to judge the authenticity of emotional expression, such as a smile, may allow an individual to assess the sincerity of another’s expression or communication, or detect possible harmful manipulations or negative social intentions (Gosselin, Perron, Legault, & Campanella, 2003). In general, accurately recognizing different smiles types would contribute to successful social interactions and effective communication; having difficulty distinguishing between posed and spontaneous smiles would be a social disadvantage.

In terms of age effects, older adults may be better at the particular task of discriminating between posed and spontaneous smiles because evidence suggests that older adults may pay more attention towards positive facial expressions. In two studies, Isaacowitz and colleagues (2006a,2006b) found that older adults showed an attentional preference toward happy faces and away from negative ones. If older adults look more at happy faces than their younger adult counterparts, then older adults may be better at distinguishing between smile types than younger adults because of what are essentially practice effects; older adults presumably have simply spent more time with individuals to become skilled at discriminating smiles. Conversely, because younger adults have less experience with (and pay less attention to) positive expressions, they may perform worse on positive emotion recognition tasks in comparison to older adults.

The use of dynamic stimuli is an advance over previous research that studied age effects of emotion recognition. Whereas older adults may not be well-practiced making discriminations with static faces, and thus show typical patterns of age-related decline in such tasks, using cue-rich dynamic ones may better tap into their actual accumulated experience of social interaction across the lifespan. In other words, using more ecologically-valid stimuli may be a better test of emotion recognition skills; thus, the combination of dynamic stimuli and the task of recognizing positive emotions may give older adults the sufficient information cues to make accurate judgments. Furthermore, given some evidence that older adults prefer positive information over negative information (e.g., Carstensen, 2006; Kryla-Lighthall & Mather, 2009), older adults may be more motivated to discern between various positive emotion expressions and increased motivation may lead to higher recognition accuracy.

Current Research

We devised the following experiments to investigate age effects in the recognition of positive emotion expressions. Participants were asked to distinguish between spontaneous and posed smiles. The goal of this research was to assess whether younger and older adults could accurately distinguish between spontaneous and posed smiles in videos, and to what extent age differences (or the lack thereof) mirrored previous research using static faces. In two studies, we videotaped posed and spontaneous smiles and asked younger and older adult participants to judge the spontaneity of the smiles. This is, to our knowledge, the first study to investigate age-related effects in the discrimination between dynamic posed and spontaneous smiles in younger and older adult targets.

Study 1

Method

Smile Stimuli—Initially, 36 females were videotaped while responding to the news that they won (or did not win) a surprise $15 prize.[2] Approximately 1/3 of targets were randomly selected to receive the prize. In order to collect as many smiles as possible from each target, the target completed a second facial-expression task. The target was asked to pose expressions based on imagined scenarios: one scenario where she had been invited on a cruise with friends and another scenario where she was left out of the group by not being invited. (The second scenario was presented simply as a counterbalance to the first scenario.) After recording the target's facial expressions, the video camera was turned off. The experimenter debriefed the target and explained that the monetary award was actually randomly determined. The target was then asked to complete a second consent form agreeing to have her videotaped image shown to others. (Five targets declined consent for use of their videotaped data; their videotaped data were not coded or used further.) All

[2]In a pilot study, we collected smiles from 7 younger adult males and 13 younger adult females. The younger adult males smiled less often than the younger adult females and reliability associated with coding the male smiles was low. For these reasons, only female stimuli were used.

targets were paid $10 for participation. (Approximately 1/3 of targets were randomly selected to receive the prize in addition to the $10 that all targets received for participation.)

Each target produced multiple smiles. Many spontaneous smiles were found between elicitations of posed smiles, when the interviewer and interviewee were talking naturally over the course of the interview. Target smiles were extracted from each videotaped session by identifying contraction of the zygomatic major. Because the videotaped data were digitally recorded, it was possible to identify the onset and offset of the zygomatic major contraction in a frame-by-frame fashion. Seventy-four smiles were extracted in this manner.

Five judges (4 females, 1 male; all undergraduate college students) were trained to identify the contraction of the zygomatic major muscles and the orbicularis oculi muscles surrounding the eyes. While the judges were not trained Facial Action Coding System coders (FACS; Ekman & Friesen, 1978), the coding system was based on information from Ekman et al.'s (1990) description of "Duchenne" smiles (e.g., spontaneous smiles or smiles associated with pleasure). Prior to any coding, judges were trained on identifying the action units (AUs) associated with orbicularis oculi muscles and the zygomatic major muscles. Judges reviewed pictures of muscle anatomy of the face and viewed videos of muscle contraction on the wesbite www.face-and-emotion.com. Judges also practiced coding smiles using videotaped smiles from previous studies.

For reliability purposes, all five judges initially coded 23 smiles (31% of the 74 extracted smiles from female targets). Reliability was $\alpha = .95$. The remaining smiles (of the 74 extracted smiles) were coded by between two and five of the five reliable judges. Smiles to be judged by participants were selected only if there was complete agreement among the two to five judges who coded the smile; this narrowed the number of smiles to 54. A separate group of six judges (4 females, 2 males; all undergraduate college students) were recruited to judge the intensity level of these 54 smiles and smiles were rated on a scale of 1 to 9. Reliability between judges rating intensity was also high, $\alpha = .96$.

To further narrow down the 54 smiles, the mean intensity ratings of each smile were calculated. We attempted to match the intensity of a spontaneous smile with the intensity of a posed smile while also attempting to obtain a range of intensity across both types of smiles. There is some evidence that the intensity of the smile affects the perceived happiness of the target [Hess et al., 1989]; because we were interested in the discrimination between posed and spontaneous smiles and not the perceived happiness of the target, we controlled for intensity. Ultimately, thirteen smiles from twelve targets were selected (5 spontaneous, 8 posed). The selected smiles were from eight Caucasian females and four Asian females, with a mean age of 22 (*SD* = 6.78). The smiles ranged in length from 1.60 to 5.80 s, *M* length = 3.55, *SD* = 1.19. Smile stimuli type, length, and intensity ratings are presented in Table 1.

Participants—There were 41 younger adult participants (30 females, 11 males); *M* age = 21.71, *SD* = 4.88, range = 18-43. Younger adult participants were recruited from a university participant pool and received partial course credit in an introductory psychology course, or recruited from an online university bulletin board and paid $10. Of the younger adult participants, 28 (68%) were Caucasian, 7 (17%) were Asian, 1 (2%) was African American, 2 (5%) were Hispanic, and 3 (7%) reported "Other." All younger adult participants completed high school and most were in their 2^{nd} year of college (*M* year in college = 2.22, *SD* = 1.89).

There were 33 older adult participants (23 females, 10 males); *M* age = 70.85, *SD* = 8.24, range = 59-89. Older adults were recruited from a database of older adults maintained in the Brandeis University Emotion lab and paid $10 per hour for their participation. Of the older adult participants, 30 (91%) were Caucasian and 3 (9%) did not report ethnicity. All older adult participants completed high school; 5 (15%) had some college education, 10 (30%) had a bachelor's degree, 1 (3%) had some graduate education, and 11 (33%) had a graduate degree.

Measures—Older adults were administered the Mini-Mental State Exam (MMSE, Folstein, Folstein, & McHugh, 1975), as a screening for possible dementia. All participants completed two vision tests to ensure adequate vision: the Snellen Visual Acuity test and the Pelli-Robson Contrast Sensitivity test (Pelli, Robson, & Wilkins, 1988).

Procedure—Participants were seated in front of a 17-inch computer monitor and read instructions regarding the smile judgment task. Participants were told, "Spontaneous smiles are usually associated with feelings of happiness and enjoyment. These smiles could be considered 'genuine' smiles. Posed smiles are simulated. Individuals may pose smiles to portray enjoyment but do not actually experience positive feelings. Posed smiles could be considered 'fake.'" The smiles were presented in the same random order to each participant. (The ordering of smiles is presented in Table 1 in the *younger adult target smiles* section). The participant viewed each smile one-at-a-time with several seconds between each smile presentation. The computer screen was blank between each smile presentation. The participant voiced his/her judgment (either "spontaneous" or "posed") during the time between each smile and the experimenter recorded each response. Because younger adult participants were viewing targets who attended the same university, participants were also asked to indicate whether s/he recognized the smiling target during the time between video presentations. (If the participant recognized a target, the response to that target was dropped from analysis). [3]

Results

Alpha was set at .05 for all statistical tests.

All older adults scored above 22 on the MMSE dementia screening test. (A score of ≤ 20 is indicative of dementia symptoms, Folstein et al., 1975). Older adults scored significantly lower on contrast sensitivity; younger adult contrast sensitivity $M = 1.51$, $SD = 0.15$; older adult contrast sensitivity $M = 1.30$, SD = 0.29; $t(70) = 3.96$, $p < .01$, $d = 0.95$. Older adults had significantly worse visual acuity; younger adult visual acuity $M = 26.71$, $SD = 9.26$; older adult visual acuity $M = 57.58$, SD = 46.61; $t(72) = -3.91$, $p < .01$, $d = -0.92$. These findings are in line with previous aging literature showing that older adults tend to experience vision declines with aging (e.g., Spear, 1993). As with previous studies conducted in our lab (e.g., Isaacowitz et al., 2006a; Murphy & Isaacowitz, in press), all participants had adequate vision to complete the experimental task and most older adult participants wore corrective lenses.

Posed and Spontaneous Smile Judgments—Signal detection analysis was used to calculate participants' sensitivity in discriminating between posed and spontaneous smiles. Sensitivity in discriminating between spontaneous and posed smiles was assessed as *d'* (Abdi, 2007). A sensitivity score of 0 indicates chance performance; negative scores indicate worse-than-chance performance, and positive scores indicate higher-than-chance performance. Response bias was calculated using *C* (Abdi, 2007); *C* values below 0 indicate a bias towards judging smiles as spontaneous (liberal bias) whereas values above 0 indicate a bias towards judging smiles as posed (conservative bias). Scores for proportion correct

[3] Participants also completed several cognitive and affective measures and eye movements were measured. Results from these measures did not yield any meaningful patterns so these data are not presented.

were also measured by calculating the number of correct scores (regardless of type of smile judged) across all completed trials. Proportion data were based on the number of trials the participant completed, excluding any trials where the participant recognized the target. (Of the 533 total trials across all younger adult participants, 30 trials [6%] were dropped due to participants recognizing a target.) All younger adult participants completed at least 10 or more (out of 13) trials. All older adult participants completed all 13 trials.

One younger adult participant was dropped from analysis as an outlier (*d*' *z*-score > 3.45). One-sample *t*-tests revealed that *d'* and *C* scores were significantly above zero for both age groups, and proportion correct scores were significantly larger than a chance proportion of .50.[4] There were no significant age differences for *d'*, *C*, or proportion correct. (See Table 2).

Discussion

Both younger adult and older adult participants scored significantly above chance in discriminating between posed and spontaneous smiles. Though the difference between younger adult and older adult sensitivity scores was not significant (see Table 2), the mean older adult *d*' (*M* = 0.70, *SD* = 0.55) was higher than younger adult *d'* (*M* = 0.59, *SD* = 0.68). Both age groups tended to judge smiles as posed rather than spontaneous and both age groups were above chance in proportion correct. The results suggest that older adults do not necessarily experience deficits in discriminating between posed and spontaneous smiles.

The age of targets appearing in Study 1 could possibly account for the lack of age-related differences; targets were relatively young (*M* target age = 22 years). Previous research typically asked participants to rate expressions of younger or middle-aged adults (e.g., Calder et al., 1996; MacPherson, Phillips, & Della Sala, 2002.) Younger adults may have been able to distinguish between posed and spontaneous smiles because the stimuli involved targets within their same age group and many individuals report having more social encounters with peers of their own age (e.g., Ebner & Johnson, 2009). However, this explanation does not account for why older adult participants were able to discriminate between the posed and spontaneous younger adult smiles as well. Perhaps older adults' ability to distinguish between posed and spontaneous smiles is due to experience; older adults presumably have more practice in social interactions and learn over time to make smile distinctions, regardless of targets' age. Yet, if this were the case, one might expect older adults to outperform younger adults. There is some research to suggest an age bias in processing facial recognition whereas participants are biased towards recognizing faces of their own age versus other ages (Bäckman, 1991; Lamont, Stewart-Willimas, & Podd, 2005; Malatesta, Izard, Culver, & Nicolich, 1987). Thus, the findings of Study 1 suggested potential hypotheses about aging and sensitivity to different types of smiles. A second study was therefore designed to further investigate smile discrimination when participants were presented with *both* younger adult and older adult target smiles.

Study 2

Method

Smile Stimuli—Eighteen older adult females were videotaped for the older adult video smile stimuli. Targets signed a consent form and were told they would be videotaped while they discussed a positive emotional experience and posed facial expressions based on described scenarios. The experimenter asked the target to recall an especially pleasant event

[4]Effect sizes based on one-sample *t*-tests for sensitivity scores (*d*') and response bias scores (*C*) were calculated by computing *d* as $d = M / SD$ (Cohen, 1988). Effect sizes for the proportion correct scores were calculated as $d = t / \sqrt{df}$ (Rosenthal & Rosnow, 1991).

where she felt particularly happy or elated. The target was given several seconds to think about this memory and was then asked if she was comfortable sharing the experience to the experimenter and video camera. All targets agreed to share their experiences and the target and experimenter typically spent several minutes discussing the experience. Following the description of the positive emotional experience, the target was asked to pose expressions based on two imagined scenarios: (1) she had been invited on a cruise with friends, and (2) she bought a lottery ticket and won five million dollars. The camera was turned off and a second consent form was presented to the target asking her permission to show her videotaped image to other participants. All targets consented. Demographic data were collected and the target was then thanked and dismissed. Targets engaged in the videotaped session while on a break from participating in another ongoing experiment in the lab. As part of this larger session, targets were paid $10 per hour. The videotaped portion of the session generally lasted less than 20 minutes but targets were paid for their entire time spent participating in both the videotaped study and the other ongoing experiment; the entire session generally lasted around 2 to 2.5 hours.

For reliability purposes, two trained female judges (using the same training procedure described in Study 1) identified contraction of the zygomatic major and orbicularis oculi muscles of older adult target smiles. (Each judge coded all smiles.) Only smiles where both judges agreed on the type of smile were selected for further coding.

A separate set of judges consisting of 15 community-dwelling older adults, aged 61-84 (*M* = 75.93, *SD* = 7.08; 4 males and 11 females), and 13 college students, aged 18-20 (*M* = 18.85, *SD* = 0.69; 5 male and 8 females) judged smile intensity; older adult smiles $\alpha = .92$, younger adult smiles $\alpha = .75$. (These judges also rated the 13 younger adult targets from Study 1 on smile type and intensity. The purpose of these judgments was to narrow down the older adult target smiles to a number comparable to the 13 younger adult target smiles, and to obtain validation data from older adult judges rating the 13 younger adult smiles. Note that these younger adult judges were different judges than those used in Study 1.)

As in Study 1, final smile selection was based on matching smile type and intensity to obtain a range of intensity across both types of smiles. Eleven older adult smiles were selected (6 spontaneous, 5 posed; approximate older adult target *M* age = 70).[5] Smiles ranged in length from 1.02 to 4.07 s, *M* length of smile = 2.36 (*SD* = 1.02). Smile stimuli type, length, and intensity ratings as rated by both younger and older adult judges are presented in Table 1.

Participants—Twenty-three younger adults (17 females, 6 males) served as participants; *M* age = 19.83, *SD* = 1.44, range = 18-22.[6] Eighteen younger adult participants (78%) were Caucasian, 3 (13%) were Asian, 1 (4%) was Hispanic, and 1 (4%) reported "Other." There were 26 older adult participants (16 females, 10 males), *M* age = 71.88, *SD* = 7.34, range = 60-90. Twenty-five (96%) of the older adult participants identified as Caucasian and one (4%) identified as "Other." Nine older adult participants (35%) were college educated, and eight (31%) had advanced degrees. All participants (both younger and older adults) had at least completed high school. Recruitment and payment procedures were the same as in Study 1.

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[5]Data were collected in such a way that age could not be linked directly to the selected targets. Thus, approximate age is based on the original 18 targets, though one target did not report age; age range = 58-90.

[6]The mean age of younger adult participants in was 21.71 years in Study 1 with an age range of 18-43 and 19.83 years in Study 2 with an age range of 18-22. While these two age means did not differ significantly ($p > .05$), analyses were re-run using only participants under 25 years in Study 1. (This resulted in the exclusion of seven younger adult participants.) Excluding the seven participants in the age range of 25-43 years did not yield any meaningful differences in the pattern of results in comparison to the analyses which included these participants. To maintain power, these participants were retained in analyses.

Measures and Procedures—Measures were similar to Study 1. Older adults were administered the Mini-Mental State Exam (MMSE; Folstein et al., 1975). All participants completed two vision tests: the Snellen Visual Acuity test and the Pelli-Robson Contrast Sensitivity test (Pelli et al., 1988).

In regards to rating smiles, participants were told that spontaneous smiles "may be thought of as enjoyed, in-the-moment smiles" whereas posed smiles were "elicited, such as when someone instructs you to smile for the camera." Smile type and target age were randomly presented; smiles were presented in the same randomized order to each participant (24 smiles total; 14 spontaneous, 10 posed). Remaining procedures were the same as Study 1.

Results

All older adults scored above 22 on the MMSE dementia screening test. As in Study 1, older adults scored significantly lower on contrast sensitivity; younger adult contrast sensitivity $M = 1.55$, $SD = 0.14$; older adult contrast sensitivity $M = 1.40$, $SD = 0.29$; $t(46) = 3.14$ $p < .01$, $d = 0.93$. Older adults had significantly worse visual acuity; younger adult visual acuity $M = 31.96$, $SD = 15.35$; older adult visual acuity $M = 41.73$, SD = 13.19; $t(47) = -2.40$, $p < .05$, $d = -0.70$.

Posed and Spontaneous Smile Judgments—Sensitivity (*d*'), criterion scores (*C*), and proportion correct were calculated for each participant. Proportion data were based on the number of trials the participant completed, excluding any trials where the participant recognized the target. (Of the 552 total trials across younger adult participants, 15 trials [3%] were dropped due to participants recognizing a target.) All younger adult participants completed at least 10 or more (out of 13) younger adult target trials. All older adult participants completed all younger adult target 13 trials. For older adult smiles, *d'* and *C* could not be calculated for one older adult and four younger adult participants. Each of these participants labeled all five older adult posed smiles as spontaneous. (It is not possible to calculate *d*' or *C* with probability = 1.00. Thus, *df*s varied slightly depending on comparisons.) Data were examined for possible outliers and there were none.

For younger adults, one-sample *t*-tests were not significantly above chance for *d'* or *C* scores, or proportion correct. For older adults, one-sample *t*-tests were significantly above chance for sensitivity *d'* and *C* scores, and proportion correct (see Table 2).

A series of 2 (within subjects: younger adult or older adult smiles) X 2 (between subjects: younger adult or older adult participant) ANOVAs tested younger adult and older adult judgments. For *d*', participants were significantly better at judging younger adult smiles, $F(1,43) = 20.75$, $p < .01$, partial $\eta = 0.58$. Also, older adult participants were significantly better at discriminating between spontaneous and posed smiles than younger adult participants, $F(1,42) = 7.37$, $p = .01$, partial $\eta = 0.39$. The interaction effect was not significant, $F(1,42) = 0.22$, $p = .64$, partial $\eta = 0.07$. See Figure 1 for a depiction of these results.

A series of planned comparisons were conducted to further investigate the age effects in smile discrimination sensitivity. A paired-samples *t*-test showed a significant difference where younger adults were more sensitive to discriminating posed and spontaneous younger adult smiles ($M = 0.53$, $SD = 0.68$) compared to older adult smiles ($M = -0.13$, $SD = 0.70$), $t(18) = 3.46$, $p < .01$, $d = 0.95$. Similar results were found for older adults, who were also better at discriminating younger adult smiles ($M = 0.99$, $SD = 0.70$) than older adult smiles ($M = 0.18$, $SD = 0.74$), $t(24) = 3.36$, $p < .01$, $d = 1.12$. Independent samples *t*-tests showed that when judging younger adult smiles, older adults ($M = 1.03$, $SD = 0.71$) had better sensitivity than younger adults ($M = 0.60$, $SD = 0.66$), $t(47) = -2.19$, $p < .05$, $d = -0.64$.

When judging older adult smiles, there was not a significant difference between older and younger adult sensitivity, $t(42) = -1.42$, $p = .16$, $d = -0.44$.

For *C*, participants had higher scores when judging younger adult smiles in comparison to older adult smiles, $F(1,42) = 14.97$, $p < .01$, partial $\eta = 0.51$. There was not a significant main effect for participant age, $F(1,42) = 0.98$, $p = .33$, partial $\eta = 0.15$. There was a significant interaction effect between target and participant age, $F(1,42) = 8.53$, $p < .01$, partial $\eta = 0.41$.

Paired-samples *t*-test showed that younger adult participants had a higher *C* when judging younger adult smiles ($M = .39$, $SD = .33$) than when judging older adult smiles ($M = -.17$, $SD = .47$), $t(18) = 5.34$, $p < .01$, $d = 1.23$; younger adult participants were more conservative in judging younger adult smiles (i.e., judging smiles as posed) but more liberal in judging older adult smiles (i.e., judging smiles as spontaneous). Older adult participants did not show significantly different *C* scores when judging younger adult ($M = .37$, $SD = .07$) and older adult smiles ($M = .16$, $SD = .46$); $t(24) = 0.65$, $p = .52$, $d = 0.19$. Independent-samples *t*-tests showed no significant difference between younger and older adult participants when judging younger adult smiles (t [47] = 1.03, $p = .31$, $d = 0.30$), but there was a significant difference between younger adult participants and older adult participants when judging older adult smiles, $t(47) = -2.38$, $p < .05$, $d = 0.73$. Response biases were significantly more conservative (i.e., bias towards judging smiles as posed) for older adults judging older adult smiles than for younger adults judging older adult smiles. See Figure 2.

For proportion correct scores, participants were significantly better at judging younger adult smiles than older adult smiles, $F(1,47) = 22.36$, $p < .01$, partial $\eta = 0.57$. Also, older adult participants had a higher proportion correct than younger adult participants, $F(1,47) = 8.60$, $p < .01$, partial $\eta = 0.39$. The interaction was not significant, $F(1,47) = 0.23$, $p = .63$, partial $\eta = 0.07$. Paired-samples *t*-test showed that younger adult participants had significantly higher proportion correct scores when judging younger adult smiles ($M = .58$, $SD = .13$) than when judging older adult smiles ($M = .47$, $SD = .12$), $t(22) = 3.46$, $p < .01$, $d = 0.88$; older adult participants also showed significantly higher proportion correct scores for younger adult smiles ($M = .67$, $SD = .14$) compared to older adult smiles ($M = .52$, $SD = .13$); $t(25) = 3.93$, $p < .01$, $d = 1.11$. Independent-samples *t*-tests showed a significant difference between proportion correct scores for younger adult participants and older adult participants when judging younger adult smiles, $t(47) = -2.26$, $p < .05$, $d = -0.66$. There was not a significant difference between proportion correct scores for younger and older adult participants when judging older adult smiles, $t(47) = -1.61$, $p = .11$, $d = -0.47$.

Discussion

In Study 2, older adult participants had higher sensitivity scores than younger adult participants. These findings differed from the findings of Study 1, which showed similar performance between the two age groups. Unlike Study 1, younger adults failed to perform above-chance in their sensitivity scores; this result seems likely due to the addition of older adult target smiles, as younger adult participants had significantly lower sensitivity scores for older adult smiles than younger adult smiles. Perhaps younger adults' performance was impaired by the presence of mixed-age faces as younger adults may be less familiar with judging older adult faces and this contributed to the at-chance level of performance on overall smile discrimination.

On the other hand, older adults were significantly above chance in their sensitivity scores, which replicates Study 1 findings. Interestingly, older adults' sensitivity was significantly higher for younger adult smiles than older adult smiles (though, again, older adult sensitivity was significantly higher than chance levels for both younger and older adult smiles). Older adults' smile sensitivity seemed to be enhanced by the presence of mixed-age stimuli.

Participants of both age groups had better sensitivity for distinguishing between younger adult posed and spontaneous smiles compared to older adult smiles. Participants were more conservative (i.e., tendency to judge smiles as posed) when judging younger adult smiles than older adult smiles. As shown by paired-samples *t*-tests, younger adults were more liberal in their response biases for older adult smiles compared to younger adult smiles, but older adult participants did not show significantly different response biases when judging younger adult or older adult smiles. However, older adult participants were more biased towards judging older adult smiles as posed whereas younger adult participants were more biased towards judging older adult smiles as spontaneous (as shown by independent-samples *t*-tests). Finally, younger adults' response bias scores and proportion correct were at chance levels, which differed from Study 1. But older adults' response bias scores and proportion correct were above chance, replicating the findings from Study 1. Overall, findings from Study 2 showed that older adults outperformed younger adults in distinguishing between posed and spontaneous smiles when presented with both younger and older adult smiles.

Synthesis of Study 1 and Study 2

Data from Studies 1 and 2 were combined to distill overall effects in smile discrimination sensitivity. In the first analysis, we compared the younger adult participants' sensitivity for discriminating younger adult posed and spontaneous smiles between Study 1 and Study 2. Results showed that there was not a significant difference between younger adults' sensitivity in judging younger adult smiles between Study 1 and 2. The same analysis with older adult participants showed a significant difference. Older adults in Study 2 were significantly better at judging the younger adult smiles in Study 2 than the younger adult smiles in Study 1, $t(57) = -2.01$, $p = .05$, $d = -0.53$. As participants in Study 1 were presented with younger adult faces only whereas participants in Study 2 judged mixed-age stimuli, the comparison across both studies appears to suggest that older adult sensitivity to younger adult smiles seemed to be enhanced by the presence of older adult smiles whereas younger adult sensitivity to younger adult smiles remained consistent across studies (*M*s = 0.59, 0.53). The at-chance overall sensitivity scores for younger adults in Study 2 seems to be driven by their significantly lower sensitivity to discriminating older adult smiles compared to younger adult smiles.

Meta-analytic techniques were used to synthesize the results from Study 1 and Study 2 to distill the overall magnitude of age effects in discriminating younger adult smiles. The effect size for younger adults mean *d'* for judging younger adult smiles in Study 1 was $d = 0.87$ and $d = 0.91$ for Study 2. Across both studies, the mean weighted *d* was 0.88, indicating a medium-to-large effect size (Cohen, 1988; Rosenthal & Rosnow, 1991). Thus, younger adults were better-than-chance at discriminating between posed and spontaneous younger adult smiles at a strong magnitude across both studies. For older adults, the effect sizes associated with the mean *d'* for judging younger smiles were $d = 1.26$ in Study 1 and $d = 1.44$ for Study 2. Across both studies, the mean weighted *d* was 1.34. Thus, older adults were better-than-chance at discriminating between younger adult posed and spontaneous smiles at a very strong magnitude across both studies.

To measure the age difference effect size in *d'* for younger adult smiles only, the results from Studies 1 and 2 were compared in a meta-analytic fashion. The age difference in *d'* scores for judging younger smiles had an effect of $d = -0.17$ in Study 1 and $d = -0.64$ in Study 2. (Negative effects indicated better performance by older adults.) The mean weighted effect was $d = -0.36$, indicating a small-to-medium effect of older adult participants being better at discriminating younger adult posed and spontaneous smiles compared to younger adult participants. (Because of differing *n*s, mean weighted effect sizes were calculated using the harmonic mean of the number of younger and older adult participants; Rosenthal & Rosnow, 1991.)

An overall synthesis of smile discrimination by participant age combined the results of Study 1 and Study 2, regardless of target age. As reported in Table 2, the age difference in *d'* scores had an effect of $d = -0.17$ in Study 1 and $d = -0.80$ in Study 2. The mean weighted effect was $d = -0.40$, indicating a small-to-medium effect of older adults being better at discriminating posed and spontaneous smiles compared to younger adults.

General Discussion

Across both studies, the findings suggest that older adults are at least equal, or possibly better, at discriminating between posed and spontaneous dynamic smiles compared to younger adults. To assess what these two studies together could tell us about overall age differences in discriminating smile types, we synthesized the results of the two studies in a meta-analytic fashion. This synthesized results showed a small-to-medium effect of older adults being better at distinguishing posed and spontaneous smiles in comparison to younger adults. In other words, even with the different results as a function of target age, an overall performance effect emerged favoring older over younger adults. Such findings may suggest an age-related practice advantage for older adults in smile discrimination. One plausible reason why older adults may be better at distinguishing posed and spontaneous smiles is due to their greater experience in social interactions across the lifespan.

Study 1 found equal performance between age groups in sensitivity to younger adult posed and spontaneous smiles. In a youth-obsessed culture, individuals may have more experience with or exposure to younger adult expressions, which allows for better performance at differentiating younger adult smiles. Study 2 found that both age groups had better sensitivity for distinguishing between younger adult posed and spontaneous smiles compared to older adult smiles. Structural changes to the face that accrue over time may make it relatively more difficult to accurately read older adult expressions. These findings replicate previous research indicating a bias towards happy younger adult faces (Hummert, Garstka, O'Brien, Greenwald, & Mellot, 2002) and better recognition of happy expressions in younger adults by both younger and older adult participants (Ebner & Johnson, 2009).

The mixed stimuli (i.e., younger and older adult faces) could account for why there was not a significant age effect in smile sensitivity in Study 1 (which only had younger adult faces) while there was a significant age effect in Study 2 (which had mixed stimuli). Notably, younger adult lower sensitivity in Study 2 appears to be primarily due to their poor performance in judging older adult smiles (which was significantly lower compared to judging younger adult smiles). The addition of older adult target smiles did not seem to greatly alter older adults' overall sensitivity. In fact, older adult sensitivity to younger adult smiles seemed to be enhanced by the presence of older adult smiles. Some research shows that older adults spend more time looking at happy faces (and away from angry or sad faces) (Isaacowitz et al.,2006a; 2006b). Perhaps paying more attention to happy faces provides older adults with sharper abilities to discriminate positive expressions, particularly in regards to younger adult faces.

Older adult faces may have been more difficult for younger adult participants to discriminate, resulting in their significantly lower sensitivity scores when judging older adults smiles compared to younger adult smiles in Study 2. Perhaps younger adults are less motivated to interpret older adult expressions, preferring own-age stimuli; perhaps the younger adults' diminished sensitivity to older adult smiles in Study 2 reflected this disinterest. Also, previous research suggested that older adult expressions may be harder to interpret because of age-related structural changes in the face (Ebner & Johnson, 2009; Malatesta et al., 1987), which may have resulted in the lower sensitivity scores in judging older adult smiles compared to younger adult smiles for participants of both age groups. Furthermore, the response bias (*C*) results suggest that there are particularly participant-age biases in the judgment of older adult smiles; younger adults were more likely to judge older smiles as spontaneous whereas older adults were more likely to judge older smiles as posed. These response biases suggest that younger and older adult participants may employ differing judgment strategies depending on the age of the target. These differing strategies could account for the differential effects of mixed-age faces on performance for both younger and older adult participants.

Another consideration is the finding by Ebner and Johnson (2009) which showed that participants' self-reported contact with their own age group affected emotion recognition accuracy in targets of other ages. For example, younger adult participants who reported having more contact with their own age group were worse at recognizing older adult expressions, though Ebner and Johnson reported near ceiling effects in happiness recognition in their study. Perhaps contact with age groups (either self-reported or actual) is a mediating factor in discriminating between posed and spontaneous smiles. Future research could investigate whether self-reported contact with difference age groups or mixed-age stimuli affect smile discrimination skills.

The present results replicated previous findings suggesting that younger adults and older adults may be equally able in recognizing positive expressions (e.g., Borod et al., 2004; Murphy & Isaacowitz, in press). However, most previous studies used static stimuli (e.g., still photographs or computer generated synthetic faces), whereas our findings extended the understanding of age-related positive expression recognition by using dynamic stimuli. Static stimuli may be a good approximation of real-world experiences, but they may not afford the same cues to observers as do dynamic stimuli, such as the ability to see a change from the beginning to the end of an emotion expression (Ambadar, Schooler, & Cohn, 2005). A dynamic face presumably yields much more social information given various facial configurations that result from a temporal expression (Berry, 1990). Temporal aspects of a smile may aid performance in rating smile spontaneity because individuals could look for *orbicularis oculi* contractions, which may be made more salient by dynamic stimuli. Any or all of these could be cues used by older adults to achieve improved performance (compared to the recognition of negative emotions). Older adults may have more experience with posed and spontaneous expressions and thus learned to utilize the cues (such as these temporal ones) which discriminate the smile types; future research is needed to delineate what cues older adults may use, and why they may use cues that young adults do not. In current context, we did not assess whether older adults report more social interactions or being better practiced at discriminating smiles; thus, the suggested practice effects are speculation. Nonetheless, results suggest that older adults do in fact have an advantage over younger adults in discriminating between spontaneous and posed smiles, particularly when the stimuli involve different age groups.

While we have framed the present task of smile discrimination as one involving subtle yet ecological aspects of positive recognition accuracy, the task may require some aspects of a theory of mind cognitive process. For example, one study interpreted age-related deficits in identifying thoughts and feelings from pictures of just the eye region of faces as reflecting theory of mind declines in older adults (Phillips et al., 2002). If age deficits in theory of mind tasks reflect underlying cognitive declines, and older adults use context to compensate for those declines, including ecologically-relevant contextual cues should make a difference, as the present results with dynamic stimuli suggest. Ultimately, a complete view of age effects on interpersonal perception, including both emotion recognition accuracy as well as theory of mind, will have to subsume (and explain) findings of tasks that reveal age deficits as well as those that find age stability or even age-related improvement (e.g., Suzuki, Hoshino, Shigemasu, & Kawamura, 2007).

Limitations include the gender of target smiles; all targets were female. Future studies could investigate the smiles of men. Also, future studies could investigate the cues afforded by dynamic stimuli other than contraction of the *orbicularis oculi* muscles, such as duration and smoothness of *zygomatic major* muscle contractions (Hess et al., 1989). Such analyses could help uncover whether certain cues lead to better discrimination abilities, and if older adults are better able to use this information than younger adults. Also, all participants received the same randomized order of stimuli, which may have resulted in order effects. Other considerations include the possible variance introduced by having one younger adult target who provided one spontaneous smile and one posed smile in the younger adult smile stimuli set and subtle differences in task instructions between Study 1 and Study 2. Future research could investigate whether stimuli sequence, repeated targets with differing smile types, or task instruction affects smile discrimination. Intensity of a smile is known to affect the judgment of that smile (e.g., Hess et al., 1989; Zlochower, 2002); while we matched the smile intensity between posed and spontaneous smiles, future studies could investigate whether a range of intensities for both posed and spontaneous smiles affects smile discrimination.

Overall, the results suggest that the issue of age differences in smile recognition is not an open-and-shut case. There is evidence that older adults may be better at discriminating smile expressions than younger adults, an exciting prospect given younger adults' better recognition performance for most other emotions. There are practical advantages to being able to distinguish between spontaneous and posed smiles. Spontaneous smiles are associated with the subjective experience of enjoyment (Ekman et al., 1990) and can be used to distinguish between truthful and untruthful experiences of positive emotions (Ekman et al., 1988). Being able to accurately make this distinction could facilitate better interpersonal functioning. Finding that older adults actually are better than young adults could help solve an apparent conundrum: on the one hand, older adults show deficits in negative emotion recognition, but on the other hand, they report strong and satisfactory interpersonal relationships (Lansford, Sherman, & Antonucci, 1998). It still remains to be seen, however, exactly *how* older adults are better at discriminating between spontaneous and posed smiles, and whether this in fact leads to any social advantages.

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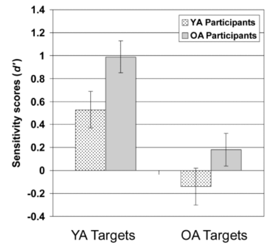

Figure 1.

Younger and older adult participants' sensitivity scores (*d'*) for discriminating between posed and spontaneous smiles by target age in Study 2. YA = younger adult, OA = older adult. Error bars represent standard errors.

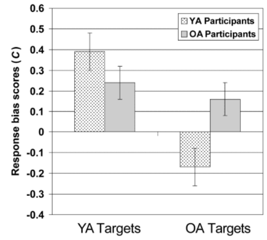

Figure 2.

Younger and older adult participants' response bias scores (*C*) for discriminating between posed and spontaneous smiles by target age in Study 2. YA = younger adult, OA = older adult. Error bars represent standard errors.

Table 1

Smile Stimuli Utilized in Studies 1 and 2: Type, Length, and Intensity Ratings of Younger and Older Adult Target Smiles as Rated by Younger and Older Adult Judges

Smile	Type	Length (*s*)	YA judge *M* intensity (*SD*)	OA judge *M* intensity (*SD*)	All judges *M* intensity
			Younger adult target smiles		
1	Spontaneous	3.74	6.33 (0.98)	5.69 (1.75)	6.00 (1.44)
2	Spontaneous	4.60	4.69 (1.44)	3.58 (1.68)	4.16 (1.62)
3	Spontaneous	5.80	4.69 (1.32)	4.50 (1.88)	4.60 (1.58)
4	Spontaneous	2.60	3.54 (0.88)	3.46 (1.45)	3.50 (1.17)
5	Posed	2.20	2.08 (0.86)	2.00 (1.77)	2.04 (1.37)
6	Posed	3.60	3.00 (1.53)	2.38 (1.85)	2.69 (1.69)
7	Posed	3.60	5.46 (1.33)	4.92 (1.51)	5.20 (1.41)
8	Spontaneous	3.54	2.54 (1.05)	2.08 (0.86)	2.31 (0.97)
9	Posed	4.47	3.38 (0.96)	3.62 (1.66)	3.50 (1.33)
10	Spontaneous	1.60	3.62 (1.04)	1.77 (0.73)	2.69 (1.29)
11	Spontaneous	3.27	4.46 (1.76)	5.38 (1.50)	4.92 (1.67)
12	Posed	2.27	1.50 (0.52)	1.62 (0.87)	1.56 (0.71)
13	Spontaneous	4.87	5.00 (1.22)	4.54 (1.45)	4.77 (1.33)
			Older adult target smiles		
1	Posed	1.42	1.85 (1.52)	1.42 (0.67)	1.64 (1.19)
2	Posed	1.13	2.77 (1.30)	2.92 (1.19)	2.85 (1.22)
3	Spontaneous	4.07	4.38 (2.10)	3.62 (1.33)	4.00 (1.77)
4	Posed	3.38	4.42 (1.78)	3.69 (1.60)	4.04 (1.70)
5	Spontaneous	3.12	2.85 (0.80)	2.15 (1.41)	2.50 (1.17)
6	Posed	1.02	3.23 (1.64)	2.31 (1.25)	2.77 (1.50)
7	Spontaneous	2.45	3.62 (0.96)	4.17 (1.64)	3.88 (1.33)
8	Spontaneous	3.12	3.42 (1.00)	2.58 (1.24)	3.00 (1.18)
9	Posed	1.37	3.08 (1.55)	2.83 (1.11)	2.96 (1.34)
10	Spontaneous	2.43	2.62 (1.26)	2.46 (1.56)	2.54 (1.39)
11	Spontaneous	2.47	3.69 (1.25)	4.17 (1.64)	3.92 (1.44)

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Note. YA = younger adult, OA = older adult. $n = 6$ for YA judges rating YA smile intensity (Study 1). $n = 13$ for YA judges rating OA smile intensity (Study 2). $n = 15$ for OA judges rating both YA and OA smile intensity (Study 2). Study 1 presented younger adult target smiles only (in the order presented in table). In Study 2, the smile presentation was randomized among smile type and target age; all participants viewed the same random order presentation of smiles.

Table 2

Signal Detection Scores and Proportion Correct for Smile Discrimination in Studies 1 and 2

	Study 1				Study 2			
	Younger adults *n* = 41	Older adults *n* = 33			Younger adults *n* = 23	Older adults *n* = 26		
	M (SD)	*M (SD)*	Between-groups *t*	Cohen's *d*	*M (SD)*	*M (SD)*	Between-groups *t*	Cohen's *d*
d'	0.59 (0.68)[a]	0.70 (0.55)[a]	−0.74	−0.17	0.17 (0.53)	0.66 (0.46)[a]	−3.47**	−0.80
C, response bias	0.33 (0.30)[a]	0.37 (0.28)[a]	−0.59	−0.14	0.05 (0.40)	0.26 (0.30)[a]	−2.13*	−0.87
Proportion correct	0.57 (0.11)[b]	0.60 (0.10)[b]	−0.90	−0.21	0.53 (0.10)	0.60 (0.08)[b]	−3.01**	−0.90

[a] One-sample *t*-test significantly different from zero at $p < .01$.

[b] One-sample *t*-test significantly different from .50 at $p < .01$.

* $p < .05$.

** $p < .01$.